

METRIC

DOD-STD-1446

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MILITARY STANDARD

METAL ORGANIC COMPOUNDS, REAGENT GRADE (METRIC)

(INCLUDING ACS AND USP-NF COMPOUNDS)



AMSC N/A

FSC 6810

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DOD-STD-1446

**DEPARTMENT OF DEFENSE
Washington, DC 20301**

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

DOD-STD-1446

1. This Department of Defense 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 Chemical Research, Development and Engineering Center, Attn: SMCCR-SPD-TS, 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.

DOD- STD-1446

FOREWORD

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.

DOD-STD-1446

CONTENTS

<u>Paragraph</u>		<u>Page</u>
1.	SCOPE	1
1.1	Coverage	1
1.2	Application	1
1.3	Classification	1
2.	REFERENCED DOCUMENTS	2
2.1	Government documents	2
2.1.1	Specifications, standards, and handbooks	2
2.1.2	Other Government documents, drawings, and publications	2
2.2	Other publications	3
2.3	Order of precedence	4
3.	DEFINITIONS	4
4.	GENERAL REQUIREMENTS	5
4.1	Packaging data and labeling	5
4.2	Hazardous materials information	5
4.3	Safety	5
4.3.1	Personal protective measures	5
4.3.1.1	Respiratory protection	5
4.3.1.2	Skin protection	5
4.3.1.3	Face and eye protection	5
4.3.1.4	Training	5
4.3.1.5	Exercises	6
4.3.2	Storage conditions	6
4.3.2.1	Flammable, combustible, pyrophoric and ignitable materials	6
4.3.2.2	Water-sensitive fire and explosive hazardous materials	6
4.3.2.3	Incompatible materials	6
4.3.3	Chemical hazardous exposure limits	7
4.3.4	Toxicity	7
4.3.4.1	EPA Toxic (T)	7
4.3.4.2	EPA Acute Hazardous Toxicity (H)	7
4.3.4.3	Hazardous toxic constituents	7
4.4	Pollution and disposal	7
4.4.1	Pollution potential	7
4.4.2	Disposal of excess or unserviceable material	7
4.4.3	Disposal and storage of hazardous wastes	8
4.4.3.1	Cleanup of liquid spills	8
4.4.3.2	Ultimate disposal	9
4.4.4	Disclaimer	9
5.	DETAILED REQUIREMENTS	10
5.1	METAL ALKOXIDES	10
5.1.1	Aluminum Ethoxide, Reagent	10
5.1.2	Aluminum Isopropoxide, Reagent	11
5.1.3	Aluminum tert-Butoxide, Reagent	11
5.1.4	Aluminum tri-sec-Butoxide, Reagent	12
5.1.5	Lithium Methoxide, Reagent	13
5.1.6	Lithium Phenoxide, Reagent	14
5.1.7	Lithium tert-Butoxide, Reagent	14

DOD-STD-1446

CONTENTS (Continued)

<u>Paragraph</u>		<u>Page</u>
5.1.8	Potassium Ethoxide, Reagent	15
5.1.9	Potassium tert-Butoxide, Reagent	16
5.1.10	Sodium Ethoxide, Reagent	16
5.1.11	Sodium tert-Butoxide, Reagent	17
5.1.12	Thallium Ethoxide, Reagent	18
5.1.13	Titanium Butoxide, Reagent	19
5.1.14	Titanium Propoxide, Reagent	19
5.2	METAL CARBOXYLATE	21
5.2.1	Barium Acetate, Anhydrous, Analyzed Reagent	21
5.2.2	Cadmium Acetate, Dihydrate, Analyzed Reagent	22
5.2.3	Calcium Acetate, Monohydrate, Analyzed Reagent	23
5.2.4	Cobaltous Acetate, Tetrahydrate, Analyzed Reagent	24
5.2.5	Cupric Acetate, Monohydrate, Analyzed Reagent	25
5.2.6	Lead Acetate, Trihydrate, Analyzed Reagent	25
5.2.7	Lead Subacetate, Anhydrous, Analyzed Reagent	26
5.2.8	Magnesium Acetate, Tetrahydrate, Analyzed Reagent	27
5.2.9	Manganous Acetate, Tetrahydrate, Analyzed Reagent	28
5.2.10	Mercuric Acetate, Anhydrous, Analyzed Reagent	29
5.2.11	Nickel Acetate, Tetrahydrate, Analyzed Reagent	30
5.2.12	Potassium Acetate, Anhydrous, Analyzed Reagent	31
5.2.13	Potassium Citrate, Monohydrate, Analyzed Reagent	32
5.2.14	Potassium Hydrogen Phthalate, Anhydrous, Acidimetric	33
5.2.15	Potassium Hydrogen Tartrate, Anhydrous, Analyzed Reagent	34
5.2.16	Potassium Oxalate, Monohydrate, Analyzed Reagent	35
5.2.17	Potassium Sodium Tartrate, Tetrahydrate, Analyzed Reagent	36
5.2.18	Potassium Tartrate, 1/2 Hydrate, Analyzed Reagent	37
5.2.19	Silver Acetate, Anhydrous, Analyzed Reagent	38
5.2.20	Sodium Acetate, Anhydrous, Analyzed Reagent	39
5.2.21	Sodium Acetate, Trihydrate, Analyzed Reagent	40
5.2.22	Sodium Bitartrate, Monohydrate, Analyzed Reagent	41
5.2.23	Sodium Formate, Anhydrous, Analyzed Reagent	42
5.2.24	Sodium Oxalate, Anhydrous, Analyzed Reagent	43
5.2.25	Sodium Salicylate, Anhydrous, Analyzed Reagent	44
5.2.26	Sodium Tartrate, Dihydrate, Analyzed Reagent	44
5.2.27	Strontium Acetate, 1/2 Hydrate, Analyzed Reagent	45
5.2.28	Thallous Acetate, Anhydrous, Reagent	46
5.2.29	Thallous Formate, Anhydrous, Reagent	47
5.2.30	Uranyl Acetate, Dihydrate, Analyzed Reagent	48
5.2.31	Zinc Acetate, Dihydrate, Analyzed Reagent	49
5.3	METAL CHELATES	51
5.3.1	Ammonium Iron (III) Oxalate, Trihydrate, Reagent	51
5.3.2	Ammonium Titanyl Oxalate, Monohydrate, Reagent	52
5.3.3	Calcium Citrate, Tetrahydrate, Analyzed Reagent	52
5.3.4	Calcium Oxalate, Monohydrate, Analyzed Reagent	53
5.3.5	Cerium (III) Oxalate, Nonylhydrate, Reagent	54
5.3.6	Chromium (III) Acetylacetonate, Reagent	55
5.3.7	Cobalt (II) Acetylacetonate, Reagent	56
5.3.8	Copper (II) Ethylacetoacetate, Reagent	56
5.3.9	Cupric Oxalate, 1/2 Hydrate, Analyzed Reagent	57

DOD-STD-1446

CONTENTS (Continued)

<u>Paragraph</u>		<u>Page</u>
5.3.10	Ferric Acetylacetonate, Reagent	58
5.3.11	Ferric Ammonium Citrate, Analyzed Reagent	58
5.3.12	Ferric Citrate, Pentahydrate, Analyzed Reagent	59
5.3.13	Ferrous Oxalate, Dihydrate, Reagent	60
5.3.14	Lead Citrate, Trihydrate, Reagent	61
5.3.15	Lithium Oxalate, Analyzed Reagent	61
5.3.16	Magnesium Acetylacetonate, Dihydrate, Reagent	62
5.3.17	Molybdenum Oxide Acetylacetonate, Reagent	63
5.3.18	Nickel Acetylacetonate, Monohydrate, Reagent	64
5.3.19	Nickel Oxalate, Dihydrate, Reagent	64
5.3.20	Palladium Acetylacetonate, Reagent	65
5.3.21	Potassium Titanyl Oxalate, Dihydrate, Reagent	66
5.3.22	Praseodymium Oxalate, Decahydrate, Reagent	66
5.3.23	Samarium Oxalate, Decahydrate, Reagent	67
5.3.24	Scandium Oxalate, Pentahydrate, Reagent	68
5.3.25	Terbium Oxalate, Decahydrate, Reagent	68
5.3.26	Tin Chloride Acetylacetonate, Reagent	69
5.4	ORGANOMETALLIC COMPOUNDS	71
5.4.1	Diethylaluminum Chloride, Reagent.	71
5.4.2	Diethyltin Dichloride, Reagent	72
5.4.3	Diisobutylaluminum Hydride, Reagent	72
5.4.4	Dimethylboron Bromide, Reagent	73
5.4.5	Dimethylcadmium, Reagent	74
5.4.6	Diphenyltin Dichloride, Reagent	75
5.4.7	Methylmercuric Chloride, Reagent	75
5.4.8	Methylmercuric Iodide, Reagent	76
5.4.9	Phenylmercury Chloride, Reagent	77
5.4.10	Tetraethyltin, Reagent	77
5.4.11	Tetramethylsilane, Analyzed Reagent	78
5.4.12	Tetramethyltin, Reagent	79
5.4.13	Tetraphenylarsenic Chloride, Monohydrate, Reagent	80
5.4.14	Tetraphenylsilane, Reagent	81
5.4.15	Tetraphenylsodium Borate, Analyzed Reagent	81
5.4.16	Tetraphenyltin, Reagent	82
5.4.17	Triethylaluminum, Reagent	83
5.4.18	Triethylboron, Reagent	84
5.4.19	Triethyldialuminum Trichloride, Reagent	85
5.4.20	Triisobutylaluminum, Reagent	86
5.4.21	Trimethylaluminum, Reagent	87
5.4.22	Trimethylarsenic, Reagent	87
5.4.23	Trimethyldialuminum Trichloride, Reagent	88
5.4.24	Triphenylantimony Dichloride, Reagent	89
5.4.25	Triphenyltin Chloride, Reagent	90
6.	NOTES	91
6.1	Subject term (key word) listings	91
6.2	Changes from previous issue	93
6.3	Abbreviations.	93
	INDEX	94

DOD-STD-1446

TABLES

	<u>Page</u>
I. Aluminum Ethoxide, Reagent - chemical requirement.	10
II. Aluminum Isopropoxide, Reagent - chemical requirements. . .	11
III. Aluminum tert-Butoxide, Reagent - chemical requirement. . .	12
IV. Aluminum tri-sec-Butoxide, Reagent - chemical requirements..	13
V. Lithium Methoxide, Reagent - chemical requirement.	13
VI. Lithium Phenoxide, Reagent - chemical requirement.	14
VII. Lithium tert-Butoxide, Reagent - chemical requirement. . . .	15
VIII. Potassium Ethoxide, Reagent - chemical requirement.	15
IX. Potassium tert-Butoxide, Reagent - chemical requirement. . .	16
X. Sodium Ethoxide, Reagent - chemical requirement.	17
XI. Sodium tert-Butoxide, Reagent - chemical requirement.	17
XII. Thallium Ethoxide, Reagent -chemical requirement.	18
XIII. Titanium Butoxide, Reagent - chemical requirement.	19
XIV. Titanium Propoxide, Reagent - chemical requirement.	20
XV. Barium Acetate, Anhydrous, Analyzed Reagent - chemical requirements (ACS).	21
XVI. Cadmium Acetate, Dihydrate, Analyzed Reagent - chemical requirements.	22
XVII. Calcium Acetate, Monohydrate, Analyzed Reagent - chemical requirements (USP).	23
XVIII. Cobaltous Acetate, Tetrahydrate, Analyzed Reagent - chemical requirements (USP).	24
XIX. Curpic Acetate, Monohydrate, Analyzed Reagent - chemical requirements (ACS).	25
XX. Lead Acetate, Trihydrate, Analyzed Reagent - chemical requirements (ACS).	26
XXI. Lead Subacetate, Anhydrous, Analyzed Reagent - chemical requirements (ACS).	27
XXII. Magnesium Acetate, Tetrahydrate, Analyzed Reagent - chemical requirements (ACS).	28
XXIII. Manganous Acetate, Tetrahydrate, Analyzed Reagent - chemical requirements.	29
XXIV. Mercuric Acetate, Anhydrous, Analyzed Reagent - chemical requirements (ACS).	30
XXV. Nickel Acetate, Tetrahydrate, Analyzed Reagent - chemical and physical requirements.	30
XXVI. Potassium Acetate, Anhydrous, Analyzed Reagent - chemical and physical requirements (ACS).	32
XXVII. Potassium Citrate, Monohydrate, Analyzed Reagent - chemical and physical requirements.	32
XXVIII. Potassium Hydrogen Phthalate, Anhydrous, Analyzed Reagent (Acidimetric Standard) - chemical and physical require- ments (ACS).	34
XXIX. Potassium Hydrogen Tartrate, Anhydrous, Analyzed Reagent - chemical requirements.	35
XXX. Potassium Oxalate, Monohydrate, Analyzed Reagent - chemical and physical requirements (ACS).	36
XXXI. Potassium Sodium Tartrate, Tetrahydrate, Analyzed Reagent - chemical and physical requirements (ACS).	37
XXXII. Potassium Tartrate, 1/2 Hydrate, Analyzed Reagent - chemical and physical requirements.	38

DOD-STD-1446

TABLES (Continued)

	<u>Page</u>
XXXIII. Silver Acetate, Anhydrous, Analyzed Reagent - chemical requirements.	38
XXXIV. Sodium Acetate, Anhydrous, Analyzed Reagent - chemical and physical requirements (ACS).	39
XXXV. Sodium Acetate, Trihydrate, Analyzed Reagent - chemical and physical requirements (ACS).	40
XXXVI. Sodium Bitartrate, Monohydrate, Analyzed Reagent - chemical requirements (USP).	41
XXXVII. Sodium Formate, Anhydrous, Analyzed Reagent - chemical requirements (ACS).	42
XXXVIII. Sodium Oxalate, Anhydrous, Analyzed Reagent - chemical and physical requirements (ACS).	43
XXXIX. Sodium Salicylate, Anhydrous, Analyzed Reagent - chemical requirements (USP).	44
XL. Sodium Tartrate, Dihydrate, Analyzed Reagent - chemical and physical requirements (ACS).	45
XLI. Strontium Acetate, 1/2 Hydrate, Analyzed Reagent - chemical requirements (NF).	46
XLII. Thallous Acetate, Anhydrous, Reagent - physical requirement.	47
XLIII. Thallous Formate, Anhydrous, Reagent - chemical requirement.	47
XLIV. Uranyl Acetate, Dihydrate, Analyzed Reagent - chemical requirements (ACS).	48
XLV. Zinc Acetate, Dihydrate, Analyzed Reagent - chemical requirements (NF).	49
XLVI. Ammonium Iron (III) Oxalate, Trihydrate, Reagent - chemical requirement.	51
XLVII. Ammonium Titanyl Oxalate, Monohydrate, Reagent - chemical requirement.	52
XLVIII. Calcium Citrate, Tetrahydrate, Analyzed Reagent - chemical and physical requirements (NF).	53
XLIX. Calcium Oxalate, Monohydrate, Analyzed Reagent - chemical requirements.	54
L. Cerium (III) Oxalate, Nonylhydrate, Analyzed Reagent - chemical requirements.	54
LI. Chromium (III) Acetylacetonate, Reagent - physical requirements.	55
LII. Cobalt (II) Acetylacetonate, Reagent - chemical requirements.	56
LIII. Copper (II) Ethylacetoacetate, Reagent - chemical and physical requirements.	57
LIV. Cupric Oxalate, 1/2 Hydrate, Analyzed Reagent - chemical requirements.	57
LV. Ferric Acetylacetonate, Reagent - chemical and physical requirements.	58
LVI. Ferric Ammonium Citrate, Analyzed Reagent - chemical requirements (USP).	59
LVII. Ferric Citrate, Pentahydrate, Analyzed Reagent - chemical requirements (USP).	60
LVIII. Ferrous Oxalate, Dihydrate, Reagent - chemical requirement.. . . .	60
LIX. Lead Citrate, Trihydrate, Reagent - chemical and physical requirements.	61

DOD-STD-1446

TABLES (Continued)

	<u>Page</u>
LX. Lithium Oxalate, Analyzed Reagent - chemical and physical requirements (NF).	62
LXI. Magnesium Acetylacetonate, Reagent - chemical requirement. .	63
LXII. Molybdenum Oxide Acetylacetonate, Reagent - chemical requirement.	63
LXIII. Nickel Acetylacetonate, Monohydrate, Reagent - chemical requirement.	64
LXIV. Nickel Oxalate, Dihydrate, Reagent - chemical requirement. .	65
LXV. Palladium Acetylacetonate, Reagent - chemical requirement. .	65
LXVI. Potassium Titanyl Oxalate, Dihydrate, Reagent - chemical requirement.	66
LXVII. Praseodymium Oxalate, Decahydrate, Reagent - chemical requirement.	67
LXVIII. Samarium Oxalate, Decahydrate, Reagent - chemical requirement.	67
LXIX. Scandium Oxalate, Pentahydrate Reagent - chemical requirement.	68
LXX. Terbium Oxalate, Decahydrate, Reagent - chemical requirement.	69
LXXI. Tin Chloride Acetylacetonate, Reagent - chemical and physical requirement.	69
LXXII. Diethylaluminum Chloride, Reagent - chemical requirement. .	71
LXXIII. Diethyltin Dichloride, Reagent - physical requirements. . .	72
LXXIV. Diisobutylaluminum Hydride, Reagent - chemical requirement..	73
LXXV. Dimethylboron Bromide, Reagent - chemical requirement. . . .	73
LXXVI. Dimethylcadmium, Reagent - chemical requirement.	74
LXXVII. Diphenyltin Dichloride, Reagent - chemical requirement. . .	75
LXXVIII. Methylmercuric Chloride, Reagent - chemical requirement. . .	76
LXXIX. Methylmercuric Iodide, Reagent - chemical requirement. . . .	76
LXXX. Phenylmercury Chloride, Reagent - chemical requirement. . .	77
LXXXI. Tetraethyltin, Reagent - chemical requirement.	78
LXXXII. Tetramethylsilane, Analyzed Reagent - chemical requirements (ACS).	79
LXXXIII. Tetramethyltin, Reagent - chemical requirement.	79
LXXXIV. Tetraphenylarsenic Chloride, Monohydrate, Reagent - physical requirement.	80
LXXXV. Tetraphenylsilane, Reagent - chemical requirement.	81
LXXXVI. Tetraphenylsodium Borate, Analyzed Reagent - chemical and physical requirements (ACS).	82
LXXXVII. Tetraphenyltin, Reagent - chemical requirement.	82
LXXXVIII. Triethylaluminum, Reagent - chemical requirement.	83
LXXXIX. Triethylboron, Reagent - chemical requirement.	84
XC. Triethyldialuminum Trichloride, Reagent - chemical requirements.	85
XCI. Triisobutylaluminum, Reagent - chemical requirement.	86
XCII. Trimethylaluminum, Reagent - chemical requirement.	87
XCIII. Trimethylarsenic, Reagent - chemical requirement.	87
XCIV. Trimethyldialuminum Trichloride, Reagent - Physical Requirements.	88
XCV. Triphenylantimony dichloride, Reagent-chemical requirement .	89
XCVI. Triphenyltin Chloride, Reagent - physical requirement. . . .	90

DOD-STD-1446

1. SCOPE

1.1 Coverage. This standard is a presentation of nomenclature, 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 catalyst, intermediates in organic synthesis, molecular weight standards, proton nmr position reference, carbonyl reducing agent, and transesterification catalyst. 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:

- Metal Alkoxides
- Metal Carboxylates
- Metal Chelates
- Organometallic Compounds

DOD-STD-1446

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this standard to the extent specified herein.

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 Specification For (Metric)

STANDARDS

FEDERAL

- FED-STD-313 - Material Safety Data Sheets, Preparation And The Submission Of

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this standard to the extent specified herein.

CODE OF FEDERAL REGULATIONS (CFR)

- Title 29 - Department Of Labor, Occupational Safety And Health Administration
- Title 40 - Protection Of The Environment; Environmental Protection Agency
- Title 49 - Department Of Transportation; Hazardous Materials Regulations

DEPARTMENT OF DEFENSE (DOD)

- DOD 4145.19-R-1 - Storage And Materials Handling
- DOD 4160.21-M - Defense Utilization And Disposal Manual
- DOD 6050.5 - DOD Hazardous Materials Information System, Hazardous Item Listing
- TB MED 502 - Occupational And Environmental Health Respiratory Protection Program
- (DLAM 1000.2)
- TB MED 506 - Occupational And Environmental Health Occupational Vision
- TM 38-250 - Packaging, Materials Handling - Preparation Of Hazardous Materials For Military Air Shipment

DOD-STD-1446

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.)

