

METRIC

MIL-STD-1447
24 AUGUST 1988

MILITARY STANDARD
ETHERS AND ORGANIC PEROXIDES, TECHNICAL GRADE (METRIC)



AMSC N/A

FSC 6810

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

MIL-STD-1447

FOREWORD

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

MIL-STD-1447

CONTENTS

<u>Paragraph</u>		<u>Page</u>
1.	SCOPE	1
1.1	Scope	1
1.2	Application	1
2.	APPLICABLE DOCUMENTS	2
2.1	Government documents	2
2.1.1	Specification , standards, and handbooks	2
2.1.2	Other Government documents, drawings, and publications . .	2
2.2	Non-Government publications	3
2.3	Order of precedence	3
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	6
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	7
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	EPA Extraction Procedure Toxicity (EP Toxicity) (E). . . .	7
4.3.4.4	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	8
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	Ethers	10
5.1.1	Diethylene glycol dibutyl ether	10
5.1.2	Diethylene glycol monobutyl ether	11
5.1.3	Diethylene glycol monoethyl ether	12
5.1.4	Diethylene glycol monomethyl ether	13
5.1.5	Diethyl ether	14
5.1.6	1,4-Dioxane	16
5.1.7	Ethylene glycol monobutyl ether	17
5.1.8	Ethylene glycol monoethyl ether	19

MIL-STD-1447

CONTENTS (Continued)

<u>Paragraph</u>		<u>Page</u>
5.1.9	Ethylene glycol monomethyl ether	21
5.1.10	Tetraethylene glycol dimethyl ether	22
5.2	Organic Peroxides	24
5.2.1	Diacyl peroxides	25
5.2.1.1	Acetyl peroxide	25
5.2.1.2	Benzoyl peroxide	26
5.2.1.3	Diisonononyl peroxide	27
5.2.1.4	Lauroyl peroxide	28
5.2.1.5	Succinic acid peroxide	29
5.2.2.	Ketone peroxides	30
5.2.2.1	Acetyl acetone peroxide	30
5.2.2.2	Methyl ethyl ketone peroxide	31
5.2.3.	Peroxydicarbonates	32
5.2.3.1	Di-sec-butyl peroxydicarbonate	32
5.2.3.2	Di(2-ethylhexyl)peroxydicarbonate	33
5.2.3.3	Di-n-propyl peroxydicarbonate	35
5.2.4.	Peroxyesters	36
5.2.4.1	tert-Amyl peroxybenzoate	36
5.2.4.2	tert-Amyl peroxy-2-ethylhexanoate	37
5.2.4.3	tert-Butyl peroxyacetate	38
5.2.4.4	tert-Butyl peroxybenzoate	39
5.2.4.5	tert-Butyl peroxy 2-ethylhexanoate	40
5.2.4.6	tert-Butyl peroxyisobutyrate	41
5.2.4.7	tert-Butyl peroxyneodecanoate	42
5.2.4.8	tert-Butyl peroxyneodecanoate	43
5.2.4.9	tert-Butyl peroxyneodecanoate	44
5.2.4.10	2,5-Dimethyl-2,5-di(benzoylperoxy)hexane	45
5.2.4.11	2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane	46
5.2.5.	Dialkyl peroxides	47
5.2.5.1	1,1-Bis(tert-butylperoxy)diisopropylbenzene	47
5.2.5.2	tert-Butyl cumyl peroxide	48
5.2.5.3	Di(tert-butyl) peroxide	49
5.2.5.4	Dicumyl peroxide	50
5.2.5.5	2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane	51
5.2.5.6	2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3	52
5.2.6.	Hydroperoxides	53
5.2.6.1	tert-Amyl hydroperoxide	53
5.2.6.2	tert-Butyl hydroperoxide	54
5.2.6.3	Cumene hydroperoxide	55
5.2.7.	Peroxyketals	56
5.2.7.1	1,1-Di(tert-amylperoxy)cyclohexane	56
5.2.7.2	1,1-Di(tert-butylperoxy)cyclohexane	57
5.2.7.3	Ethyl-3,3-di(tert-butylperoxy)butyrate	58
6.	NOTES	60
6.1	Intended use	60
6.2	Issue of DODISS	60
6.3	Subject term (key word) listing	60
6.4	Abbreviations	62
	INDEX	63

MIL-STD-1447

TABLES

	<u>Page</u>
I. Diethylene glycol dibutyl ether - physical properties and characteristics	10
II. Diethylene glycol dibutyl ether - military specification physical and chemical requirements.	11
III. Diethylene glycol monobutyl ether - physical properties and characteristics	11
IV. Diethylene glycol monoethyl ether - physical properties and characteristics	13
V