2.2 Other publications. The following document(s) form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of DODISS specified in the solicitation. The issues of documents which have not been adopted shall be those in effect on the date of the cited DODISS.

AMERICAN CONFERENCE OF GOVERNMENT INDUSTRIAL HYGIENISTS (ACGIH)

TLVs® Threshold Limit Values for Chemical Substances in the Work Environment Adopted by American Conference of Government 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, 6500 Glenway Avenue, Bldg D-7, Cincinnati, OH 45211.)

AMERICAN CHEMICAL SOCIETY SPECIFICATIONS, REAGENT CHEMICALS (ACS)

(Application for copies should be addressed to American Chemical Society, 1155 Sixteenth Street, N.W., Washington, D.C. 20036.)

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.)

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.)

UNITED STATES PHARMACOPEIA (USP) - NATIONAL FORMULARY (NF)

(Application for copies should be addressed to United States Pharmacopeia, 12601 Twinbrook Parkway, Rockville, MD 20852.)

DOD- STD-1446

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

2.3 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS (Not applicable)

DOD-STD-1446

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. Shipping containers shall be labeled in accordance with current Department of Transportation (DOT) Hazardous Materials Regulations applicable to each chemical. When shipping by military aircraft the requirements of TM 38-250 shall apply. In addition, each item shall be packaged and labeled as specified in the applicable contract or order. All labels shall also comply with Hazard Communication Standard, 29 CFR 1910.1200 (f).

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 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 exposure or for supplementing other control measures (refer to TB MED 502 or DLAM 1000.2). Ventilation shall be adequate to remove hazardous concentrations.

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. In case of contact with the skin, wash affected areas thoroughly with water. Eye lavages and emergency showers shall be located where there is a potential for direct contact with harmful chemicals.

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 MSDS on all chemical items in their work area, in accordance with 29 CFR 1910.1200 (h), to ensure that employees know potential hazards of the chemicals with which they come in contact and the symptoms of

DOD-STD-1446

exposure as well as how these chemicals affect the body and bodily functions. Employees shall be adequately trained to render first aid.

4.3.1.5 Exercises. Participation in 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.

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 Part 173, Subpart D, Section 173.115 of 49 CFR, defines a flammable liquid as one having a closed cup flash point below 37.8°C (100°F). A combustible liquid is defined, by DOT in the above reference, as one having a closed cup flash point at or above 37.8°C and below 93.3°C (200°F). A pyrophoric liquid is defined, by DOT in the above reference, 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 or higher are to be considered as burnable. The Environmental Protection Agency (EPA), in Part 261, Subpart C, Section 261.21 of 40 CFR*, designates the criteria for flammable and combustible materials and oxidizers that exhibit the characteristic of ignitability (I). 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 are materials that react on contact with water or steam to ignite or evolve heat or explosive gases. Such materials exhibit the characteristic of reactivity (R) as designated by the EPA in Section 261.23 of the above reference.* 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, and separated from other storage areas.

*Refers only to materials that have become waste materials.

DOD-STD-1446

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.

4.3.3 Chemical hazardous exposure limits. Chemical hazardous exposure limits for airborne concentrations of substances are obtained from the current TLVs® Threshold Limit Values for Chemical Substances in the Work Environment, adopted by the American Conference of Government Industrial Hygienists (ACGIH); current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL), 29 CFR, Section 1910.1000; and NIOSH Recommendation for Environmental Exposure Limits. Such information is also shown in MSDSs and the HMIS referred to in 4.2. The identity of sources establishing if a chemical is a carcinogen or potential carcinogen, for hazard communication purposes, is shown in 29 CFR 1910.1200 (d)(4).

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

4.3.4.1 EPA Toxic (T). Some chemical compounds have been designated by the EPA as toxic (T) in accordance with the criteria shown in Part 261, Subpart B, Section 261.11(a)(3) of 40 CFR.* Some commercial chemical products are listed as toxic under Subpart D, Section 261.33(f).

4.3.4.2 EPA Acute Hazardous Toxicity (H). Some chemical compounds have been designated by the EPA as acute hazardous (H) in toxicity in accordance with the criteria shown in Subpart B, Section 261.11(a)(2) of 40 CFR.* Some commercial chemical products are listed as acute hazardous in toxicity under Subpart D, Section 261.33(e).

4.3.4.3 EPA Extraction Procedure Toxicity (EP Toxicity) (E). Some chemical contaminants, that are not listed in Subpart D, have been designated by the EPA as exhibiting the characteristic of EP toxicity, and are listed in Section 261.24 Table 1 of 40 CFR.*

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 Utiliza-

*Refers only to materials that have become waste materials.

DOD-STD-1446

tion 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 (i.e., ignitable, corrosive, reactive or EP toxic) or are listed (i.e., toxic or acute hazardous) according to Identification and Listing of Hazardous Waste, Part 261; 40 CFR; 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 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 Section 262.34, Part 262 of the above reference. 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 Part 262 of the above reference. Transportation of the waste shall be in accordance with Part 263 of the above reference, Standards Applicable to Transporters of Hazardous Waste.

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 installations 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 materials. It is imperative that the proper description of waste accompany the packaged item at all times. Final disposal of the waste item shall be accomplished by reutilization, transfer, donation or sales by DRMS 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 in to the DRMO shall first

DOD-STD-1446

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. 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.

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 THEIR PARTICULAR SITUATION REGARDLESS OF SIMILARITY TO A CORRESPONDING DEPARTMENT OF DEFENSE OR OTHER GOVERNMENT SITUATION.

DOD- STD-1446

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 the 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 Name. Aluminum Ethoxide, Reagent $\text{Al}(\text{C}_2\text{H}_5\text{O})_3$ FW 162.14
Aluminum ethylate
Aluminum triethoxide

5.1.1.1 Technical description. Aluminum ethoxide (pure) exists as white crystals with a density of 1.142 g/cm^3 ($20^\circ/0^\circ\text{C}$). Its melting point is $150\text{--}160^\circ\text{C}$ and boiling point is 205°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 $[\text{Al}(\text{C}_2\text{H}_5\text{O}_3)_3]$, % 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)

DOD- STD-1446

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)

Aluminum ethoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.2 Name. Aluminum Isopropoxide, Reagent $\text{Al}(\text{C}_3\text{H}_7\text{O})_3$ FW 204.25
Aluminum tri-iso-propoxide

5.1.2.1 Technical description. Aluminum isopropoxide (pure) exists as white crystals with a density of 1.0346 g/cm^3 at 20°C . Its melting point is 118.5°C and its boiling point is 140.5°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 requirement. (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 requirements.

Assay $[\text{Al}(\text{C}_3\text{H}_7\text{O})_3]$, % by wt	98.0-102.0
Assay (Al), % by wt, min - max	12.9-13.5

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.

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)

Aluminum isopropoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

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

DOD-STD-1446

5.1.3.1 Technical description. Aluminum tert-butoxide (pure) exists as white crystals with a density of 1.0251 g/cm³ at 20°C. It sublimes at 180°C and its melting point is >300°C (sealed tube). It is very soluble in organic solvents. The commercially available product is a powder with a melting point of 241.5-246.5°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)

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)

Aluminum tert-butoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.4 Name. Aluminum tri-sec-Butoxide, Reagent $\text{Al}(\text{OC}_4\text{H}_9)_3$ FW 246.30
Aluminum tri-sec-butylate

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/cm³ and its refractive index is 1.4405. 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.

DOD-STD-1446

TABLE IV. Aluminum tri-sec-Butoxide, Reagent - chemical requirements.

Assay $[Al(OC_4H_9)_3]$, min-max, % by wt	98.0-102.0
Assay (Al), min-max, % by wt	10.7-11.2

NOTE: Actual assay shall be 99.4% based on surplus aluminum content being $Al(OH)_3$.

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 liquid. 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)

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 Classifications - Reactive, Waste No. D003; and Ignitable, Waste No. D001.

5.1.5 Name. Lithium Methoxide, Reagent $LiOCH_3$ FW 37.97
Lithium methylate

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 $500^\circ C$. 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 requirement.

Assay ($LiOCH_3$), % 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

DOD- STD-1446

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)

Lithium methoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.6 Name. Lithium Phenoxide, Reagent LiOC_6H_5 FW 100.05
Lithium phenylate

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 (LiOC_6H_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)

Lithium phenoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.7 Name. Lithium tert-Butoxide, Reagent LiOC_4H_9 FW 80.05
Lithium butylate

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.

DOD-STD-1446

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.

TABLE VII. Lithium tert-Butoxide, Reagent - chemical requirement.

Assay (LiOC_4H_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)

Lithium tert-butoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.8 Name. Potassium Ethoxide, Reagent KOC_2H_5 FW 84.16
Potassium ethylate

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 (KOC_2H_5), % by wt	95.0+
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5.1.8.3 Use. Potassium ethoxide is used in chemical synthesis.

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)

DOD-STD-1446

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)

Potassium ethoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.9 Name. Potassium tert-Butoxide, Reagent $(\text{CH}_3)_3\text{COK}$ FW 112.22
Potassium butylate

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 $[(\text{CH}_3)_3\text{COK}]$, % 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)

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

Potassium tert-butoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.10 Name. Sodium Ethoxide, Reagent $\text{C}_2\text{H}_5\text{ONa}$ FW 68.05
Sodium ethylate
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°C. It is soluble without decomposition in absolute alcohol.

DOD- STD-1446

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)

Sodium ethoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.11 Name. Sodium tert-Butoxide, Reagent $NaOC(CH_3)_3$ FW 96.11
Sodium butylate

5.1.11.1 Technical description. Commercially available sodium tert-butoxide exists as a white powder with a density of 1.04 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 [$NaOC(CH_3)_3$], % 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)

DOD- STD-1446

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)

Sodium tert-butoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.12 Name. Thallium Ethoxide, Reagent TLOC₂H₅ FW 249.43
Thallous ethoxide
Thallium (I) ethoxide

5.1.12.1 Technical description. Thallium ethoxide (pure) exists as a colorless liquid with a density of 3.493 g/cm³ at 20°C. Its melting point is -3°C. It decomposes at 130°C. Its refractive index is 1.6714 at 20°C. It is slightly soluble in alcohol and soluble in ether. It is moisture sensitive.

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 (TLOC ₂ 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 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 eyes, skin 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)

Thallium ethoxide has an EPA Hazardous Waste Classification - Reactive and Toxic.

DOD-STD-1446

5.1.13 Name. Titanium Butoxide, Reagent $\text{Ti}(\text{C}_4\text{H}_9\text{O})_4$ FW 340.36
 Titanium (IV) butoxide
 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°C (170°F). It is moisture sensitive.

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

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 $[\text{Ti}(\text{C}_4\text{H}_9\text{O})_4]$, % 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, 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)

Titanium butoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003.

5.1.14 Name. Titanium Propoxide, Reagent $\text{Ti}(\text{C}_3\text{H}_7\text{O})_4$ FW 284.25
 Titanium (IV) propoxide
 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 g/cm³. Its boiling point is 170°C at 3 mm. Its refractive index is 1.4986. Its flash point is 42°C (109°F) (cc). It is moisture sensitive.

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

DOD-STD-1446

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

TABLE XIV. Titanium Propoxide, Reagent - chemical requirement.

Assay $\text{Ti}(\text{C}_3\text{H}_7\text{O})_4$, % 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)

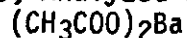
Titanium propoxide has an EPA Hazardous Waste Classification - Reactive, Waste No. D003; and Ignitable, Waste No. D001.

DOD-STD-1446

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 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

5.2.1.1 Technical description. Barium acetate, anhydrous (pure) exists as colorless crystals with a density of 2.468 g/cm³. 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 ₃)	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

DOD-STD-1446

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

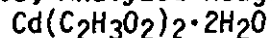
5.2.1.4 Safety. Barium acetate, anhydrous may cause burns to skin, eyes and mucous membranes. It is toxic if inhaled, ingested or absorbed through skin. Breathing of dust, vapor or mist shall be avoided. Barium acetate shall be used with adequate ventilation. The TLV for barium soluble compounds, as Ba, is 0.5 mg/m³. The PEL is the same. (Refer to 4.3.1)

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 has an EPA Hazardous Waste Classification - EP Toxic; Waste No. D005.

5.2.2 Name. Cadmium Acetate, Dihydrate, Analyzed Reagent



FW 266.54

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/cm³. 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 Requirements. 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 ₃)	0.02
Sulfate (SO ₄)	0.005
Zinc (Zn)	0.05
Alkalies and 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.

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

DOD-STD-1446

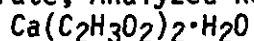
handling. The TLV for cadmium, dusts and salts, as Cd, is 0.05 mg/m³. Cadmium acetate is a confirmed carcinogen. (Refer to 4.3.1)

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 has an EPA Hazardous Waste Classification - EP Toxic; Waste No. D006.

5.2.3 Name. Calcium Acetate, Monohydrate, Analyzed Reagent



FW 176.19

Vinegar salt

Gray acetate

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.

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 ₃ COOH)	0.2
Chloride (Cl)	0.005
Nitrate (as NO ₃)	0.003
Sulfate (SO ₄)	0.04
Alkalies and magnesium (as SO ₄)	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)

DOD-STD-1446

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
 $\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ FW 249.08
 Cobalt II acetate

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/cm³ 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.

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 ₃)	0.02
Sulfate (SO ₄)	0.02
Substances not precipitated by hydrogen sulfide (as SO ₄)	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)

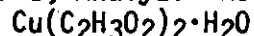
5.2.4.5 Storage. Cobaltous acetate, tetrahydrate shall be stored in a cool, dry well-ventilated place in tightly closed containers. (Refer to 4.3.2)

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

DOD-STD-1446

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

5.2.5 Name. Cupric Acetate, Monohydrate, Analyzed Reagent



FW 199.65

Neutral verdigris

Copper II acetate

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/cm³. 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 ₄)	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.

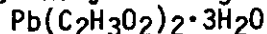
5.2.5.4 Safety. Cupric acetate, monohydrate is irritating to eyes, skin and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Cupric acetate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound.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

5.2.6 Name. Lead Acetate, Trihydrate, Analyzed Reagent



FW 379.33

Sugar of lead

Salt of Saturn

DOD-STD-1446

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/cm³. 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 ₃), 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.

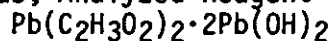
5.2.6.4 Safety. Lead acetate, trihydrate is toxic by inhalation. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Lead acetate shall be used with adequate ventilation. Fire may produce irritating or poisonous gases. Wash thoroughly after handling. Lead acetate is a confirmed carcinogen. The PEL for lead acetate is 50 µg/m³. (Refer to 4.3.1)

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 has an EPA Hazardous Waste Classification - Toxic; Waste No. U144.

5.2.7 Name. Lead Subacetate, Anhydrous, Analyzed Reagent



FW 807.75

Lead monosubacetate

Monobasic lead acetate

DOD-STD-1446

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 CO₂ 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
Nitrate and nitrite (as NO ₃) To pass absorbance test, Limit about	0.003
Copper (Cu)	0.002
Substances not precipitated by hydrogen sulfide (as sulfates)	0.3
Iron (Fe)	0.002

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

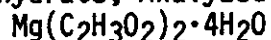
5.2.7.4 Safety. Lead subacetate, anhydrous is toxic by ingestion, inhalation and may be absorbed from denuded skin. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Lead subacetate shall be used with adequate ventilation. Fire may produce irritating or poisonous gases. Wash thoroughly after handling. Lead subacetate is a suspected carcinogen. The PEL for lead subacetate is 50 µg/m³. (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 and 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

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/cm³. Its melting point is 80°C. Its

DOD-STD-1446

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.

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 ₄)	0.005
Barium (Ba)	0.001
Calcium (Ca)	0.01
Manganese (Mn)	0.001
Potassium (K)	0.005
Sodium (Na)	0.005
Strontium (Sr)	0.005
Maximum Limits of Impurities (ppm)	
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 the 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.

5.2.9 Name. Manganous Acetate, Tetrahydrate, Analyzed Reagent

$\text{Mn}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ FW 245.08

Manganese II acetate, tetrahydrate

5.2.9.1 Technical description. Manganous acetate, tetrahydrate (pure) exists as pale red, monoclinic crystals. It has a density of 1.589 g/cm³. Its melting point is 80°C. It is soluble in cold water and soluble in alcohol.

DOD-STD-1446

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 (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.

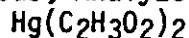
5.2.9.4 Safety. Manganous acetate, tetrahydrate dust and fumes are minor irritants to the eyes and mucous membranes of the respiratory tract. Breathing of dust, fumes and mist of manganous acetate shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Manganous acetate shall be used with adequate ventilation. The TLV (ceiling limit) for manganese (as Mn) dust and compounds is 5 mg/m³; for fumes, the TLV is 1 mg/m³. The PEL (ceiling limit) for manganese is 5 mg/m³. (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)

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

5.2.10.1 Technical description. Mercuric acetate, anhydrous (pure) exists as white scales or powder with a density of 3.270 g/cm³. It melts with decomposition. Its solubility in water is 25 g/100 mL at 10°C and 100 g/100 mL at 100°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.

DOD -STD-1446

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 (NO_3)	0.005
Sulfate (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 the 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 mg/m^3 . (Refer to 4.3.1)

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 has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D009.

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

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

5.2.11.2 Specification. Manufacturer's requirement. (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°C	6.0 - 7.0

DOD-STD-1446

TABLE XXV. Nickel Acetate, Tetrahydrate, Analyzed Reagent - chemical and physical requirements - (Continued).

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 (NH ₄) ₂ S (as SO ₄)	0.2
Sulfate (SO ₄)	0.005

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

5.2.11.4 Safety. Nickel acetate tetrahydrate is irritating to the eyes, skin and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Nickel acetate shall be used with adequate ventilation. Wash thoroughly after handling. Nickel acetate is a confirmed carcinogen. There is no TLV or PEL referenced for water insoluble nickel compounds. If heated to decomposition nickel acetate may evolve toxic fumes. (Refer to 4.3.1)

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

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

Nickel acetate has an EPA Hazardous Waste Classification - Toxic.

5.2.12 Name. Potassium Acetate, Anhydrous, Analyzed Reagent
KC₂H₃O₂

FW 98.15

5.2.12.1 Technical description. Potassium acetate, anhydrous (pure) exists as a white, lustrous, deliquescent powder with a density of 1.57 g/cm³ at 25°C. Its melting point is 292°C. Its solubility in water is 253 g/100 mL at 20°C and 492 g/100 mL at 62°C. It has a solubility of 33 g/100 mL alcohol, 24.24 g/100 mL methyl alcohol at 15°C. It is slightly soluble in liquid ammonia and insoluble in ether and acetone.

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

5.2.12.2.1 Requirements. The federal specification chemical and physical requirements for potassium acetate, anhydrous, analyzed reagent are shown in Table XXVI.

DOD -STD-1446

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 ₄)	0.001
Sulfate (SO ₄)	0.002
Calcium, magnesium and R ₂ O ₃ 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 hyperkalemia. 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. 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
 $K_3C_6H_5O_7 \cdot H_2O$ FW 324.42

5.2.13.1 Technical description. Potassium citrate, monohydrate (pure) exists as white crystals with a density of 1.98 g/cm³. 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 ($K_3C_6H_5O_7 \cdot H_2O$), min, %	99.0
pH of a 5% solution at 25°C (min-max)	7.0 - 9.0

DOD -STD-1446

TABLE XXVII. Potassium Citrate, Monohydrate, Analyzed Reagent - chemical and physical requirements - (Continued).

Maximum Limits of Impurities (% by wt)	
Insoluble matter	0.005
Chloride (Cl)	0.001
Sulfate (SO ₄)	0.005
Calcium (Ca)	0.005
Iron (Fe)	0.001
Sodium (Na)	0.03
Maximum Limits of Impurities (ppm)	
Phosphate (PO ₄)	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.

5.2.14 Name. Potassium Hydrogen Phthalate, Anhydrous, Analyzed Reagent
 (Acidimetric Standard) KHC8H4O4 FW 204.23
 Potassium acid phthalate
 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/cm³. 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.

DOD-STD-1446

TABLE XXVIII. Potassium Hydrogen Phthalate, Anhydrous, Analyzed Reagent (Acidimetric Standard) - chemical and physical requirements (ACS).

Assay ($C_8H_5O_4K$), min-max, % by wt	99.5 - 100.05
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.

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 the 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 Name. Potassium Hydrogen Tartrate, Anhydrous, Analyzed Reagent
 $KHC_4H_4O_6$ FW 188.18
 Potassium bitartrate
 Potassium acid tartrate
 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/cm³ 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)

DOD -STD-1446

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

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)	
Insoluble in ammonium hydroxide	0.005
Chloride (Cl)	0.002
Sulfate (SO_4)	0.01
Ammonia (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
 $\text{K}_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$ FW 184.24

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^3 . 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.

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.

DOD-STD-1446

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 ₄)	0.01
Ammonium (NH ₄)	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 the 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.

5.2.17 Name. Potassium Sodium Tartrate, Tetrahydrate, Analyzed Reagent
 $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$ FW 282.23
 Rochelle salt
 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/cm³. 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.

DOD-STD-1446

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 ₄)	0.002
Sulfate (SO ₄)	0.005
Ammonium (NH ₄)	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.

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, Analyzed Reagent
 $K_2C_4H_4O_6 \cdot 1/2H_2O$ FW 235.28
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/cm³ 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 requirement. (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.

DOD -STD-1446

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
Maximum Limits of Impurities (ppm)	
Chloride (Cl)	5
Phosphate (PO_4)	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. Sodium 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
 $AgC_2H_3O_2$

FW 166.92

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_3 . It is light sensitive.

5.2.19.2 Specification. Manufacturer's requirement. (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.

TABLE XXXIII. Silver Acetate, Anhydrous, Analyzed Reagent - chemical requirements.

Assay ($AgC_2H_3O_2$), % by wt	>98.0
Maximum Limits of Impurities (ppm)	
Chloride (Cl)	<0.005
Sulfate (SO_4)	<0.005
Copper (Cu)	<0.005

DOD-STD-1446

TABLE XXXIII. Silver Acetate, Anhydrous, Analyzed Reagent - chemical requirements - (Continued).

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 mg/m³. 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 has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D011.

5.2.20 Name. Sodium Acetate, Anhydrous, Analyzed Reagent

NaC₂H₃O₂

FW 82.03

Acetic acid, sodium salt

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 g/cm³. It has a melting point of 324°C. Its solubility in water is 119 g/100 mL at 0°C and 170.15 g/100 mL at 100°C. It is slightly soluble in alcohol.

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 ₄)	0.001

DOD-STD-1446

TABLE XXXIV. Sodium Acetate, Anhydrous, Analyzed Reagent - chemical and physical requirements (ACS) - (Continued).

Sulfate (SO ₄)	0.003
Calcium, magnesium, and R ₂ O ₃ 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.

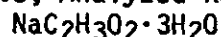
5.2.20.4 Safety. Sodium acetate, anhydrous has a low toxicity. Large doses may cause alkalosis. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

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

5.2.21.1 Technical description. Sodium acetate, trihydrate (pure) exists as colorless, efflorescent monoclinic prisms. Its index of refraction is 1.464 and a density of 1.45 g/cm³. Its melting point is 58°C and boiling point is 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 ₄)	0.002
Calcium, magnesium, and R ₂ O ₃ precipitate	0.010
Substances reducing permanganate	To pass color test
Potassium (K)	0.005

DOD-STD-1446

TABLE XXXV. Sodium Acetate, Trihydrate, Analyzed Reagent - chemical and physical requirements (ACS) - (Continued).

Maximum Limits of Impurities (ppm)	
Phosphate (PO_4)	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)

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
 $NaHC_4H_4O_6 \cdot H_2O$ FW 190.09
 Sodium acid tartrate

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 $100^\circ C$ and decomposes at $234^\circ C$. Its solubility in water is 6.7 g/100 mL at $18^\circ C$ and 9.2 g/100 mL at $30^\circ C$.

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 ($NaHC_4H_4O_6 \cdot H_2O$) (min-max) % by wt	99.0 - 100.5
Maximum Limits of Impurities (% by wt)	
Insoluble matter	0.01
Chloride (Cl)	0.02
Heavy metals (as Pb)	0.001
Sulfate (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 effervescing mixtures.

DOD-STD-1446

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)

5.2.22.5 Storage. Sodium bitartrate, monohydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.2.22.6 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.

5.2.23 Name. Sodium Formate, Anhydrous, Analyzed Reagent
NaCHO₂

FW 68.01

5.2.23.1 Technical description. Sodium formate, anhydrous (pure) exists as colorless monoclinic, deliquescent crystals. It has a density of 1.919 g/cm³ and a melting point of 253°C. It melts with decomposition. Its solubility in water is 97.2 g/100 mL at 20°C and 160 g/100 mL at 100°C. It is slightly soluble in alcohol and insoluble in ether.

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

5.2.23.2.1 Requirements. The federal specification chemical requirements for sodium formate, anhydrous, analyzed reagent are shown in Table XXXVII.

TABLE XXXVII. Sodium Formate, Anhydrous, Analyzed Reagent - chemical requirements (ACS).

Assay (NaCHO ₂), (min), % by wt	99.0
Maximum Limits of Impurities (% by wt)	
Insoluble matter	0.005
Chloride (Cl)	0.001
Sulfate (SO ₄)	0.001
Calcium (Ca)	0.005
Maximum Limits of Impurities (ppm)	
Heavy metals (as Pb)	5
Iron (Fe)	5

5.2.23.3 Use. Sodium formate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is used to solubilize trivalent metal ions in solution by forming complex ions. It is also used to adjust the pH of strong mineral acids.

5.2.23.4 Safety. Sodium formate, anhydrous 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 formate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

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

DOD-STD-1446

5.2.23.6 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.

5.2.24 Name. Sodium Oxalate, Anhydrous, Analyzed Reagent
Na₂C₂O₄

FW 134.00

5.2.24.1 Technical description. Sodium oxalate, anhydrous (pure) exists as colorless crystals or white powder with a density of 2.34 g/cm³. It decomposes at 250-270°C. Its solubility in water is 3.7 g/100 mL at 20°C and 6.33 g/100 mL at 100°C. It is insoluble in alcohol and ether. It is hygroscopic.

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

5.2.24.2.1 Requirements. The federal specification chemical and physical requirements for sodium oxalate, anhydrous, analyzed reagent are shown in Table XXXVIII.

TABLE XXXVIII. Sodium Oxalate, Anhydrous, Analyzed Reagent - chemical and physical requirements (ACS).

Maximum Limits of Impurities (% by wt)	
Insoluble matter	0.005
Loss on drying at 105°C	0.01
Neutrality	To pass color test
Chloride (Cl)	0.002
Sulfate (SO ₄)	0.002
Ammonium (NH ₄)	0.002
Heavy metals (as Pb)	0.002
Iron (Fe)	0.001
Potassium (K)	0.005
Substances darkened by hot sulfuric acid	To pass color test

5.2.24.3 Use. Sodium oxalate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in medicine as a coagulant of blood.

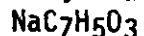
5.2.24.4 Safety. Sodium oxalate, anhydrous is toxic by inhalation or ingestion and irritating to eyes, skin, and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Sodium oxalate shall be used with adequate ventilation. When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

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

5.2.24.6 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.

DOD -STD-1446

5.2.25 Name. Sodium Salicylate, Anhydrous, Analyzed Reagent

FW 160.11

Monosodium salicylate

Benzoic acid, 2-hydroxy-monosodium salt

5.2.25.1 Technical description. Sodium salicylate, anhydrous (pure) exists as a white crystalline powder. Its solubility in water is 111 g/100 mL at 15°C and 125 g/100 mL at 25°C. Its solubility in alcohol is 17 g/100 mL at 15°C and in glycerine is 25 g/100 mL. Its aqueous solution is slightly acid. It is light sensitive.

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

5.2.25.2.1 Requirements. The federal specification chemical requirements for sodium salicylate, anhydrous, analyzed reagent are shown in Table XXXIX.

TABLE XXXIX. Sodium Salicylate, Anhydrous, Analyzed Reagent - chemical requirements (USP).

Assay ($\text{NaC}_7\text{H}_5\text{O}_3$) (min-max) % by wt	99.5 - 100.5
Maximum Limits of Impurities (% by wt)	
Water	0.5
Sulfite or thiosulfate	To pass color test
Heavy metals (as Pb)	0.002
Nitrate (NO_3)	To pass color test

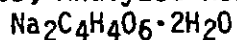
5.2.25.3 Use. Sodium salicylate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in medicine.

5.2.25.4 Safety. Sodium salicylate, anhydrous has a low toxicity. Large doses may cause tinnitus, nausea, vomiting, diarrhea and GI bleeding. Sodium salicylate is combustible. It is irritating to eyes, skin and mucous membranes. Inhalation of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Sodium salicylate shall be used with adequate ventilation. Fire may produce irritating gases. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.2.25.5 Storage. Sodium salicylate, anhydrous shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of heat and open flame. Protect from light. (Refer to 4.3.2)

5.2.25.6 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.

5.2.26 Name. Sodium Tartrate, Dihydrate, Analyzed Reagent

FW 230.08

Tartaric acid, disodium salt, dihydrate

Disodium tartrate

DOD -STD-1446

5.2.26.1 Technical description. Sodium tartrate, dihydrate (pure) exists as colorless rhombic crystals with refractive indices of 1.545 and 1.49 and a density of 1.818 g/cm³. It loses two molecules of water of hydration at 150°C. Its solubility in water is 29.0 g/100 mL at 6.0°C and 66.0 g/100 mL at 43.0°C. It is insoluble in alcohol.

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

5.2.26.2.1 Requirements. The federal specification chemical and physical requirements for sodium tartrate, dihydrate, analyzed reagent are shown in Table XL.

TABLE XL. Sodium Tartrate, Dihydrate, Analyzed Reagent - chemical and physical requirements (ACS).

pH of a 5% solution at 25°C (min-max)	7.0 - 9.0
Maximum Limits of Impurities (% by wt)	
Loss on drying at 150°C (min-max)	15.61 - 15.71
Insoluble matter	0.005
Sulfate (SO ₄)	0.005
Ammonium (NH ₄)	0.003
Calcium (Ca)	0.01
Iron (Fe)	0.001
Maximum Limits of Impurities (ppm)	
Chloride (Cl)	5
Phosphate (PO ₄)	5
Heavy metals (as Pb)	5

NOTE: This reagent is suitable for standardization of Karl Fischer reagent as used for the determination of trace amounts of water (less than 1%).

5.2.26.3 Use. Sodium tartrate, dihydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in medicine.

5.2.26.4 Safety. Sodium tartrate, dihydrate 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)

5.2.26.5 Storage. Sodium tartrate, dihydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.2.26.6 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.

5.2.27 Name. Strontium Acetate, 1/2 Hydrate, Analyzed Reagent
 $\text{Sr}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 1/2\text{H}_2\text{O}$ FW 214.72

5.2.27.1 Technical description. Strontium acetate, 1/2 hydrate (pure) exists as white crystalline powder. It loses 1/2 molecule water of hydration

DOD-STD-1446

at 150°C. It is soluble in cold water and slightly soluble in alcohol. Its aqueous solutions are practically neutral to litmus.

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

5.2.27.2.1 Requirements. The federal specification chemical requirements for strontium acetate, 1/2 hydrate, analyzed reagent are shown in Table XLI.

TABLE XLI. Strontium Acetate, 1/2 Hydrate, Analyzed Reagent - chemical requirements (NF).

Assay ($\text{Sr}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 1/2\text{H}_2\text{O}$) (min) %	99.0
Maximum Limits of Impurities (% by wt)	
Insoluble matter	0.02
Free alkali, or free acid	To pass color test
Barium (Ba)	0.02
Calcium (Ca)	0.3
Chloride (Cl)	0.01
Heavy metals (as Pb)	0.001
Iron (Fe)	0.001
Alkali salts	0.3
Nitrate (NO_3)	0.01

5.2.27.3 Use. Strontium acetate, 1/2 hydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in medicine.

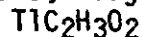
5.2.27.4 Safety. Strontium acetate, 1/2 hydrate has a low toxicity. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes and skin shall be avoided. Strontium acetate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

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

5.2.27.6 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.

5.2.28 Name. Thallous Acetate, Anhydrous, Reagent



FW 263.42

Acetic acid, thallium (I) salt

Thallium (I) acetate

5.2.28.1 Technical description. Thallous acetate, anhydrous (pure) exists as silky white deliquescent crystals with a density of 3.765 g/cm^3 at 137°C. Its melting point is 131°C. It is very soluble in cold water. It is very soluble in alcohol and chloroform and insoluble in acetone. Thallous acetate is hygroscopic.

DOD -STD-1446

5.2.28.2 Specification. Military, MIL-C-51130 - Chemicals, Reagent Grade; General Specification For (Metric).

5.2.28.2.1 Requirements. The military specification physical requirement for thallous acetate, anhydrous, reagent is shown in Table XLII.

TABLE XLII. Thallous Acetate, Anhydrous, Reagent - physical requirement.

Melting point (°C)	131.0
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5.2.28.3 Use. Thallous acetate, anhydrous, reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in medicine.

5.2.28.4 Safety. Thallous acetate, anhydrous is toxic by ingestion, inhalation and is absorbed by skin. It is a cumulative poison. It is irritating 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. Thallous acetate shall be used with adequate ventilation. Wash thoroughly after handling. Fire may produce irritating or poisonous gases. The TLV for thallium, soluble compounds as Tl-skin is 0.1 mg/m³; PEL is 0.1 mg/m³. (Refer to 4.3.1)

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

5.2.28.6 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 - Toxic; Waste No. U214.

5.2.29 Name. Thallous Formate, Anhydrous, Reagent

TlHCO₂

FW 249.39

Thallium (I) formate

5.2.29.1 Technical description. Thallous formate, anhydrous (pure) exists as colorless hygroscopic needles with a density of 4.967 g/cm³ at 104°C. Its melting point is 101°C. Its solubility in cold water is 500 g/100 mL at 10°C. It is very soluble in methyl alcohol, slightly soluble in alcohol and insoluble in chloroform.

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

5.2.29.2.1 Requirements. Thallous formate, anhydrous, analyzed reagent is available commercially with chemical requirement as shown in Table XLIII.

TABLE XLIII. Thallous Formate, Anhydrous, Reagent - chemical requirement.

Assay (TlHCO ₂ by titration) min, % by wt	95.0
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5.2.29.3 Use. Thallous formate, anhydrous, reagent is used in analytical chemistry as a reagent in tests and assays.

DOD-STD-1446

5.2.29.4 Safety. Thallous formate, anhydrous is toxic by ingestion, inhalation and is absorbed by skin. It is a cumulative poison. It is irritating 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. Thallous formate shall be used with adequate ventilation. Wash thoroughly after handling. Fire may produce irritating or poisonous gases. The TLV for thallium, soluble compounds as Tl-skin is 0.1 mg/m³; PEL is 0.1 mg/m³. (Refer to 4.3.1)

5.2.29.5 Storage. Thallous formate, anhydrous shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.2.29.6 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.

5.2.30 Name. Uranyl Acetate, Dihydrate, Analyzed Reagent
 $\text{UO}_2(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$ FW 422.19
 Uranium oxyacetate

NOTE: The formula weight of this reagent is likely to deviate from the value cited above since the natural distribution of uranium isotope is often altered in current sources of uranium compounds.

5.2.30.1 Technical description. Uranyl acetate, dihydrate (pure) exists as yellow rhombic crystals with a density of 2.893 g/cm³ at 15°C. It loses two molecules of water of hydration at 110°C. Its melting point is 275°C with decomposition. Its solubility in cold water is 7.694 g/100 mL at 15°C. It decomposes in hot water. It is very soluble in alcohol.

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

5.2.30.2.1 Requirements. The federal specification chemical requirements for uranyl acetate, dihydrate, analyzed reagent are shown in Table XLIV.

TABLE XLIV. Uranyl Acetate, Dihydrate, Analyzed Reagent - chemical requirements (ACS).

Maximum Limits of Impurities (% by wt)	
Insoluble matter	0.01
Chloride (Cl)	0.003
Sulfate (SO ₄)	0.01
Alkalies and alkaline earths (as sulfates)	0.05
Heavy metals (as Pb)	0.002
Iron (Fe)	0.001
Substances reducing permanganate (as U ^{IV})	
To pass color test, limit about	0.06

5.2.30.3 Use. Uranyl acetate, dihydrate, analyzed reagent used in analytical chemistry as a reagent in tests and assays.

DOD-STD-1446

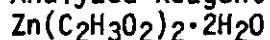
5.2.30.4 Safety. Uranyl acetate, dihydrate presents both chemical and radiation hazards. Acute chemical toxicity produces damage primarily to the kidneys. Breathing of dust, fumes and mist shall be avoided. Prolonged contact with skin shall be avoided to prevent radiation injury. Uranyl acetate shall be used with adequate ventilation. The TLV for uranium, soluble and insoluble compounds (as U) is 0.2 mg/m³; PEL for uranium, soluble compounds is 0.05 mg/m³. (Refer to 4.3.1)

5.2.30.5 Storage. Uranyl acetate, dihydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.2.30.6 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.

5.2.31 Name. Zinc Acetate, Dihydrate, Analyzed Reagent



FW 219.49

5.2.31.1 Technical description. Zinc acetate, dihydrate (pure) exists as colorless, monoclinic crystals with a refractive index of 1.494 and a density of 1.735 g/cm³. It loses two molecules of water of hydration at 110°C. It melts at 237°C. Its solubility in water is 31.1 g/100 mL at 20°C and 66.6 g/100 mL at 100°C. Its solubility in alcohol is 2 g/100 mL.

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

5.2.31.2.1 Requirements. The federal specification chemical requirements for zinc acetate, dihydrate, analyzed reagent are shown in Table XLV.

TABLE XLV. Zinc Acetate, Dihydrate, Analyzed Reagent - chemical requirements (NF).

Maximum Limits of Impurities (% by wt)	
Insoluble matter	0.05
Chloride (Cl)	0.0005
Nitrate (NO ₃)	0.005
Sulfate (SO ₄)	0.002
Alkalies and earths	0.1
Iron (Fe)	0.0005
Lead (Pb)	0.004
Maximum Limits of Impurities (ppm)	
Arsenic (As)	0.5

5.2.31.3 Use. Zinc acetate, dihydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in medicine and as a negative stain for electron microscopy.

5.2.31.4 Safety. Zinc acetate, dihydrate is irritating to eyes, skin and mucous membranes. Inhalation of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Zinc acetate shall be used with adequate ventilation. Fire may produce irritating gases. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

DOD -STD-1446

5.2.31.5 Storage. Zinc acetate, dihydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.2.31.6 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.

DOD-STD-1446

5.3 Metal Chelates. Complex coordination compounds or ions are those in which negative groups or neutral polar molecules are attached to metal ions or atoms. Formation of a complex compound or ion requires the combination of an ion or molecule which has at least one pair of electrons available for bonding with a metal ion or atom, which has sufficient attraction for electrons, to form a coordinate covalent bond with the attaching group. The coordination number is the number of electron pairs which an acceptor metal ion attracts in forming a complex ion. The groups attached to the central metal ion are referred to as coordinating groups or ligands. Ligands which have more than one electron pair available for coordination with metal ions are said to be bi-, tri-, or polydentate. Polydentate ligands whose structures permit the attachment of two or more electron donor sites to the same metal ion simultaneously, thus closing one or more rings, are called chelate ligands. Chelation refers to the coordination of a metal ion with a polydentate ligand. The metal chelate so formed may be an insoluble compound that precipitates or a water-soluble compound. Ligands that form stable, water-soluble metal chelates are said to be sequestering agents. Metal chelate stability decreases with increasing ring size and no compounds are known with a ring size greater than seven.

5.3.1 General Use. Metal chelates are used extensively in analytical laboratory work, both in qualitative and quantitative analysis. They are also employed as specialized reagents which include use as contrast reagent in electron microscopy, catalyst, catalyst intermediate, nuclear magnetic resonance (NMR) shift reagents, standards for atomic absorption, and a source of a particular soluble metal where required.

5.3.2 Specific Requirements

5.3.2.1 Name. Ammonium Iron (III) Oxalate, Trihydrate, Reagent
 $(\text{NH}_4)_3\text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$ FW 428.07
 Ammonium oxalatoferate (III), trihydrate

5.3.2.1.1 Technical description. Ammonium iron (III) oxalate, trihydrate (pure) exists as green monoclinic crystals with a density of 1.78 g/cm^3 . It decomposes at 165°C . Its solubility in water is 42.7 g/100 mL at 0°C and 345.0 g/100 mL at 100°C . It is light sensitive.

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

5.3.2.1.2.1 Requirements. Ammonium iron (III) oxalate, trihydrate, reagent is available commercially with chemical requirement as shown in Table XLVI.

TABLE XLVI. Ammonium Iron (III) Oxalate, Trihydrate, Reagent -chemical requirement.

Assay $(\text{NH}_4)_3\text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$, % by wt.	99.99
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5.3.2.1.3 Safety. Ammonium iron (III) oxalate, trihydrate is highly toxic. Breathing of dust, fumes and mists of ammonium iron (III) oxalate shall be avoided. It shall be used with adequate ventilation. Ammonium iron (III) oxalate is also irritating to eyes and skin. Contact with eyes, skin and clothing

DOD-STD-1446

shall be avoided. Wash thoroughly after handling. Ammonium iron (III) oxalate is burnable. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.3.2.1.4 Storage. Ammonium iron (III) oxalate, trihydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers protected from light. (Refer to 4.3.2)

5.3.2.1.5 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.

5.3.2.2 Name. Ammonium Titanyl Oxalate, Monohydrate, Reagent
 $(\text{NH}_4)_2\text{TiO}(\text{C}_2\text{O}_4)_2 \cdot \text{H}_2\text{O}$ FW 294.03
 Ammonium bis(oxalato)oxotitanate(IV)monohydrate
 Ammonium titanium oxalate, basic

5.3.2.2.1 Technical description. Ammonium titanyl oxalate, monohydrate (pure) is very soluble in cold water.

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

5.3.2.2.2.1 Requirements. Ammonium titanyl oxalate, monohydrate, reagent is available commercially with chemical requirement as shown in Table XLVII.

TABLE XLVII. Ammonium Titanyl Oxalate, Monohydrate, Reagent - chemical requirement.

Assay $(\text{NH}_4)_2\text{TiO}(\text{C}_2\text{O}_4)_2 \cdot \text{H}_2\text{O}$, % by wt	99.99
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5.3.2.2.3 Safety. Ammonium titanyl oxalate, monohydrate is highly toxic. Breathing of dust, fumes and mist of ammonium titanyl oxalate, monohydrate shall be avoided. It shall be used with adequate ventilation. It is also irritating to eyes and skin. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

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

5.3.2.2.5 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.

5.3.2.3 Name. Calcium Citrate, Tetrahydrate, Analyzed Reagent
 $\text{Ca}_3(\text{C}_6\text{H}_5\text{O}_7)_2 \cdot 4\text{H}_2\text{O}$ FW 570.51
 Lime citrate, tetrahydrate
 Tricalcium citrate, tetrahydrate

DOD-STD-1446

5.3.2.3.1 Technical description. Calcium citrate, tetrahydrate (pure) exists as white needles. It loses four molecules of water of hydration at 120°C. Its solubility in water is 0.085 g/100 mL at 18°C and 0.096 g/100 mL at 23°C. Its solubility in alcohol is 0.0065 g/100 mL at 18°C.

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

5.3.2.3.2.1 Requirements. The federal specification chemical requirements for calcium citrate, tetrahydrate, analyzed reagent are shown in Table XLVIII.

TABLE XLVIII. Calcium Citrate, Tetrahydrate, Analyzed Reagent - chemical and physical requirements (NF).

Assay [$\text{Ca}_3(\text{C}_6\text{H}_5\text{O}_7)_2 \cdot 4\text{H}_2\text{O}$, min-max, % by wt	97.5-101.0
Maximum Limits of Impurities (%)	
Hydrochloric acid - insoluble matter	0.05
Loss on drying at 150°C (min-max)	12.2-13.3
Arsenic (As)	0.0006
Heavy metals (as Pb)	0.002

5.3.2.3.3 Safety. Calcium citrate, tetrahydrate has a low toxicity. Calcium compounds can be irritating to the eyes, skin and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Calcium citrate shall be used with adequate ventilation. Calcium citrate, tetrahydrate is burnable. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.3.2.3.4 Storage. Calcium citrate, tetrahydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.3.5 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.

5.3.2.4 Name. Calcium Oxalate, Monohydrate, Analyzed Reagent

$\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ FW 146.12

Calcium ethanedioate

5.3.2.4.1 Technical description. Calcium oxalate, monohydrate (pure) exists as colorless crystals with a density of 2.2 g/cm³. It loses its water of hydration at 200°C. It is insoluble in hot or cold water. It is soluble in acid but insoluble in acetic acid.

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

5.3.2.4.2.1 Requirements. Calcium oxalate, monohydrate, analyzed reagent is available commercially with chemical requirements as shown in Table XLIX.

DOD-STD-1446

TABLE XLIX. Calcium Oxalate, Monohydrate, Analyzed Reagent - chemical requirements.

Maximum Limits of Impurities (%)	
Nitrate (NO ₃)	0.005
Chloride (Cl)	0.001
Iron (Fe)	0.01
Heavy metals (as Pb)	0.005
Magnesium (Mg)	0.02
Sodium (Na)	0.02
Potassium (K)	0.02
Strontium (Sr)	0.02

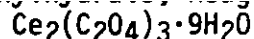
5.3.2.4.3 Safety. Calcium oxalate, monohydrate, is highly toxic. Breathing of dust, fumes and mist of calcium oxalate shall be avoided. It shall be used with adequate ventilation. Calcium oxalate, monohydrate is irritating to the eyes, skin and mucous membranes. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Calcium oxalate, monohydrate is burnable. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

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

5.3.2.4.5 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.

5.3.2.5 Name. Cerium (III) Oxalate, Nonylhydrate, Reagent



FW 706.44

Cerous oxalate, nonylhydrate

5.3.2.5.1 Technical description. Cerium (III) oxalate, nonylhydrate (pure) exists as yellow-white crystals. It melts with decomposition. It is very slightly soluble in cold water. It is soluble in sulfuric and hydrochloric acid and insoluble in alkali, ether and alcohol.

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

5.3.2.5.2.1 Requirements. Cerium (III) oxalate, nonylhydrate, reagent is available commercially with chemical requirements as shown in Table L.

TABLE L. Cerium (III) Oxalate, Nonylhydrate, Reagent - chemical requirements.

Assay [Ce ₂ (C ₂ O ₄) ₃], % by wt	99.9
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5.3.2.5.3 Safety. Cerium oxalate, nonylhydrate, is highly toxic. Breathing of dust, fumes and mist of cerium oxalate, nonylhydrate shall be avoided. It shall be used with adequate ventilation. Cerium oxalate, nonylhydrate, is highly irritating to eyes, skin and mucous membranes. Contact with the eyes,

DOD-STD-1446

skin and clothing shall be avoided. Cerium oxalate, nonylhydrate is burnable. Wash thoroughly after handling. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.3.2.5.4 Storage. Cerium oxalate, nonylhydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.5.5 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.

5.3.2.6 Name. Chromium (III) Acetylacetonate, Reagent
 $\text{Cr}(\text{C}_5\text{H}_7\text{O}_2)_3$ FW 349.33
 Chromium (III) 2,4-pentanedionate

5.3.2.6.1 Technical description. Chromium acetylacetonate (pure) exists as a purple powder or red violet crystals. Its melting point is 216°C and boiling point is 340°C . It is insoluble in cold water and ligroin. It is soluble in organic solvents.

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

5.3.2.6.2.1 Requirements. Chromium (III) acetylacetonate, reagent is available commercially with physical requirements as shown in Table LI.

TABLE LI. Chromium (III) Acetylacetonate, Reagent - physical requirements.

Melting point ($^\circ\text{C}$)	210
Boiling point ($^\circ\text{C}$)	340

5.3.2.6.3 Safety. Chromium compounds in the +3 state are toxic. Breathing of dust, fumes and mist of chromium (III) acetylacetonate shall be avoided. Chromium (III) acetylacetonate shall be used with adequate ventilation. Chromium (III) acetylacetonate may be irritating to the eyes, skin and mucous membranes. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. The TLV and PEL for chromium (III) compounds as Cr is 0.5 mg/m^3 . Chromium (III) is a potential carcinogen. Burning of chromium (III) can form chromium (VI). Chromium (VI) is considered a confirmed carcinogen by the International Agency for Research on Cancer (IARC) and Transactions of ACGIH. The TLV for chromium (VI) is 0.05 mg/m^3 . Breathing of mists or fumes of chromium (VI) shall be avoided. (Refer to 4.3.1)

5.3.2.6.4 Storage. Chromium (III) acetylacetonate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

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

DOD-STD-1446

Chromium (III) acetylacetonate has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D007.

5.3.2.7 Name. Cobalt (II) Acetylacetonate, Reagent

$\text{Co}(\text{C}_5\text{H}_7\text{O}_2)_2$ FW 257.16

Cobalt (II) 2,4-pentanedionate

5.3.2.7.1 Technical description. Commercially available cobalt (II) acetylacetonate, reagent exists as black monoclinic crystals with a density of 1.43 g/cm^3 . Its melting point is 241°C .

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

5.3.2.7.2.1 Requirements. Cobalt (II) acetylacetonate, reagent is available commercially with chemical requirements as shown in Table LII.

TABLE LII. Cobalt (II) Acetylacetonate, Reagent - chemical requirements.

Assay ($\text{Co}(\text{C}_5\text{H}_7\text{O}_2)_2$), % by wt	99.0
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5.3.2.7.3 Safety. Cobalt (II) acetylacetonate has a low toxicity. Breathing of dust, fumes and mist shall be avoided. Cobalt (II) acetylacetonate shall be used with adequate ventilation. It may be irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Cobalt (II) acetylacetonate is burnable. When heated to decomposition, it can emit toxic and irritating fumes. There is no TLV or PEL referenced for cobalt (II) acetylacetonate. The TLV for cobalt metal, dust and fume, as Co is 0.1 mg/m^3 , with proposed change to 0.05 mg/m^3 ; PEL is 0.1 mg/m^3 . (Refer to 4.3.1)

5.3.2.7.4 Storage. Cobalt (II) acetylacetonate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.7.5 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.

5.3.2.8 Name. Copper (II) Ethylacetoacetate, Reagent

$\text{Cu}[\text{CH}(\text{COCH}_3)\text{COOC}_2\text{H}_5]_2$ FW 321.81

Cupric ethylacetoacetate

5.3.2.8.1 Technical description. Copper (II) ethylacetoacetate (pure) exists as green crystalline needles. Its melting point is $192\text{--}193^\circ\text{C}$, and it sublimates at higher temperatures. It is very soluble in alcohol or ether. Its solubility in benzene is 10 g/100 mL at 80°C .

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

5.3.2.8.2.1 Requirements. Copper (II) ethylacetoacetate, reagent is available commercially with chemical and physical requirements as shown in Table LIII.

DOD-STD-1446

TABLE LIII. Copper (II) Ethylacetoacetate, Reagent - chemical and physical requirements.

Assay (by titration), % by wt	99.0
Melting point (°C)	198

5.3.2.8.3 Safety. Copper (II) ethylacetoacetate is moderately toxic. Breathing of dust, fumes and mist shall be avoided. It shall be used with adequate ventilation. It is irritating to eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Copper (II) ethylacetoacetate is burnable. When heated to decomposition, it can emit toxic and irritating fumes. There is no TLV for copper (II) ethylacetoacetate. The TLV for copper fume is 0.2 mg/m³, for copper dusts and mists (as Cu) is 1.0 mg/m³; and PEL for copper fume is 0.1 mg/m³. (Refer to 4.3.1)

5.3.2.8.4 Storage. Copper (II) ethylacetoacetate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.8.5 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.

5.3.2.9 Name. Cupric Oxalate, 1/2 Hydrate, Analyzed Reagent
 $\text{CuC}_2\text{O}_4 \cdot 1/2\text{H}_2\text{O}$ FW 160.57
 Copper (II) oxalate

5.3.2.9.1 Technical description. Cupric oxalate, 1/2 hydrate (pure) exists as a bluish white powder. Its solubility in water is 0.00253 g/100 mL at 25°C. It is soluble in ammonium hydroxide and insoluble in acetic acid.

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

5.3.2.9.2.1 Requirements. Cupric oxalate, 1/2 hydrate, analyzed reagent is available commercially with chemical requirements as shown in Table LIV.

TABLE LIV. Cupric Oxalate, 1/2 Hydrate, Analyzed Reagent - chemical requirements.

Assay, min, % by wt	98.0
Maximum Limits of Impurities (% by wt)	
Ammonium (NH ₄)	0.01
Iron (Fe)	0.05

5.3.2.9.3 Safety. Cupric oxalate, 1/2 hydrate, is toxic. It is irritating to the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist of cupric oxalate shall be avoided. It shall be used with adequate ventilation. Cupric oxalate is irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. There is no TLV or PEL referenced for cupric oxalate 1/2 hydrate. When heated to decomposition it can evolve toxic fumes. The TLV for copper fume is

DOD-STD-1446

0.2 mg/m³; PEL for copper fume is 0.1 mg/m³; and the TLV for copper dust and mists (as Cu) is 1.0 mg/m³. (Refer to 4.3.1)

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

5.3.2.9.5 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.

5.3.2.10 Name. Ferric Acetylacetonate, Reagent $\text{Fe}(\text{C}_5\text{O}_2\text{H}_7)_3$ FW 353.18
Iron (III) 2,4-pentanedionate
Iron (III) acetylacetonate

5.3.2.10.1 Technical description. Ferric acetylacetonate (pure) exists as ruby red, rhombic crystals with a density of 1.33 g/cm³ and melting point of 184°C. It is slightly soluble in cold or hot water. It is soluble in alcohol, acetone, benzene and chloroform.

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

5.3.2.10.2.1 Requirements. Ferric acetylacetonate, reagent is available commercially with chemical and physical requirements as shown in Table LV.

TABLE LV. Ferric Acetylacetonate, Reagent - chemical and physical requirements.

Assay [$\text{Fe}(\text{C}_5\text{O}_2\text{H}_7)_3$], % by wt	~97
Melting range (°C), min - max	180 - 182

5.3.2.10.3 Safety. Ferric acetylacetonate is moderately toxic. Breathing of dust, fumes and mist shall be avoided. Ferric acetylacetonate shall be used with adequate ventilation. It is irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Ferric acetylacetonate is burnable. There is no TLV or PEL referenced for ferric acetylacetonate. The TLV for iron oxide fumes, as Fe, is 5 mg/m³. The PEL is 10 mg/m³. When heated to decomposition, it can emit toxic and irritating fumes. (Refer to 4.3.1)

5.3.2.10.4 Storage. Ferric acetylacetonate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.10.5 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.

5.3.2.11 Name. Ferric Ammonium Citrate, Analyzed Reagent
Ammonium citratoferrate
Iron (III) ammonium citrate

DOD-STD-1446

NOTE: Ferric ammonium citrate exists as thin, transparent, garnet red scales or granules or brownish yellow powder. The formula is indefinite.

5.3.2.11.1 Technical description. Ferric ammonium citrate exists as thin, transparent, garnet red scales or granules, or as a brownish yellow powder; odorless (or slight ammonia odor); saline, mildly ferruginous taste. It is deliquescent, affected by light, and hygroscopic. It is soluble in water and insoluble in alcohol.

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

5.3.2.11.2.1 Requirements. The federal specification chemical requirements for ferric ammonium citrate, analyzed reagent are shown in Table LVI.

TABLE LVI. Ferric Ammonium Citrate, Analyzed Reagent - chemical requirements (USP).

Assay (as Fe), min-max, % by wt	16.5 - 18.5
Impurities:	
Ferric citrate	No blue precipitate is formed when tested as specified in USP.
Tartrate	No crystalline white precipitate is formed when tested as specified in USP.
Lead (Pb), max, % by wt	0.002

5.3.2.11.3 Safety. Ferric ammonium citrate presents little immediate health hazard. Contact may cause some irritation of the eyes. Contact with the eyes shall be avoided. Ferric ammonium citrate is burnable. There is no TLV or PEL referenced for ferric ammonium citrate. When heated to decomposition it can evolve toxic fumes. The TLV for iron oxide fumes, as Fe, is 5 mg/m³. The PEL is 10 mg/m³. (Refer to 4.3.1)

5.3.2.11.4 Storage. Ferric ammonium citrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers protected from light. (Refer to 4.3.2)

5.3.2.11.5 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.

5.3.2.12 Name. Ferric Citrate, Pentahydrate, Analyzed Reagent
FeC6H5O7·5H2O FW 335.03
 Iron (III) citrate

5.3.2.12.1 Technical description. Ferric citrate, pentahydrate (pure) exists as red-brown scales. It is slightly soluble in cold water and soluble in hot water. It is insoluble in alcohol. It is sensitive to light.

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

DOD-STD-1446

5.3.2.12.2.1 Requirements. The federal specification chemical requirements for ferric citrate, pentahydrate, analyzed reagent are shown in Table LVII.

TABLE LVII. Ferric Citrate, Pentahydrate, Analyzed Reagent - chemical requirements (USP).

Assay (as Fe), min-max, % by wt	16.5-18.5
Impurities:	
Alkali citrate	To pass alkaline reaction test to litmus.
Ammonium (NH ₄)	To pass odor test for ammonia.
Chloride (Cl)	To pass turbidity test.
Sulfate (SO ₄)	To pass turbidity test.

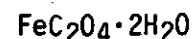
5.3.2.12.3 Safety. Ferric citrate, pentahydrate, has a low toxicity. Breathing of dust, fumes and mist shall be avoided. It shall be used with adequate ventilation. It is irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. There is no TLV or PEL referenced for ferric citrate pentahydrate. When heated to decomposition it can evolve toxic fumes. The TLV for iron oxide fumes, as Fe, is 5 mg/m³. The PEL is 10 mg/m³. (Refer to 4.3.1)

5.3.2.12.4 Storage. Ferric citrate, pentahydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers protected from light. (Refer to 4.3.2)

5.3.2.12.5 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.

5.3.2.13 Name. Ferrous Oxalate, Dihydrate, Reagent



FW 179.90

Iron (II) oxalate
Iron protoxalate

5.3.2.13.1 Technical description. Ferrous oxalate, dihydrate (pure) exists as pale yellow *rhombic crystals* with a density of 2.28 g/cm³. It melts at 190°C with decomposition. Its solubility in cold water is 0.022 g/100 mL and 0.026 g/100 mL in hot water. It is soluble in acid.

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

5.3.2.13.2.1 Requirements. Ferrous oxalate, dihydrate, reagent is available commercially with chemical requirement as shown in Table LVIII.

TABLE LVIII. Ferrous Oxalate, Dihydrate, Reagent - chemical requirement.

Assay (FeC ₂ O ₄), % by wt	>98
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DOD-STD-1446

5.3.2.13.3 Safety. Ferrous oxalate, dihydrate, is highly toxic. It is irritating to the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Ferrous oxalate shall be used with adequate ventilation. It is also irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. There is no TLV or PEL referenced for ferrous oxalate. When heated to decomposition it may evolve toxic fumes. The TLV for iron oxide fumes, as Fe, is 5 mg/m³. The PEL is 10 mg/m³. (Refer to 4.3.1)

5.3.2.13.4 Storage. Ferrous oxalate, dihydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.13.5 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.

5.3.2.14 Name. Lead Citrate, Trihydrate, Reagent
 $\text{Pb}_3(\text{C}_6\text{H}_5\text{O}_7)_2 \cdot 3\text{H}_2\text{O}$ FW 1053.82
 Citrato trilead

5.3.2.14.1 Technical description. Lead citrate, trihydrate (pure) exists as a white crystalline powder. It is soluble in cold water and very slightly soluble in alcohol.

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

5.3.2.14.2.1 Requirements. Lead citrate, trihydrate, reagent is available commercially with chemical and physical requirements as shown in Table LIX.

TABLE LIX. Lead Citrate, Trihydrate, Reagent - chemical and physical requirements.

Assay [$\text{Pb}_3(\text{C}_6\text{H}_5\text{O}_7)_2$] (min), % by wt	92.0
Loss on drying at 105°C (max), % by wt	4.0

5.3.2.14.3 Safety. Lead citrate, trihydrate, is highly toxic by inhalation and ingestion. It is a cumulative poison. Breathing of dust, fumes and mist shall be avoided. Lead citrate shall be used with adequate ventilation. Wash thoroughly after handling. When heated to decomposition, it emits toxic fumes. Lead citrate is a suspected carcinogen. The PEL for lead is 50 µg/m³. (Refer to 4.3.1)

5.3.2.14.4 Storage. Lead citrate, trihydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

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

Lead citrate, trihydrate has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D008.

5.3.2.15 Name. Lithium Oxalate, Analyzed Reagent $\text{Li}_2\text{C}_2\text{O}_4$ FW 101.90
 Lithium ethanedioate

DOD- STD-1446

5.3.2.15.1 Technical description. Lithium oxalate (pure) exists as colorless, rhombic crystals with refractive indices of 1.465, 1.53 and 1.696 and a density of 2.12 g/cm³. It melts with decomposition. Its solubility in cold water is 8.0 g/100 mL at 19.5°C. It is insoluble in alcohol and ether.

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

5.3.2.15.2.1 Requirements. The federal specification chemical and physical requirements for lithium oxalate, analyzed reagent are shown in Table LX.

TABLE LX. Lithium Oxalate, Analyzed Reagent - chemical and physical requirements (NF).

Assay (Li ₂ C ₂ O ₄), min, % by wt	99.0
Neutrality	To pass color test
Maximum Limits of Impurities	
Chloride (Cl)	To pass turbidity test
Sulfate (SO ₄)	To pass turbidity test
Heavy metals (as Pb)	To pass color test
Sodium (as Na ₂ C ₂ O ₄) (%)	<0.05
Potassium (K) (max) (%)	0.01

5.3.2.15.3 Safety. Lithium oxalate is irritating to the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist of lithium oxalate shall be avoided. It shall be used with adequate ventilation. It is also irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

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

5.3.2.15.5 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.

5.3.2.16 Name. Magnesium Acetylacetonate, Reagent

Mg(C₅H₇O₂)₂ FW 222.53

Magnesium 2,4-pentanedionate

5.3.2.16.1 Technical description. Commercially available magnesium acetylacetonate, exists as a white powder with a melting point of 262-263°C, and a density of 1.162 g/cm³ (20°/4°C). It decomposes before boiling. Its solubility in 100 mL solvent is as follows: benzene 0.7 g at 25°C; methyl alcohol 2.9 g at 25°C; cyclohexane 0.01 g at 70°C; n-hexane 0.01 g at 70°C. It is insoluble in ether.

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

5.3.2.16.2.1 Requirements. Magnesium acetylacetonate, reagent is available commercially with chemical requirement as shown in Table LXI.

DOD-STD-1446

TABLE LXI. Magnesium Acetylacetonate, Reagent - chemical requirement.

Assay $[\text{Mg}(\text{C}_5\text{H}_7\text{O}_2)_2]$, % by wt	98.0
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5.3.2.16.3 Safety. Magnesium acetylacetonate has a low toxicity. If inhaled, it may cause irritation of the respiratory tract. Breathing of dust, fumes and mist shall be avoided. Magnesium acetylacetonate shall be used with adequate ventilation. It may be irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Magnesium acetylacetonate is burnable. When heated to decomposition, it can emit toxic and irritating fumes of magnesium oxide. The TLV for magnesium oxide fumes is 10 mg/m³. The PEL is 15 mg/m³. (Refer to 4.3.1)

5.3.2.16.4 Storage. Magnesium acetylacetonate shall be stored in a cool, dry, well-ventilated place in tightly closed corrosion resistant containers. (Refer to 4.3.2)

5.3.2.16.5 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.

5.3.2.17 Name. Molybdenum Oxide Acetylacetonate, Reagent

$\text{MoO}_2(\text{C}_5\text{H}_7\text{O}_2)_2$ FW 326.17

Molybdenum(VI)oxide bis(2,4-pentanedionate)

5.3.2.17.1 Technical description. Commercially available molybdenum oxide acetylacetonate exists as crystalline with a melting point of 181°C with decomposition. It is hygroscopic.

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

5.3.2.17.2.1 Requirements. Molybdenum oxide acetylacetonate, reagent is available commercially with chemical requirement as shown in Table LXII.

TABLE LXII. Molybdenum Oxide Acetylacetonate, Reagent - chemical requirement.

Assay $[\text{MoO}_2(\text{C}_5\text{H}_7\text{O}_2)_2]$, % by wt	99.9
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5.3.2.17.3 Safety. Molybdenum oxide acetylacetonate has a low toxicity. If inhaled, it may cause irritation of the respiratory tract. Breathing of dust, fumes and mist shall be avoided. Molybdenum oxide acetylacetonate shall be used with adequate ventilation. It may be irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Molybdenum oxide acetylacetonate is burnable. When heated to decomposition, it may emit toxic fumes. The TLV for molybdenum soluble compounds (as Mo) is 5 mg/m³. The PEL is 5 mg/m³. (Refer to 4.3.1)

5.3.2.17.4 Storage. Molybdenum oxide acetylacetonate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

DOD-STD-1446

5.3.2.17.5 Disposal. For appropriated 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.

5.3.2.18 Name. Nickel Acetylacetonate, Monohydrate, Reagent
 $\text{Ni}(\text{C}_5\text{H}_7\text{O}_2)_2 \cdot \text{H}_2\text{O}$ FW 274.94
 Nickel (II) acetylacetonate
 Nickel (II) 2,4-pentanedionate

5.3.2.18.1 Technical description. Commercially available nickel acetylacetonate, monohydrate exists as crystalline with a melting point of 285°C with decomposition. Its solubility per 100 mL solvent at 25°C is as follows: benzene 1.5 g; methyl alcohol 2.2 g; ethyl alcohol 10.6 g. It is soluble in chloroform.

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

5.3.2.18.2.1 Requirements. Nickel acetylacetonate, monohydrate, reagent is available commercially with chemical requirement as shown in Table LXIII.

TABLE LXIII. Nickel Acetylacetonate, Monohydrate, Reagent - chemical requirement.

Melting point (°C)	285 with decomposition
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5.3.2.18.3 Safety. Nickel acetylacetonate has a low toxicity. If inhaled, it may cause irritation of the respiratory tract. Breathing of dust, fumes and mist shall be avoided. Nickel acetylacetonate shall be used with adequate ventilation. It may be irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Nickel acetylacetonate is burnable. When heated to decomposition, it can emit toxic and irritating fumes. The TLV for nickel soluble compounds (as Ni) is 0.1 mg/m³. The PEL for nickel, metal and soluble compounds (as Ni) is 1.0 mg/m³. (Refer to 4.3.1)

5.3.2.18.4 Storage. Nickel acetylacetonate shall be stored in a cool, dry, well-ventilated place in tightly closed corrosion resistant containers. (Refer to 4.3.2)

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

Nickel acetylacetonate has an EPA Hazardous Waste Classification - Toxic.

5.3.2.19 Name. Nickel Oxalate, Dihydrate, Reagent
 $\text{NiC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ FW 182.76
 Nickel (II) oxalate dihydrate

5.3.2.19.1 Technical description. Nickel oxalate, dihydrate (pure) exists as a light-green powder. It is insoluble in cold water. It is soluble in acid and ammonium salts and very slightly soluble in oxalic acid.

DOD-STD-1446

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

5.3.2.19.2.1 Requirements. Nickel oxalate, dihydrate, reagent is available commercially with chemical requirement as shown in Table LXIV.

TABLE LXIV. Nickel Oxalate, Dihydrate, Reagent - chemical requirement.

Assay (metals basis), % by wt	99.99
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5.3.2.19.3 Safety. Nickel oxalate, dihydrate, is highly toxic. It is irritating to the upper respiratory tract and mucous membranes of the nose and throat. Breathing of dust, fumes and mist shall be avoided. Nickel oxalate shall be used with adequate ventilation. It is also irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, it emits toxic fumes. Nickel compounds are confirmed carcinogens. There is no TLV or PEL referenced for nickel oxalate as a water insoluble compound. (Refer to 4.3.1)

5.3.2.19.4 Storage. Nickel oxalate, dihydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

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

Nickel oxalate, dihydrate, has an EPA Hazardous Waste Classification - Toxic.

5.3.2.20 Name. Palladium Acetylacetonate, Reagent $\text{Pd}(\text{C}_5\text{H}_7\text{O}_2)_2$ FW 304.92
Palladium (II) acetylacetonate
Palladium (II) 2,4-pentanedionate

5.3.2.20.1 Technical description. Commercially available palladium acetylacetonate is crystalline. It melts with decomposition.

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

5.3.2.20.2.1 Requirements. Palladium acetylacetonate, reagent is available commercially with chemical requirement as shown in Table LXV.

TABLE LXV. Palladium Acetylacetonate, Reagent - chemical requirement.

Assay (metal basis), % by wt	99.8
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5.3.2.20.3 Safety. Palladium acetylacetonate has a low toxicity. If inhaled, it may cause irritation of the respiratory tract. Breathing of dust, fumes and mist shall be avoided. Palladium acetylacetonate shall be used with adequate ventilation. It may be irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Palladium acetylacetonate is burnable. When heated to decomposition, it can emit toxic and irritating fumes. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

DOD-STD-1446

5.3.2.20.4 Storage. Palladium acetylacetonate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.20.5 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.

5.3.2.21 Name. Potassium Titanyl Oxalate, Dihydrate, Reagent
 $K_2[TiO(C_2O_4)_2] \cdot 2H_2O$ FW 354.17
 Potassium bis(oxalato)oxotitanate(IV)dihydrate

5.3.2.21.1 Technical description. Commercially available potassium titanyl oxalate, dihydrate exists as colorless lustrous crystals. It is soluble in water.

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

5.3.2.21.2.1 Requirements. Potassium titanyl oxalate, dihydrate, reagent is available commercially with chemical requirement as shown in Table LXVI.

TABLE LXVI Potassium Titanyl Oxalate, Dihydrate, Reagent - chemical requirement.

Assay (metal basis), % by wt	99.9
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5.3.2.21.3 Safety. Potassium titanyl oxalate, dihydrate, is irritating to the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Potassium titanyl oxalate shall be used with adequate ventilation. It is also irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, it emits toxic fumes. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

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

5.3.2.21.5 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.

5.3.2.22 Name. Praseodymium Oxalate, Decahydrate, Reagent
 $Pr_2(C_2O_4)_3 \cdot 10H_2O$ FW 726.03
 Praseodymium ethanedioate, decahydrate

5.3.2.22.1 Technical description. Praseodymium oxalate, decahydrate (pure) exists as light green crystals. It is insoluble in cold water and slightly soluble in acid.

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

DOD-STD-1446

5.3.2.22.2.1 Requirements. Praseodymium oxalate, decahydrate, reagent is available commercially with chemical requirement as shown in Table LXVII.

TABLE LXVII. Praseodymium Oxalate, Decahydrate, Reagent - chemical requirement.

Assay [$\text{Pr}_2(\text{C}_2\text{O}_4)_3$], % by wt	99.9
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5.3.2.22.3 Safety. Praseodymium oxalate, decahydrate, is toxic. It is irritating to the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Praseodymium oxalate shall be used with adequate ventilation. It is also irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, it emits toxic fumes. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.3.2.22.4 Storage. Praseodymium oxalate, decahydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.22.5 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.

5.3.2.23 Name. Samarium Oxalate, Decahydrate, Reagent
 $\text{Sm}_2(\text{C}_2\text{O}_4)_3 \cdot 10\text{H}_2\text{O}$ FW 744.91
 Samarium (III) oxalate decahydrate
 Samarium ethanedioate

5.3.2.23.1 Technical description. Samarium oxalate, decahydrate (pure) exists as white crystals. Its solubility in cold water is 0.000054 g/100 mL. It is soluble in sulfuric acid.

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

5.3.2.23.2.1 Requirements. Samarium oxalate, decahydrate, reagent is available commercially with chemical requirement as shown in Table LXVIII.

TABLE LXVIII. Samarium Oxalate, Decahydrate, Reagent - chemical requirement.

Assay [$\text{Sm}_2(\text{C}_2\text{O}_4)_3$], % by wt	99.9
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5.3.2.23.3 Safety. Samarium oxalate, decahydrate, is irritating to the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Samarium oxalate shall be used with adequate ventilation. It is irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, it emits toxic fumes. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

DOD-STD-1446

5.3.2.23.4 Storage. Samarium oxalate, decahydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.23.5 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.

5.3.2.24 Name. Scandium Oxalate, Pentahydrate, Reagent
 $\text{Sc}_2(\text{C}_2\text{O}_4)_3 \cdot 5\text{H}_2\text{O}$ FW 444.05
 Scandium ethanedioate, pentahydrate

5.3.2.24.1 Technical description. Scandium oxalate, pentahydrate (pure) exists as crystals. It loses four molecules of water at 140°C .

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

5.3.2.24.2.1 Requirements. Scandium oxalate, pentahydrate, reagent is available commercially with chemical requirement as shown in Table LXIX.

TABLE LXIX. Scandium Oxalate, Pentahydrate Reagent - chemical requirement.

Assay $[\text{Sc}_2(\text{C}_2\text{O}_4)_3]$, % by wt	99.9
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5.3.2.24.3 Safety. Scandium oxalate, pentahydrate is irritating to the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Scandium oxalate shall be used with adequate ventilation. It is irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, it emits toxic fumes. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.3.2.24.4 Storage. Scandium oxalate, pentahydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.24.5 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.

5.3.2.25 Name. Terbium Oxalate, Decahydrate, Reagent
 $\text{Tb}_2(\text{C}_2\text{O}_4)_3 \cdot 10\text{H}_2\text{O}$ FW 762.06
 Terbium ethanedioate, decahydrate

5.3.2.25.1 Technical description. Terbium oxalate, decahydrate (pure) exists as white crystals with a density of 2.60 g/cm^3 . It loses water of hydration at 40°C . It is insoluble in cold or hot water. It is insoluble in dilute acid.

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

DOD-STD-1446

5.3.2.25.2.1 Requirements. Terbium oxalate, decahydrate, reagent is available commercially with chemical requirement as shown in Table LXX.

TABLE LXX. Terbium Oxalate, Decahydrate, Reagent - chemical requirement.

Assay $[Tb_2(C_2O_4)_3]$, % by wt	99.9
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5.3.2.25.3 Safety. Terbium oxalate, decahydrate, is irritating to the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Terbium oxalate shall be used with adequate ventilation. It is irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, it emits toxic fumes. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.3.2.25.4 Storage. Terbium oxalate, decahydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.3.2.25.5 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.

5.3.2.26 Name. Tin Chloride Acetylacetonate, Reagent
 $SnCl_2(C_5H_7O_2)_2$ FW 387.83
 Tin(IV)chloride acetylacetonate
 Tin(IV)chloride bis(2,4-pentanedionate)

5.3.2.26.1 Technical description. Commercially available tin chloride acetylacetonate exists as crystalline with a melting point of 199°C.

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

5.3.2.26.2.1 Requirements. Tin chloride acetylacetonate, reagent is available commercially with chemical requirement as shown in Table LXXI.

TABLE LXXI. Tin Chloride Acetylacetonate, Reagent - chemical and physical requirement.

Assay $[SnCl_2(C_5H_7O_2)_2]$, % by wt	99.9
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5.3.2.26.3 Safety. Tin chloride acetylacetonate is toxic and may cause irritation of the upper respiratory tract and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Tin chloride acetylacetonate shall be used with adequate ventilation. It is irritating to the eyes and skin. Contact with the eyes, skin and clothing shall be avoided. Tin chloride acetylacetonate can be absorbed through skin. Wash thoroughly after handling. Tin chloride acetylacetonate is burnable. When heated to decomposition or on contact with acid, it can emit toxic and irritating fumes. The TLV for tin organic compounds (as Sn)-skin is 0.1 mg/m³ and PEL for tin (organic compounds) is 0.1 mg/m³. (Refer to 4.3.1)

DOD-STD-1446

5.3.2.26.4 Storage. Tin chloride acetylacetonate shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids, acid fumes and open flame. (Refer to 4.3.2)

5.3.2.26.5 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.

DOD- STD-1446

5.4 Organometallic Compounds. An organometallic compound is defined as 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. Organic derivatives of the metalloids (boron, silicon, germanium, arsenic and tellurium) are included, and are also termed as organometalloidal compounds.

Compounds in which carbon-containing moieties are bound to a metal via some other atom, such as oxygen, nitrogen, or sulfur, are not included in the category of organometallic compounds.

5.4.1 Name. Diethylaluminum Chloride, Reagent $(C_2H_5)_2AlCl$ FW 120.56
Aluminum diethyl monochloride

5.4.1.1 Technical description. Diethylaluminum chloride (pure) exists as a colorless liquid with a melting point of $-50^\circ C$ and a boiling point of $125-126^\circ C$ at 60 mm Hg.

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

5.4.1.2.1 Requirement. Diethylaluminum chloride, reagent is available commercially with chemical requirement as shown in Table LXXII.

TABLE LXXII. Diethylaluminum chloride, reagent - chemical requirement.

Assay $[(C_2H_5)_2AlCl]$, % by wt	95.0+
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5.4.1.3 Use. Diethylaluminum chloride, reagent, is used as a catalyst component in Ziegler type systems for olefin and diene polymerizations. Included in its use is alkylation reactions and as a catalyst component in linear oligomerization and cyclization of unsaturated hydrocarbons.

5.4.1.4 Safety. Diethylaluminum chloride is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Hydrocarbon solutions of diethylaluminum chloride may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes and smoke. There is no TLV or PEL referenced for diethylaluminum chloride, but the TLV for aluminum alkyls, as Al, not otherwise classified is 2.0 mg/m^3 . Inhalation of fumes from burning liquid shall be avoided. Diethylaluminum chloride produces severe chemical and thermal burns, predominantly thermal, on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

5.4.1.5 Storage. Diethylaluminum chloride shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool, well-ventilated place. (Refer to 4.3.2)

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

DOD-STD-1446

Diethylaluminum chloride has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.2 Name. Diethyltin Dichloride, Reagent (C₂H₅)₂SnCl₂ FW 247.72
Dichloro-diethyltin

5.4.2.1 Technical description. Diethyltin dichloride (pure) exists as white needles. Its melting point is 84-5°C and boiling point is 220°C. It is soluble in cold and hot water. It is soluble in hydrochloric acid and organic solvents.

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

5.4.2.2.1 Requirements. Diethyltin dichloride, reagent is available commercially with physical requirements as shown in Table LXXIII.

TABLE LXXIII. Diethyltin dichloride, reagent - physical requirements.

Melting point (°C)	84.0
Boiling point (°C)	220.0

5.4.2.3 Use. Diethyltin dichloride, reagent, is used in organic synthesis as an intermediate.

5.4.2.4 Safety. Diethyltin dichloride is highly toxic by inhalation and percutaneous absorption. It is also irritating to mucous membranes. Breathing of fumes and mists shall be avoided. Diethyltin dichloride shall be used with adequate ventilation. Diethyltin dichloride is irritating to the eyes and skin. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When diethyltin dichloride is heated to decomposition or in the presence of acids or acid fumes, it emits toxic chloride fumes. The TLV for organic tin compounds, as Sn - skin is 0.1 mg/m³. The PEL for organic tin compounds is 0.1 mg/m³. (Refer to 4.3.1)

5.4.2.5 Storage. Diethyltin dichloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.4.2.6 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.

5.4.3 Name. Diisobutylaluminum Hydride, Reagent AlH(C₄H₉)₂ FW 142.2
Aluminum diisobutylhydride

5.4.3.1 Technical description. Commercially available diisobutylaluminum hydride exists as a colorless liquid with a density of 0.78 g/cm³ at 22°C. Its melting point is -70°C and boiling point is 140°C at 4 mm Hg. It is air and moisture sensitive.

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

DOD-STD-1446

5.4.3.2.1 Requirement. Diisobutylaluminum hydride, reagent is available commercially with chemical requirement as shown in Table LXXIV.

TABLE LXXIV. Diisobutylaluminum hydride, reagent - chemical requirement.

Assay $[\text{AlH}(\text{C}_4\text{H}_9)_2]$, % by wt	98.0
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5.4.3.3 Use. Diisobutylaluminum hydride, reagent, is used as a reducing agent in pharmaceuticals.

5.4.3.4 Safety. Diisobutylaluminum hydride is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Hydrocarbon solutions of diisobutylaluminum hydride may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes and smoke. There is no TLV or PEL referenced for diisobutylaluminum hydride, but the TLV for aluminum alkyls, as Al, not otherwise classified is 2.0 mg/m^3 . Inhalation of fumes from burning liquid shall be avoided. Diisobutylaluminum hydride produces severe chemical and thermal burns on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

5.4.3.5 Storage. Diisobutylaluminum hydride shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool, dry, well-ventilated place. (Refer to 4.3.2)

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

Diisobutylaluminum hydride has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive, Waste No. D 03.

5.4.4 Name. Dimethylboron Bromide, Reagent $(\text{CH}_3)_2\text{BBr}$ FW 120.79
Bromo-dimethylboron

5.4.4.1 Technical description. Dimethylboron bromide (pure) exists as a colorless liquid or gas. Its melting point is -123.4°C and boiling point is 22°C . It decomposes in hot or cold water.

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

5.4.4.2.1 Requirement. Dimethylboron bromide, reagent is available commercially with chemical requirement as shown in Table LXXV.

TABLE LXXV. Dimethylboron bromide, reagent - chemical requirement.

Assay $[(\text{CH}_3)_2\text{BBr}]$, % by wt	99.0
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5.4.4.3 Use. Dimethylboron bromide, reagent, is used as a catalyst in organic synthesis.

DOD-STD-1446

5.4.4.4 Safety. Dimethylboron bromide is an irritant to the respiratory tract, mucous membranes, skin and eyes. Breathing of vapors and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Dimethylboron bromide shall be used with adequate ventilation. Wash thoroughly after handling. There is no TLV or PEL referenced for dimethylboron bromide. When heated to decomposition, dimethylboron bromide emit toxic fumes of bromine. The TLV and PEL for bromine is 0.7 mg/m³. (Refer to 4.3.1)

5.4.4.5 Storage. Dimethylboron bromide shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.4.4.6 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.

5.4.5 Name. Dimethylcadmium, Reagent Cd(CH₃)₂ FW 142.47
Cadmium dimethyl

5.4.5.1 Technical description. Dimethylcadmium (pure) exists as an oil with a density of 1.9846 g/cm³ at 17.9°C. Its melting point is -4.5°C and boiling point is 105.5 at 758 mm Hg. It decomposes in hot and cold water.

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

5.4.5.2.1 Requirement. Dimethylcadmium, reagent is available commercially with chemical requirement as shown in Table LXXVI.

TABLE LXXVI. Dimethylcadmium, reagent - chemical requirement.

Assay [Cd(CH ₃) ₂], % by wt	95.0
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5.4.5.3 Use. Dimethylcadmium, reagent, is used as a polymerization catalyst.

5.4.5.4 Safety. Dimethylcadmium is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. It explosively decomposes above 100°C (212°F). Dilute solutions of dimethylcadmium may not be pyrophoric depending on concentration and temperature. The burning liquid can release toxic fumes which are irritating to the respiratory tract and mucous membranes. Inhalation of fumes from burning liquid shall be avoided. Dimethylcadmium produces severe burns of the eyes and skin by reactions with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

Upon decomposition, dimethylcadmium emits toxic fumes of cadmium oxide. Cadmium oxide is a confirmed carcinogen. The TLV for cadmium oxide fumes, as Cd, is 0.05 mg/m³ (ceiling limit).

5.4.5.5 Storage. Dimethylcadmium shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool, dry, well-ventilated place. (Refer to 4.3.2)

DOD-STD-1446

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

Dimethylcadmium has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D006; Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.6 Name. Diphenyltin Dichloride, Reagent $(C_6H_5)_2SnCl_2$ FW 343.81
Dichloro-diphenyltin

5.4.6.1 Technical description. Diphenyltin dichloride (pure) exists as colorless crystals. Its melting point is $42.0^\circ C$ and boiling point is $333-337^\circ C$ with decomposition. It is very slightly soluble in cold water with decomposition. It is soluble in alcohol, ether, and ligroin.

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

5.4.6.2.1 Requirement. Diphenyltin dichloride, reagent is available commercially with chemical requirement as shown in Table LXXVII.

TABLE LXXVII. Diphenyltin dichloride, reagent - chemical requirement.

Assay $(C_6H_5)_2SnCl_2$, % by wt	96.0
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5.4.6.3 Use. Diphenyltin dichloride, reagent, is used in organic synthesis as an intermediate.

5.4.6.4 Safety. Diphenyltin dichloride is toxic by inhalation, ingestion and percutaneous absorption. It is irritating to the respiratory tract and mucous membranes. Breathing of fumes and mists shall be avoided. It shall be used with adequate ventilation. Diphenyltin dichloride is irritating to the eyes and skin. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Diphenyltin dichloride is burnable. When heated to decomposition or on contact with acids or acid fumes, it may emit toxic fumes of chlorides. The TLV for organic tin compounds, as Sn - skin is 0.1 mg/m^3 . The PEL for organic tin compounds is 0.1 mg/m^3 . (Refer to 4.3.1)

5.4.6.5 Storage. Diphenyltin dichloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acid and acid fumes. (Refer to 4.3.2)

5.4.6.6 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.

5.4.7 Name. Methylmercuric Chloride, Reagent CH_3HgCl FW 251.09
Methylmercury(II)chloride

5.4.7.1 Technical description. Methylmercuric chloride (pure) exists as white crystals with a disagreeable odor and a density of 4.063 g/cm^3 . Its melting point is $170^\circ C$.

DOD-STD-1446

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

5.4.7.2.1 Requirement. Methylmercuric chloride, reagent is available commercially with chemical requirement as shown in Table LXXVIII.

TABLE LXXVIII. Methylmercuric Chloride, Reagent - chemical requirement.

Assay (CH_3HgCl), % by wt	95.0+
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5.4.7.3 Use. Methylmercuric chloride, reagent, is used as a catalyst.

5.4.7.4 Safety. Methylmercuric chloride is highly toxic by inhalation. It is also toxic by percutaneous absorption. Breathing of dust, fumes and mists shall be avoided. Methylmercuric chloride shall be used with adequate ventilation. Methylmercuric chloride causes eye and skin burns and other forms of irritation. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, methylmercuric chloride emits highly toxic fumes of mercury. The TLV for alkyl mercury compounds, as Hg - skin is 0.01 mg/m^3 . (Refer to 4.3.1)

5.4.7.5 Storage. Methylmercuric chloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

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

Methylmercuric chloride has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D009.

5.4.8 Name. Methylmercuric Iodide, Reagent CH_3HgI FW 342.53
Methylmercury(II)iodide

5.4.8.1 Technical description. Methylmercuric iodide (pure) exists as colorless pearly leaflets. Its melting point is 143°C . It is insoluble in cold water. It is very soluble in methyl alcohol; soluble in ether and alcohol.

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

5.4.8.2.1 Requirement. Methylmercuric iodide, reagent is available commercially with chemical requirement as shown in Table LXXIX.

TABLE LXXIX. Methylmercuric Iodide, Reagent - chemical requirement.

Assay (CH_3HgI), % by wt	98.0+
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5.4.8.3 Use. Methylmercuric iodide, reagent, is used in organic synthesis.

5.4.8.4 Safety. Methylmercuric iodide is highly toxic by inhalation. It is also toxic by percutaneous absorption. Breathing of dust, fumes and mists shall be avoided. Methylmercuric iodide shall be used with adequate ventilation. Methylmercuric iodide causes skin burns and other forms of irritation. Contact with the skin and clothing shall be avoided. Wash thoroughly after

DOD-STD-1446

handling. When heated to decomposition, methylmercuric iodide emits highly toxic fumes of mercury. The TLV for alkyl mercury compounds, as Hg - skin is 0.01 mg/m³. (Refer to 4.3.1)

5.4.8.5 Storage. Methylmercuric iodide shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

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

Methylmercuric iodide has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D009.

5.4.9 Name Phenylmercury Chloride, Reagent C6H5HgCl FW 313.15
Phenylmercuric chloride

5.4.9.1 Technical description. Phenylmercury chloride (pure) exists as white satiny leaflets. Its melting point is 251.0°C. It is slightly soluble in hot alcohol, benzene, pyridine and ether.

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

5.4.9.2.1 Requirements. Phenylmercury chloride, reagent is available commercially with chemical requirement as shown in Table LXXX.

TABLE LXXX. Phenylmercury Chloride, Reagent - chemical requirement.

Assay (Hg), % by wt	97.0
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5.4.9.3 Use. Phenylmercury chloride, reagent, is used in medicine as a dilute solution.

5.4.9.4 Safety. Phenylmercury chloride is toxic by inhalation. It is also toxic by percutaneous absorption. Breathing of dust, fumes and mist shall be avoided. Phenylmercury chloride shall be used with adequate ventilation. Phenylmercury chloride also causes eye and skin burns and other forms of irritation. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When phenylmercury chloride is heated to decomposition, it emits toxic fumes of mercury. The TLV for aryl mercury compounds, as Hg, is 0.1 mg/m³. (Refer to 4.3.1)

5.4.9.5 Storage. Phenylmercury chloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

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

Phenylmercury chloride has an EPA Hazardous Waste Classification - EP Toxic; Waste No. D009.

5.4.10 Name. Tetraethyltin, Reagent Sn(C2H5)4 FW 234.94
Tin tetraethyl

DOD-STD-1446

5.4.10.1 Technical description. Tetraethyltin (pure) exists as a colorless liquid with a refractive index of 1.4724 and a density of 1.187 g/cm³ at 23°C. Its melting point is -112°C and boiling point is 181°C. Its flash point is 53°C (128°F). It is insoluble in hot and cold water. It is soluble in organic solvent.

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

5.4.10.2.1 Requirement. Tetraethyltin, reagent is available commercially with chemical requirement as shown in Table LXXXI.

TABLE LXXXI. Tetraethyltin, Reagent - chemical requirement.

Assay	Sn(C ₂ H ₅) ₄ , % by wt	97.0
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5.4.10.3 Use. Tetraethyltin, reagent, is used as a catalyst.

5.4.10.4 Safety. Tetraethyltin is combustible and highly toxic by inhalation, ingestion, and percutaneous absorption. It is irritating to the respiratory tract and mucous membranes. Breathing of fumes and mist shall be avoided. It shall be used with adequate ventilation. Tetraethyltin is irritating to the eyes and skin. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. Upon decomposition, it emits toxic fumes. The TLV for organic tin compounds, as Sn - skin is 0.1 mg/m³. The PEL for organic tin compounds, as Sn is 0.1 mg/m³. Tetraethyltin is a moderate fire hazard when exposed to heat or flame. It can react with oxidizing materials. (Refer to 4.3.1)

5.4.10.5 Storage. Tetraethyltin shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of heat, flame and oxidizing materials. (Refer to 4.3.2)

5.4.10.6 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.

5.4.11 Name. Tetramethylsilane, Analyzed Reagent Si(CH₃)₄ FW 88.23
Tetramethylsilane

5.4.11.1 Technical description. Tetramethylsilane (pure) exists as a colorless liquid with a density of 0.651 g/cm³ at 15°C. Its boiling point is 26.5°C. It is soluble in ether and insoluble in concentrated sulfuric acid.

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

5.4.11.2.1 Requirements. The federal specification chemical requirements for tetramethylsilane, analyzed reagent are shown in Table LXXXII.

DOD-STD-1446

TABLE LXXXII. Tetramethylsilane, Analyzed Reagent - chemical requirements (ACS).

Residue after evaporation, max, % by wt	0.05
Volatile impurities, % by wt. To pass test (Analyze sample by gas chromatography)	Limit about 0.2
Suitability for proton nmr position reference	To pass proton nmr reference spectrum test.

5.4.11.3 Use. Tetramethylsilane, analyzed reagent, is used as a reagent for proton nmr position reference.

5.4.11.4 Safety. Tetramethylsilane is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Diluted solutions of tetramethylsilane may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes. Inhalation of fumes from burning liquid shall be avoided. Tetramethylsilane can produce severe chemical and thermal burns, predominantly thermal, on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.4.11.5 Storage. Tetramethylsilane shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from oxidizing materials. (Refer to 4.3.2)

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

Tetramethylsilane has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive - Waste No. D003.

5.4.12 Name. Tetramethyltin, Reagent $\text{Sn}(\text{CH}_3)_4$ FW 178.83
Tin tetramethyl

5.4.12.1 Technical description. Tetramethyltin (pure) exists as a colorless liquid with a refractive index of 1.4386 and a density of 1.314 g/cm³ at 0°C. Its melting point is -54.8°C and boiling point is 78°C. It is soluble in organic solvents.

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

5.4.12.2.1 Requirement. Tetramethyltin, reagent is available commercially with chemical requirement as shown in Table LXXXIII.

TABLE LXXXIII. Tetramethyltin, Reagent - chemical requirement.

Assay $\text{Sn}(\text{CH}_3)_4$, % by wt	99.5
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5.4.12.3 Use. Tetramethyltin, reagent, is used as a catalyst.

DOD-STD-1446

5.4.12.4 Safety. Tetramethyltin is highly toxic by ingestion and irritating to mucous membranes. Breathing of fumes and mists shall be avoided. It shall be used with adequate ventilation. Tetramethyltin is irritating to the eyes and skin. Contact with eyes, skin, and clothing shall be avoided. Wash thoroughly after handling. The TLV for organic tin compounds, as Sn - skin is 0.1 mg/m³. The PEL for organic tin compounds is 0.1 mg/m³. Tetramethyltin is a moderate fire hazard when exposed to heat or flame. When heated it emits acid fumes. It can react with oxidizing materials. (Refer to 4.3.1)

5.4.12.5 Storage. Tetramethyltin shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from heat, flame and oxidizing materials. (Refer to 4.3.2)

5.4.12.6 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.

5.4.13 Name. Tetraphenylarsenic Chloride, Monohydrate, Reagent
 $(C_6H_5)_4AsCl \cdot H_2O$ FW 436.80
 Tetraphenylarsonium chloride, monohydrate

5.4.13.1 Technical description. Commercially available tetraphenylarsenic chloride, monohydrate exists as crystalline with a carbon content of 65.63% and hydrogen content of 5.06%. It loses its water of hydration at 100°C. It is freely soluble in water, soluble in alcohol or methanol and sparingly soluble in acetone.

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

5.4.13.2.1 Requirement. Tetraphenylarsenic chloride, monohydrate, reagent is available commercially with physical requirement as shown in Table LXXXIV.

TABLE LXXXIV. Tetraphenylarsenic Chloride, Monohydrate, Reagent - physical requirement.

Melting point (°C)	257.0
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5.4.13.3 Use. Tetraphenylarsenic chloride, monohydrate, is used as a reagent for Cd, Hg, Zn, perchlorate, periodate and other ions.

5.4.13.4 Safety. Tetraphenylarsenic chloride, monohydrate is highly toxic by inhalation or ingestion and can be irritating to mucous membranes. Breathing of fumes, mist and dust shall be avoided. It shall be used with adequate ventilation. Tetraphenylarsenic chloride, monohydrate, can cause irritation of the skin and eyes. Contact with skin, eyes and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, tetraphenylarsenic chloride, monohydrate, emits highly toxic fumes of arsenic. On contact with acids or acid fumes or when water solutions of arsenicals are in contact with active metals such as Fe, Al, Zn, it emits highly toxic fumes of arsenic. Arsenic compounds are confirmed carcinogens. The TLV for arsenic and soluble compounds, as As, is 0.2 mg/m³. The PEL for arsenic organic compounds, as As, is 0.5 mg/m³. (Refer to 4.3.1)

DOD-STD-1446

5.4.13.5 Storage. Tetraphenylarsenic chloride, monohydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of heat, acids and acid fumes. (Refer to 4.3.2)

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

Tetraphenylarsenic chloride, monohydrate, has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D004.

5.4.14 Name. Tetraphenylsilane, Reagent $\text{Si}(\text{C}_6\text{H}_5)_4$ FW 336.51
Tetraphenylsilane

5.4.14.1 Technical description. Tetraphenylsilane (pure) exists as colorless flocculent amorphous particles. Its melting point is 237°C and boiling point is 428°C . It is soluble in acetic anhydride and chlorosulphonic acid.

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

5.4.14.2.1 Requirement. Tetraphenylsilane, reagent is available commercially with chemical requirement as shown in Table LXXXV.

TABLE LXXXV. Tetraphenylsilane, Reagent - chemical requirement.

Assay $[\text{Si}(\text{C}_6\text{H}_5)_4]$, % by wt	96.0
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5.4.14.3 Use. Tetraphenylsilane, reagent, is used as an nmr shift reagent.

5.4.14.4 Safety. Tetraphenylsilane is highly toxic by inhalation. Breathing of fumes and mists shall be avoided. It shall be used with adequate ventilation. Tetraphenylsilane is irritating to the eyes and skin. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.4.14.5 Storage. Tetraphenylsilane shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

5.4.14.6 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.

5.4.15 Name. Tetraphenylsodium Borate, Analyzed Reagent $\text{NaB}(\text{C}_6\text{H}_5)_4$ FW 342.23
Sodium tetraphenylboron

5.4.15.1 Technical description. Commercially available tetraphenylsodium borate exists as white crystals with a melting point of $>300^\circ\text{C}$. It is freely soluble in water and acetone. It is less soluble in ether and chloroform and practically insoluble in petroleum ether. The solubility in polar solvents increases as the temperature decreases.

DOD-STD-1446

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

5.4.15.2.1 Requirements The federal specification chemical and physical requirements for tetraphenylsodium borate, analyzed reagent are shown in Table LXXXVI.

TABLE LXXXVI. Tetraphenylsodium Borate, Analyzed Reagent - chemical and physical requirements (ACS).

Assay $[\text{NaB}(\text{C}_6\text{H}_5)_4]$, min, % by wt	99.5
Loss on drying at 105°C, max, % by wt	0.5
Clarity of solution	To pass test

5.4.15.3 Use. Tetraphenylsodium borate, analyzed reagent, is used as a reagent for the determination of potassium, ammonium, rubidium and cesium ions.

5.4.15.4 Safety. Boron compounds are not highly toxic. It can be absorbed through skin. Prolonged contact with the skin shall be avoided. It can affect the central nervous system. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1)

5.4.15.5 Storage. Tetraphenylsodium borate shall be stored in a cool, dry place in tightly closed containers. (Refer to 4.3.2)

5.4.15.6 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.

5.4.16 Name. Tetraphenyltin, Reagent $\text{Sn}(\text{C}_6\text{H}_5)_4$ FW 427.12
Tin tetraphenyl

5.4.16.1 Technical description. Tetraphenyltin (pure) exists as colorless, tetragonal crystals from xylene with a density of 1.490 g/cm³ at 0°C. Its melting point is 226°C and boiling point is >420°C. It is insoluble in cold and hot water. It is soluble in hot benzene, pyridine, carbon tetrachloride, chloroform and acetic acid. It is slightly soluble in alcohol.

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

5.4.16.2.1 Requirement. Tetraphenyltin, reagent is available commercially with chemical requirement as shown in Table LXXXVII.

TABLE LXXXVII. Tetraphenyltin, Reagent - chemical requirement.

Assay $[\text{Sn}(\text{C}_6\text{H}_5)_4]$, % by wt	97.0
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5.4.16.3 Use. Tetraphenyltin, reagent, is used as an intermediate in organic synthesis.

5.4.16.4 Safety. Tetraphenyltin is highly toxic by inhalation. It is also toxic by percutaneous absorption. It is irritating to the respiratory tract and mucous membranes. Breathing of fumes and mists shall be avoided.

DOD-STD-1446

Tetraphenyltin shall be used with adequate ventilation. Tetraphenyltin is irritating to the eyes and skin. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition, it emits toxic fumes. It can react with oxidizing materials. Tetraphenyltin is a slight fire hazard when exposed to heat or flame. The TLV for organic tin compounds, as Sn - skin is 0.1 mg/m^3 . The PEL for organic tin compounds, as Sn, is 0.1 mg/m^3 . (Refer to 4.3.1)

5.4.16.5 Storage. Tetraphenyltin shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of heat and flame and oxidizing materials. (Refer to 4.3.2)

5.4.16.6 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.

5.4.17 Name. Triethylaluminum, Reagent $\text{Al}(\text{C}_2\text{H}_5)_3$ FW 114.17
Aluminum triethyl

5.4.17.1 Technical description. Triethylaluminum (pure) exists as a colorless liquid with a density of 0.837 g/cm^3 at 20°C . Its refractive index is 1.480. It has a freezing point of about -46°C producing two crystalline forms. Its boiling point is 194°C . It is soluble in liquid hydrocarbons. It is dimerized in the liquid state and in solution. It is decomposed by water and is reactive with polar compounds including halogenated hydrocarbons.

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

5.4.17.2.1 Requirement. Triethylaluminum, reagent is available commercially with chemical requirement as shown in Table LXXXVIII.

TABLE LXXXVIII. Triethylaluminum, Reagent - chemical requirement.

Assay $[\text{Al}(\text{C}_2\text{H}_5)_3]$, % by wt	95.0
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5.4.17.3 Use. Triethylaluminum, reagent, is used as a component of the catalyst in Ziegler-type systems of olefin and diene polymerization.

5.4.17.4 Safety. Triethylaluminum is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Hydrocarbon solutions of triethylaluminum may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes and smoke. There is no PEL or TLV referenced for triethylaluminum, but the TLV for aluminum alkyls, as Al, not otherwise classified is 2.0 mg/m^3 . Inhalation of fumes from burning liquid shall be avoided. Triethylaluminum produces severe chemical and thermal burns, predominantly thermal, on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

5.4.17.5 Storage. Triethylaluminum shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool, well-ventilated place. (Refer to 4.3.2)

DOD- STD-1446

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

Triethylaluminum has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.18 Name. Triethylboron, Reagent B(C₂H₅)₃ FW 98.0
Triethylborine
Boron triethyl

5.4.18.1 Technical description. Triethylboron (pure) exists as a colorless liquid with a density of 0.6961 g/cm³ at 23°C. Its melting point is -92.9°C and boiling point is 0°C at 12.5 mm. It is soluble in alcohol and ether.

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

5.4.18.2.1 Requirement. Triethylboron, reagent is available commercially with chemical requirement as shown in Table LXXXIX.

TABLE LXXXIX. Triethylboron, Reagent - chemical requirement.

Assay [B(C ₂ H ₅) ₃], % by wt	98.0
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5.4.18.3 Use. Triethylboron, reagent, is used as a component of the catalyst in Ziegler type systems of olefin polymerization.

5.4.18.4 Safety. Triethylboron is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Solutions of triethylboron may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes. There is no PEL or TLV referenced for triethylboron but inhalation of fumes from burning liquid shall be avoided. Triethylboron produces severe chemical and thermal burns, predominantly thermal, on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

5.4.18.5 Storage. Triethylboron shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool, well-ventilated place. (Refer to 4.3.2)

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

Triethylboron has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.19 Name. Triethyldialuminum Trichloride, Reagent (C₂H₅)₃Al₂Cl₃ FW 247.51
Ethylaluminum sesquichloride

DOD-STD-1446

5.4.19.1 Technical description. Commercially available triethyldialuminum trichloride exists as a clear liquid with a density of 1.092 g/cm³ at 25°C. Its freezing point is -20°C and boiling point of 204°C (extrapolated) at 760 mm Hg. It is miscible with most liquid hydrocarbons. It is decomposed by water and is reactive with polar compounds including halogenated hydrocarbons. Triethyldialuminum trichloride is a 1:1 complex of ethylaluminum dichloride and diethylaluminum chloride.

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

5.4.19.2.1 Requirements. Triethyldialuminum trichloride, reagent is available commercially with chemical requirements as shown in Table XC.

TABLE XC. Triethyldialuminum Trichloride, Reagent - chemical requirements.

Assay [(C ₂ H ₅) ₃ Al ₂ Cl ₃], min, % by wt	95.0
Aluminum (Al) (wt %), % by wt	21.5
Chlorine (Cl) (wt %), % by wt	42.2

5.4.19.3 Use. Triethyldialuminum trichloride is used as a catalyst for polymerization of olefins and hydrogenation of aromatic compounds.

5.4.19.4 Safety. Triethyldialuminum trichloride is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Hydrocarbon solutions of triethyldialuminum trichloride may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes and smoke. There is no PEL or TLV referenced for triethyldialuminum trichloride, but the TLV for aluminum alkyls, as Al, not otherwise classified is 2.0 mg/m³. Inhalation of fumes from burning liquid shall be avoided. Triethyldialuminum trichloride produces severe chemical and thermal burns, predominantly thermal, on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

5.4.19.5 Storage. Triethyldialuminum trichloride shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool, well-ventilated place. (Refer to 4.3.2)

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

Triethyldialuminum trichloride has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.20 Name. Triisobutylaluminum, Reagent Al(C₄H₉)₃ FW 198.33
Aluminum triisobutyl
Tibal

DOD-STD-1446

5.4.20.1 Technical description. Commercially available triisobutylaluminum exists as a colorless liquid with a density of 0.787 g/cm³ at 20°C. Its melting point is 4°C and boiling point 73°C at 5 mm Hg. It is miscible with hydrocarbons. It is decomposed by water and reactive with polar compounds including halogenated hydrocarbons. Triisobutylaluminum undergoes conversion to diisobutylaluminum hydride when heated above 50°C.

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

5.4.20.2.1 Requirement. Triisobutylaluminum, reagent is available commercially with chemical requirements as shown in Table XCI.

TABLE XCI. Triisobutylaluminum, Reagent - chemical requirement.

Assay $Al(C_4H_9)_3$, % by wt	95.7
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5.4.20.3 Use. Triisobutylaluminum, reagent, is used as a catalyst for olefin polymerization.

5.4.20.4 Safety. Triisobutylaluminum is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with the release of flammable and explosive vapors that can be ignited by the heat of reaction. Hydrocarbon solutions of triisobutylaluminum may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes and smoke. There is no PEL or TLV referenced for triisobutylaluminum, but the TLV for aluminum alkyls, as Al not otherwise classified is 2.0 mg/m³. Inhalation of fumes from burning liquid shall be avoided. Triisobutylaluminum produces severe chemical and thermal burns on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

5.4.20.5 Storage. Triisobutylaluminum shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool, dry, well-ventilated place. (Refer to 4.3.2)

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

Triisobutylaluminum has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.21 Name. Trimethylaluminum, Reagent $Al(CH_3)_3$ FW 72.09
Aluminum trimethyl

5.4.21.1 Technical description. Trimethylaluminum (pure) exists as a colorless liquid. Its refractive index is 1.432 at 12°C and its density is 0.752 g/cm³. Its freezing point is 15.4°C and boiling point is 127°C at 760 mm Hg. It is explosive in water and decomposes to $Al(OH)_3 + CH_4$. It is soluble in ether and alcohol.

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

DOD-STD-1446

5.4.21.2.1 Requirement. Trimethylaluminum, reagent is available commercially with chemical requirement as shown in Table XCII.

TABLE XCII. Trimethylaluminum, Reagent - chemical requirement.

Assay $[\text{Al}(\text{CH}_3)_3]$, % by wt	98.0
--	------

5.4.21.3 Use. Trimethylaluminum, reagent, is used as a catalyst for olefin polymerization.

5.4.21.4 Safety. Trimethylaluminum is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Hydrocarbon solutions of trimethylaluminum may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes and smoke. There is no PEL or TLV referenced for trimethylaluminum, but the TLV for aluminum alkyls, as Al, not otherwise classified is 2.0 mg/m³. Inhalation of fumes from burning liquid shall be avoided. Trimethylaluminum produces severe chemical and thermal burns, predominantly thermal, on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

5.4.21.5 Storage. Trimethylaluminum shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool well-ventilated place. (Refer to 4.3.2)

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

Trimethylaluminum has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.22 Name. Trimethylarsenic, Reagent $\text{As}(\text{CH}_3)_3$ FW 120.03
Trimethylarsine
Arsenic trimethyl

5.4.22.1 Technical description. Trimethylarsenic (pure) exists as a colorless liquid with a density of 1.124 g/cm³. Its boiling point is 70°C. It is slightly soluble in cold water. It is soluble in ether.

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

5.4.22.2.1 Requirement. Trimethylarsenic, Reagent is available commercially with chemical requirement as shown in Table XCV.

TABLE XCV. Trimethylarsenic, Reagent - chemical requirement.

Assay $[\text{As}(\text{CH}_3)_3]$, % by wt	99.8
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5.4.22.3 Use. Trimethylarsenic, reagent, is used in the synthesis of heterocyclic compounds containing arsenic.

DOD-STD-1446

5.4.22.4 Safety. Trimethylarsenic is a pyrophoric liquid that flames spontaneously on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Dilute solutions of trimethylarsenic may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes. Inhalation of fumes from burning liquid shall be avoided. Trimethylarsenic produces irritation of the eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. Arsenic compounds are carcinogens of the skin, lungs and liver. The TLV for arsenic and soluble compounds, as As, is 0.2 mg/m^3 . The PEL for arsenic organic compounds (as As) is 0.5 mg/m^3 . (Refer to 4.3.1)

5.4.22.5 Storage. Trimethylarsenic shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure in a cool well-ventilated place. (Refer to 4.3.2)

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

Trimethylarsenic has an EPA Hazardous Waste Classification - EP Toxic, Waste No. D004; Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.23 Name. Trimethyldialuminum Trichloride, Reagent
 $(\text{CH}_3)_3\text{Al}_2\text{Cl}_3$ FW 205.43
 Methyaluminum sesquichloride

5.4.23.1 Technical description. Commercially available trimethyldialuminum trichloride exists as a clear colorless liquid with a density of 1.1629 g/cm^3 at 25°C . It has a freezing point of 22.8°C and a boiling point of 143.7°C (extrapolated) at 760 mm Hg. It is miscible with most liquid hydrocarbons. It is decomposed by water and is reactive with polar compounds including halogenated hydrocarbons.

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

5.4.23.2.1 Requirements. Trimethyldialuminum trichloride, reagent is available commercially with physical requirements as shown in Table XCIV.

TABLE XCIV. Trimethyldialuminum Trichloride, Reagent - physical requirements.

Melting point ($^\circ\text{C}$)	23.0
Boiling point ($^\circ\text{C}$)	144.0
Density (g/cm^3)	1.151

5.4.23.3 Use. Trimethyldialuminum trichloride is used as a catalyst for polymerization of olefins and hydrogenation of aromatics.

5.4.23.4 Safety. Trimethyldialuminum trichloride is a pyrophoric liquid that flames spontaneously and gives off dense smoke on exposure to air. It is reactive with water with release of flammable and explosive vapors that can be ignited by the heat of reaction. Hydrocarbon solutions of trimethyldialuminum trichloride may not be pyrophoric depending on concentration and temperature. The burning liquid can release irritating and toxic fumes and smoke. There is

DOD-STD-1446

no PEL or TLV referenced for trimethyldialuminum trichloride, but the TLV for aluminum alkyls, as Al, not otherwise classified is 2.0 mg/m³. Inhalation of fumes from burning liquid shall be avoided. Trimethyldialuminum trichloride causes severe chemical and thermal burns, predominantly thermal, on contact with eyes and skin by reaction with body moisture. Contact with eyes, skin and clothing shall be avoided. (Refer to 4.3.1)

5.4.23.5 Storage. Trimethyldialuminum trichloride shall be stored in special containers, blanketed with dry nitrogen under a slight positive pressure, in a cool well-ventilated place. (Refer to 4.3.2)

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

Trimethyldialuminum trichloride has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and Reactive, Waste No. D003.

5.4.24 Name. Triphenylantimony Dichloride, Reagent
(C₆H₅)₃SbCl₂ FW 423.98
Dichloro-triphenylantimony

5.4.24.1 Technical description. Triphenylantimony dichloride (pure) exists as white crystalline solid. Its melting point is 143.0°C. It is insoluble in hot or cold water. It is soluble in benzene, carbon disulfide and hot alcohol.

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

5.4.24.2.1 Requirement. Triphenylantimony dichloride, reagent is available commercially with chemical requirements as shown in Table XCV.

TABLE XCV. Triphenylantimony Dichloride, Reagent - chemical requirement.

Assay [(C ₆ H ₅) ₃ SbCl ₂], % by wt	99.0+
---	-------

5.4.24.3 Use. Triphenylantimony dichloride, reagent, is used as a molecular weight standard.

5.4.24.4 Safety. Triphenylantimony dichloride is toxic by inhalation and percutaneous absorption. It is irritating to the respiratory tract and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Triphenylantimony dichloride shall be used with adequate ventilation. Triphenylantimony dichloride is irritating to the eyes and skin. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. The TLV and PEL for antimony and compounds, as Sb, is 0.5 mg/m³. (Refer to 4.3.1)

5.4.24.5 Storage. Triphenylantimony dichloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2)

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

Antimony and compounds (not otherwise specified)(NOS) has an EPA Hazardous Waste Classification - Toxic.

DOD-STD-1446

5.4.25 Name. Triphenyltin Chloride, Reagent (C₆H₅)₃SnCl FW 385.46
Chloro-triphenyltin

5.4.25.1 Technical description. Triphenyltin chloride (pure) exists as colorless crystals. Its melting point is 106.0°C and its boiling point is 240.0°C at 13.5 mm. It is insoluble in hot or cold water and soluble in organic solvents.

5.4.25.2 Specification. Military, MIL-STD-51130, Chemicals, Reagent Grade; General Specification For (Metric)

5.4.25.2.1 Requirement. The military specification physical requirement for triphenyltin chloride, reagent is shown in Table XCVI.

TABLE XCVI. Triphenyltin Chloride, Reagent - physical requirement.

Melting point (°C), min - max	105 - 107
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5.4.25.3 Use. Triphenyltin chloride, reagent, is used in organic synthesis as an intermediate.

5.4.25.4 Safety. Triphenyltin chloride is highly toxic by inhalation. It is irritating to mucous membranes. Breathing of dust and mist shall be avoided. It shall be used with adequate ventilation. Triphenyltin chloride is irritating to the eyes and skin. Organic tin compounds are also toxic by percutaneous absorption. Contact with eyes, skin and clothing shall be avoided. Wash thoroughly after handling. When heated to decomposition or in the presence of acids or acid fumes, triphenyltin chloride emits highly toxic chloride fumes. The TLV for organic tin compounds, as Sn - skin is 0.1 mg/m³. The PEL for tin organic compounds is 0.1 mg/m³. (Refer to 4.3.1)

5.4.25.5 Storage. Triphenyltin chloride shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids and acid fumes. (Refer to 4.3.2)

5.4.25.6 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.

DOD-STD-1446

6. NOTES

6.1 Intended use. This standard is intended to cite nomenclature, formulas, physical and chemical properties, specifications requirements, military and typical commercial uses, safety information, storage information, disposal information for metal organic compounds, reagent grade (including ACS and USP-NF Compounds) prepared for applications by the Department of Defense.

6.2 Subject term (key word) listing.

Aluminum Butoxide (tert-), Reagent
 Aluminum Butoxide (tri-sec-), Reagent
 Aluminum Ethoxide, Reagent
 Aluminum Isopropoxide, Reagent
 Ammonium Iron (III) Oxalate, Trihydrate, Reagent
 Ammonium Titanyl Oxalate, Monohydrate, Reagent
 Barium Acetate, Anhydrous, Analyzed Reagent
 Cadmium Acetate, Dihydrate, Analyzed Reagent
 Calcium Acetate, Monohydrate, Analyzed Reagent
 Calcium Citrate, Tetrahydrate, Analyzed Reagent
 Calcium Oxalate, Monohydrate, Analyzed Reagent
 Cerium (III) Oxalate, Nonylhydrate, Reagent
 Chromium (III) Acetylacetonate, Reagent
 Cobalt (II) Acetylacetonate, Reagent
 Cobaltous Acetate, Tetrahydrate, Analyzed Reagent
 Copper (II) Ethylacetoacetate, Reagent
 Cupric Acetate, Monohydrate, Analyzed Reagent
 Cupric Oxalate, 1/2 Hydrate, Analyzed Reagent
 Diethylaluminum Chloride, Reagent
 Diethyltin Dichloride, Reagent
 Diisobutylaluminum Hydride, Reagent
 Dimethylboron Bromide, Reagent
 Dimethylcadmium, Reagent
 Diphenyltin Dichloride, Reagent
 Exposure limits, hazardous chemicals
 Ferric Acetylacetonate, Reagent
 Ferric Ammonium Citrate, Analyzed Reagent
 Ferric Citrate, Pentahydrate, Analyzed Reagent
 Ferrous Oxalate, Dihydrate, Reagent
 Hazardous wastes, disposal and storage of
 Information, hazardous chemicals
 Lead Acetate, Trihydrate, Analyzed Reagent
 Lead Citrate, Trihydrate, Reagent
 Lead Subacetate, Anhydrous, Analyzed Reagent
 Lithium Butoxide (tert-), Reagent
 Lithium Methoxide, Reagent
 Lithium Oxalate, Analyzed Reagent
 Lithium Phenoxide, Reagent
 Magnesium Acetate, Tetrahydrate, Analyzed Reagent
 Magnesium Acetylacetonate, Dihydrate, Reagent
 Manganous Acetate, Tetrahydrate, Analyzed Reagent
 Mercuric Acetate, Anhydrous, Analyzed Reagent
 Metal Alkoxides
 Metal Carboxylate

DOD-STD-1446

Metal Chelates

Methylmercuric Chloride, Reagent
 Methylmercuric Iodide, Reagent
 Molybdenum Oxide Acetylacetonate, Reagent
 Nickel Acetate, Tetrahydrate, Analyzed Reagent
 Nickel Acetylacetonate, Monohydrate, Reagent
 Nickel Oxalate, Dihydrate, Reagent
 Organometallic Compounds
 Palladium Acetylacetonate, Reagent
 Phenylmercury Chloride, Reagent
 Potassium Acetate, Anhydrous, Analyzed Reagent
 Potassium Butoxide (tert-), Reagent
 Potassium Citrate, Monohydrate, Analyzed Reagent
 Potassium Ethoxide, Reagent
 Potassium Hydrogen Phthalate, Anhydrous, Acidimetric
 Potassium Hydrogen Tartrate, Anhydrous, Analyzed Reagent
 Potassium Oxalate, Monohydrate, Analyzed Reagent
 Potassium Sodium Tartrate, Tetrahydrate, Analyzed Reagent
 Potassium Tartrate, 1/2 Hydrate, Analyzed Reagent
 Potassium Titanyl Oxalate, Dihydrate, Reagent
 Praseodymium Oxalate, Decahydrate, Reagent
 Safety, hazardous chemicals
 Samarium Oxalate, Decahydrate, Reagent
 Scandium Oxalate, Pentahydrate, Reagent
 Silver Acetate, Anhydrous, Analyzed Reagent
 Sodium Acetate, Anhydrous, Analyzed Reagent
 Sodium Acetate, Trihydrate, Analyzed Reagent
 Sodium Bitartrate, Monohydrate, Analyzed Reagent
 Sodium Butoxide (tert-), Reagent
 Sodium Ethoxide, Reagent
 Sodium Formate, Anhydrous, Analyzed Reagent
 Sodium Oxalate, Anhydrous, Analyzed Reagent
 Sodium Salicylate, Anhydrous, Analyzed Reagent
 Sodium Tartrate, Dihydrate, Analyzed Reagent
 Strontium Acetate, 1/2 Hydrate, Analyzed Reagent
 Terbium Oxalate, Decahydrate, Reagent
 Tetraethyltin, Reagent
 Tetramethylsilane, Analyzed Reagent
 Tetramethyltin, Reagent
 Tetraphenylarsenic Chloride, Monohydrate, Reagent
 Tetraphenylsilane, Reagent
 Tetraphenylsodium Borate, Analyzed Reagent
 Tetraphenyltin, Reagent
 Thallium Ethoxide, Reagent
 Thallous Acetate, Anhydrous, Reagent
 Thallous Formate, Anhydrous, Reagent
 Tin Chloride Acetylacetonate, Reagent
 Titanium Butoxide, Reagent
 Titanium Propoxide, Reagent
 Triethylaluminum, Reagent
 Triethylboron, Reagent
 Triethylaluminum Trichloride, Reagent
 Triisobutylaluminum, Reagent
 Trimethylaluminum, Reagent

DOD-STD-1446

Trimethylarsenic, Reagent
Trimethyldialuminum Trichloride, Reagent
Triphenylantimony Dichloride, Reagent
Triphenyltin Chloride, Reagent
Uranyl Acetate, Dihydrate, Analyzed Reagent
Zinc Acetate, Dihydrate, Analyzed Reagent

6.3 Abbreviations. The use of abbreviations in this military standard are in accordance with MIL-STD-12 where applicable. Metric system abbreviations and symbols are in accordance with ASTM E 380.

DOD-STD-1446

INDEX

	PARAGRAPH	PAGE
ALUMINUM BUTOXIDE (TERT-), REAGENT	5.1.3	11
ALUMINUM BUTOXIDE (TERT-), REAGENT - CHEMICAL REQUIREMENT.	TAB. III.	12
ALUMINUM BUTOXIDE (TRI-SEC-), REAGENT.	5.1.4	12
ALUMINUM BUTOXIDE (TRI-SEC-), REAGENT - CHEMICAL REQUIREMENTS	TAB. IV.	13
ALUMINUM ETHOXIDE, REAGENT	5.1.1	10
ALUMINUM ETHOXIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. I.	10
ALUMINUM ISOPROPOXIDE, REAGENT	5.1.2	11
ALUMINUM ISOPROPOXIDE, REAGENT - CHEMICAL REQUIREMENTS	TAB. II.	11
AMMONIUM IRON (III) OXALATE, TRIHYDRATE, REAGENT	5.3.1	51
AMMONIUM IRON (III) OXALATE, TRIHYDRATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. XLVI.	51
AMMONIUM TITANYL OXALATE, MONOHYDRATE, REAGENT	5.3.2	52
AMMONIUM TITANYL OXALATE, MONOHYDRATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. XLVII.	52
APPLICATION	1.2	1
BARIUM ACETATE, ANHYDROUS, ANALYZED REAGENT	5.2.1	21
BARIUM ACETATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. XV.	21
CADMIUM ACETATE, DIHYDRATE, ANALYZED REAGENT	5.2.2	22
CADMIUM ACETATE, DIHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS.	TAB. XVI.	22
CALCIUM ACETATE, MONOHYDRATE, ANALYZED REAGENT	5.2.3	23
CALCIUM ACETATE, MONOHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (USP).	TAB. XVII.	23
CALCIUM CITRATE, TETRAHYDRATE, ANALYZED REAGENT	5.3.3	52
CALCIUM CITRATE, TETRAHYDRATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (NF).	TAB. XLVIII.	53
CALCIUM OXALATE, MONOHYDRATE, ANALYZED REAGENT	5.3.4	53
CALCIUM OXALATE, MONOHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS.	TAB. XLIX.	54
CERIUM (III) OXALATE, NONYLHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS.	TAB. L.	54
CERIUM (III) OXALATE, NONYLHYDRATE, REAGENT	5.3.5	54
CHANGES FROM PREVIOUS ISSUE	6.2	93
CHEMICAL HAZARDOUS EXPOSURE LIMITS	4.3.3	7
CHROMIUM (III) ACETYLACETONATE, REAGENT.	5.3.6	55
CHROMIUM (III) ACETYLACETONATE, REAGENT - PHYSICAL REQUIREMENTS.	TAB. LI.	55
CLASSIFICATION	1.3	1
CLEANUP OF LIQUID SPILLS	4.4.3.1	8
COBALT (II) ACETYLACETONATE, REAGENT	5.3.7	56
COBALT (II) ACETYLACETONATE, REAGENT - CHEMICAL REQUIREMENTS.	TAB. LII.	56
COBALTOUS ACETATE, TETRAHYDRATE, ANALYZED REAGENT	5.2.4	24
COBALTOUS ACETATE, TETRAHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (USP).	TAB. XVIII.	24
COPPER (II) ETHYLACETOACETATE, REAGENT	5.3.8	56
COPPER (II) ETHYLACETOACETATE, REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS.	TAB. LIII.	57

DOD-STD-1446

INDEX (Continued)

	PARAGRAPH	PAGE
COVERAGE	1.1	1
CUPRIC ACETATE, MONOHYDRATE, ANALYZED REAGENT	5.2.5	25
CUPRIC ACETATE, MONOHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. XIX.	25
CUPRIC OXALATE, 1/2 HYDRATE, ANALYZED REAGENT	5.3.10	57
CUPRIC OXALATE, 1/2 HYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS.	TAB. LIV.	58
DEFINITIONS	3	4
DETAILED REQUIREMENTS	5.	10
DIETHYLALUMINUM CHLORIDE, REAGENT	5.4.1	71
DIETHYLALUMINUM CHLORIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXII.	71
DIETHYL TIN DICHLORIDE, REAGENT	5.4.2	72
DIETHYL TIN DICHLORIDE, REAGENT - PHYSICAL REQUIREMENTS.	TAB. LXXIII.	72
DIISOBUTYLALUMINUM HYDRIDE, REAGENT	5.4.3	72
DIISOBUTYLALUMINUM HYDRIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXIV.	73
DIMETHYLBORON BROMIDE, REAGENT	5.4.4	73
DIMETHYLBORON BROMIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXV.	73
DIMETHYLCADMIUM, REAGENT	5.4.5	74
DIMETHYLCADMIUM, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXVI.	74
DIPHENYL TIN DICHLORIDE, REAGENT	5.4.6	75
DIPHENYL TIN DICHLORIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXVII.	75
DISCLAIMER	4.4.4	9
DISPOSAL AND STORAGE OF HAZARDOUS WASTES	4.4.3	8
DISPOSAL OF EXCESS OR UNSERVICEABLE MATERIAL	4.4.2	7
EPA ACUTE HAZARDOUS TOXICITY (H)	4.3.4.2	7
EPA TOXIC (T)	4.3.4.1	7
EXERCISES	4.3.1.5	6
FACE AND EYE PROTECTION	4.3.1.3	5
FERRIC ACETYLACETONATE, REAGENT	5.3.11	58
FERRIC ACETYLACETONATE, REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS.	TAB. LV.	59
FERRIC AMMONIUM CITRATE, ANALYZED REAGENT	5.3.12	58
FERRIC AMMONIUM CITRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (USP).	TAB. LVI.	59
FERRIC CITRATE, PENTAHYDRATE, ANALYZED REAGENT	5.3.13	59
FERRIC CITRATE, PENTAHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (USP).	TAB. LVII.	60
FERROUS OXALATE, DIHYDRATE, REAGENT	5.3.14	60
FERROUS OXALATE, DIHYDRATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LVIII.	61
FLAMMABLE, COMBUSTIBLE, PYROPHORIC AND IGNITABLE MATERIALS	4.3.2.1	6
GENERAL REQUIREMENTS	4	5
GOVERNMENT DOCUMENTS	2.1	2
HAZARDOUS MATERIALS INFORMATION	4.2	5
HAZARDOUS TOXIC CONSTITUENTS	4.3.4.3	7
INCOMPATIBLE MATERIALS	4.3.2.3	6
LEAD ACETATE, TRIHYDRATE, ANALYZED REAGENT	5.2.6	25
LEAD ACETATE, TRIHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. XX.	26
LEAD CITRATE, TRIHYDRATE, REAGENT	5.3.15	61

DOD- STD-1446

INDEX (Continued)

	PARAGRAPH	PAGE
LEAD CITRATE, TRIHYDRATE, REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS.	TAB. LIX.	62
LEAD SUBACETATE, ANHYDROUS, ANALYZED REAGENT	5.2.7	26
LEAD SUBACETATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. XXI.	27
LITHIUM BUTOXIDE (TERT-), REAGENT	5.1.7	14
LITHIUM BUTOXIDE (TERT-), REAGENT - CHEMICAL REQUIREMENT	TAB. VII.	15
LITHIUM METHOXIDE, REAGENT	5.1.5	13
LITHIUM METHOXIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. V.	13
LITHIUM OXALATE, ANALYZED REAGENT	5.3.16	61
LITHIUM OXALATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (NF).	TAB. LX.	62
LITHIUM PHENOXIDE, REAGENT	5.1.6	14
LITHIUM PHENOXIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. VI.	14
MAGNESIUM ACETATE, TETRAHYDRATE, ANALYZED REAGENT	5.2.8	27
MAGNESIUM ACETATE, TETRAHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. XXII.	28
MAGNESIUM ACETYLACETONATE, DIHYDRATE, REAGENT	5.3.17	62
MAGNESIUM ACETYLACETONATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXI.	63
MANGANOUS ACETATE, TETRAHYDRATE, ANALYZED REAGENT	5.2.9	28
MANGANOUS ACETATE, TETRAHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS.	TAB. XXIII.	29
MERCURIC ACETATE, ANHYDROUS, ANALYZED REAGENT	5.2.10	29
MERCURIC ACETATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. XXIV.	30
METAL ALKOXIDES	5.1	10
METAL CARBOXYLATE	5.2	21
METAL CHELATES	5.3	51
METHYLMERCURIC CHLORIDE, REAGENT	5.4.7	75
METHYLMERCURIC CHLORIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXVIII.	76
METHYLMERCURIC IODIDE, REAGENT	5.4.8	76
METHYLMERCURIC IODIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXIX.	77
MOLYBDENUM OXIDE ACETYLACETONATE, REAGENT	5.3.18	63
MOLYBDENUM OXIDE ACETYLACETONATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXII.	64
NICKEL ACETATE, TETRAHYDRATE, ANALYZED REAGENT	5.2.11	30
NICKEL ACETATE, TETRAHYDRATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS.	TAB. XXV.	30
NICKEL ACETYLACETONATE, MONOHYDRATE, REAGENT	5.3.19	64
NICKEL ACETYLACETONATE, MONOHYDRATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXIII.	65
NICKEL OXALATE, DIHYDRATE, REAGENT	5.3.20	64
NICKEL OXALATE, DIHYDRATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXIV.	65
NOTES	6.	91
ORDER OF PRECEDENCE	2.3	4
ORGANOMETALLIC COMPOUNDS	5.4	71
OTHER GOVERNMENT DOCUMENTS, DRAWINGS, AND PUBLICATIONS	2.1.2	2
OTHER PUBLICATIONS	2.2	3
PACKAGING DATA AND LABELING	4.1	5
PALLADIUM ACETYLACETONATE, REAGENT	5.3.21	65

DOD-STD-1446

INDEX (Continued)

	PARAGRAPH	PAGE
PALLADIUM ACETYLACETONATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXV.	66
PERSONAL PROTECTIVE MEASURES	4.3.1	5
PHENYLMERCURY CHLORIDE, REAGENT	5.4.9	77
PHENYLMERCURY CHLORIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXX.	77
POLLUTION AND DISPOSAL	4.4	7
POLLUTION POTENTIAL	4.4.1	7
POTASSIUM ACETATE, ANHYDROUS, ANALYZED REAGENT	5.2.12	31
POTASSIUM ACETATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (ACS).	TAB. XXVI.	32
POTASSIUM BUTOXIDE (TERT-), REAGENT	5.1.9	16
POTASSIUM BUTOXIDE (TERT-), REAGENT - CHEMICAL REQUIREMENT	TAB. IX.	16
POTASSIUM CITRATE, MONOHYDRATE, ANALYZED REAGENT	5.2.13	32
POTASSIUM CITRATE, MONOHYDRATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS.	TAB. XXVII.	32
POTASSIUM ETHOXIDE, REAGENT	5.1.8	15
POTASSIUM ETHOXIDE, REAGENT - CHEMICAL REQUIREMENT	TAB. VIII.	15
POTASSIUM HYDROGEN PHTHALATE, ANHYDROUS, ACIDIMETRIC	5.2.14	33
POTASSIUM HYDROGEN PHTHALATE, ANHYDROUS, ANALYZED REAGENT (ACIDIMETRIC STANDARD) - CHEMICAL AND PHYSICAL REQUIRE- MENTS (ACS).	TAB. XXVIII.	34
POTASSIUM HYDROGEN TARTRATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL REQUIREMENTS.	TAB. XXIX.	35
POTASSIUM HYDROGEN TARTRATE, ANHYDROUS, ANALYZED REAGENT	5.2.15	34
POTASSIUM OXALATE, MONOHYDRATE, ANALYZED REAGENT	5.2.16	35
POTASSIUM OXALATE, MONOHYDRATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (ACS).	TAB. XXX.	36
POTASSIUM SODIUM TARTRATE, TETRAHYDRATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (ACS).	TAB. XXXI.	37
POTASSIUM SODIUM TARTRATE, TETRAHYDRATE, ANALYZED REAGENT	5.2.17	36
POTASSIUM TARTRATE, 1/2 HYDRATE, ANALYZED REAGENT	5.2.18	37
POTASSIUM TARTRATE, 1/2 HYDRATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS.	TAB. XXXII.	38
POTASSIUM TITANYL OXALATE, DIHYDRATE, REAGENT	5.3.22	66
POTASSIUM TITANYL OXALATE, DIHYDRATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXVI.	67
PRASEODYMIUM OXALATE, DECAHYDRATE, REAGENT	5.3.23	66
PRASEODYMIUM OXALATE, DECAHYDRATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXVII.	67
REFERENCED DOCUMENTS	2	2
RESPIRATORY PROTECTION	4.3.1.1	5
SAFETY	4.3	5
SAMARIUM OXALATE, DECAHYDRATE, REAGENT	5.3.24	67
SAMARIUM OXALATE, DECAHYDRATE, REAGENT - CHEMICAL REQUIRE- MENT.	TAB. LXVIII.	68
SCANDIUM OXALATE, PENTAHYDRATE, REAGENT	5.3.25	68
SCANDIUM OXALATE, PENTAHYDRATE REAGENT - CHEMICAL REQUIRE- MENT.	TAB. LXIX.	69
SCOPE	1	1
SILVER ACETATE, ANHYDROUS, ANALYZED REAGENT	5.2.19	38

DOD-STD-1446

INDEX (Continued)

	PARAGRAPH	PAGE
SILVER ACETATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL REQUIREMENTS.	TAB. XXXIII.	38
SKIN PROTECTION	4.3.1.2	5
SODIUM ACETATE, ANHYDROUS, ANALYZED REAGENT	5.2.20	39
SODIUM ACETATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (ACS).	TAB. XXXIV.	39
SODIUM ACETATE, TRIHYDRATE, ANALYZED REAGENT	5.2.21	40
SODIUM ACETATE, TRIHYDRATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (ACS).	TAB. XXXV.	40
SODIUM BITARTRATE, MONOHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (USP).	TAB. XXXVI.	41
SODIUM BITARTRATE, MONOHYDRATE, ANALYZED REAGENT	5.2.22	41
SODIUM BUTOXIDE (TERT-), REAGENT	5.1.11	17
SODIUM BUTOXIDE (TERT-), REAGENT - CHEMICAL REQUIREMENT.	TAB. XI.	17
SODIUM ETHOXIDE, REAGENT	5.1.10	16
SODIUM ETHOXIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. X.	17
SODIUM FORMATE, ANHYDROUS, ANALYZED REAGENT	5.2.23	42
SODIUM FORMATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. XXXVII.	42
SODIUM OXALATE, ANHYDROUS, ANALYZED REAGENT	5.2.24	43
SODIUM OXALATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (ACS).	TAB. XXXVIII.	43
SODIUM SALICYLATE, ANHYDROUS, ANALYZED REAGENT	5.2.25	44
SODIUM SALICYLATE, ANHYDROUS, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (USP).	TAB. XXXIX.	44
SODIUM TARTRATE, DIHYDRATE, ANALYZED REAGENT	5.2.26	44
SODIUM TARTRATE, DIHYDRATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (ACS).	TAB. XL.	45
SPECIFICATIONS, STANDARDS, AND HANDBOOKS	2.1.1	2
STORAGE CONDITIONS	4.3.2	6
STRONTIUM ACETATE, 1/2 HYDRATE, ANALYZED REAGENT	5.2.27	45
STRONTIUM ACETATE, 1/2 HYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (NF).	TAB. XLI.	46
SUBJECT TERM (KEY WORD) LISTING	6.1	91
TERBIUM OXALATE, DECAHYDRATE, REAGENT	5.3.26	68
TERBIUM OXALATE, DECAHYDRATE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXX.	69
TETRAETHYL TIN, REAGENT	5.4.10	77
TETRAETHYL TIN, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXXI.	78
TETRAMETHYLSILANE, ANALYZED REAGENT	5.4.11	78
TETRAMETHYLSILANE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. LXXXII.	79
TETRAMETHYL TIN, REAGENT	5.4.12	79
TETRAMETHYL TIN, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXXIII.	80
TETRAPHENYLARSENIC CHLORIDE, MONOHYDRATE, REAGENT - PHYSICAL REQUIREMENT.	TAB. LXXXIV.	80
TETRAPHENYLARSENIC CHLORIDE, MONOHYDRATE, REAGENT	5.4.13	80
TETRAPHENYLSILANE, REAGENT	5.4.14	81
TETRAPHENYLSILANE, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXXV.	81
TETRAPHENYLSODIUM BORATE, ANALYZED REAGENT	5.4.15	81

DOD-STD-1446

INDEX (Continued)

	PARAGRAPH	PAGE
TETRAPHENYLSODIUM BORATE, ANALYZED REAGENT - CHEMICAL AND PHYSICAL REQUIREMENTS (ACS).	TAB. LXXXVI.	82
TETRAPHENYLTIN, REAGENT	5.4.16	82
TETRAPHENYLTIN, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXXVII.	83
THALLIUM ETHOXIDE, REAGENT	5.1.12	18
THALLIUM ETHOXIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. XII.	18
THALLOUS ACETATE, ANHYDROUS, REAGENT	5.2.28	46
THALLOUS ACETATE, ANHYDROUS, REAGENT - PHYSICAL REQUIREMENT.	TAB. XLII.	47
THALLOUS FORMATE, ANHYDROUS, REAGENT	5.2.29	47
THALLOUS FORMATE, ANHYDROUS, REAGENT - CHEMICAL REQUIREMENT.	TAB. XLIII.	47
TIN CHLORIDE ACETYLACETONATE, REAGENT	5.3.27	69
TIN CHLORIDE ACETYLACETONATE, REAGENT - CHEMICAL AND PHYSICAL REQUIREMENT.	TAB. LXXI.	70
TITANIUM BUTOXIDE, REAGENT	5.1.13	19
TITANIUM BUTOXIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. XIII.	29
TITANIUM PROPOXIDE, REAGENT	5.1.14	19
TITANIUM PROPOXIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. XIV.	20
TOXICITY	4.3.4	7
TRAINING	4.3.1.4	5
TRIETHYLALUMINUM, REAGENT	5.4.17	83
TRIETHYLALUMINUM, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXXVIII.	83
TRIETHYLBORON, REAGENT	5.4.18	84
TRIETHYLBORON, REAGENT - CHEMICAL REQUIREMENT.	TAB. LXXXIX.	84
TRIETHYLDIALUMINUM TRICHLORIDE, REAGENT	5.4.19	85
TRIETHYLDIALUMINUM TRICHLORIDE, REAGENT - CHEMICAL REQUIREMENTS.	TAB. XC.	85
TRIISOBUTYLALUMINUM, REAGENT	5.4.20	86
TRIISOBUTYLALUMINUM, REAGENT - CHEMICAL REQUIREMENT.	TAB. XCI.	86
TRIMETHYLALUMINUM, REAGENT	5.4.21	87
TRIMETHYLALUMINUM, REAGENT - CHEMICAL REQUIREMENT.	TAB. XCII.	87
TRIMETHYLARSENIC, REAGENT	5.4.22	87
TRIMETHYLARSENIC, REAGENT - CHEMICAL REQUIREMENT.	TAB. XCIII.	88
TRIMETHYLDIALUMINUM TRICHLORIDE, REAGENT	5.4.23	88
TRIMETHYLDIALUMINUM TRICHLORIDE, REAGENT - PHYSICAL REQUIREMENTS.	TAB. XCIV.	89
TRIPHENYLANTIMONY DICHLORIDE, REAGENT	5.4.24	89
TRIPHENYLANTIMONY DICHLORIDE, REAGENT - CHEMICAL REQUIREMENT.	TAB. XCV.	89
TRIPHENYLTIN CHLORIDE, REAGENT	5.4.25	90
TRIPHENYLTIN CHLORIDE, REAGENT - PHYSICAL REQUIREMENT.	TAB. XCVI.	90
ULTIMATE DISPOSAL	4.4.3.2	9
URANYL ACETATE, DIHYDRATE, ANALYZED REAGENT	5.2.30	48
URANYL ACETATE, DIHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (ACS).	TAB. XLIV.	48
WATER-SENSITIVE FIRE AND EXPLOSIVE HAZARDOUS MATERIALS	4.3.2.2	6
ZINC ACETATE, DIHYDRATE, ANALYZED REAGENT	5.2.31	49
ZINC ACETATE, DIHYDRATE, ANALYZED REAGENT - CHEMICAL REQUIREMENTS (NF).	TAB. XLV.	49

DOD-STD-1446

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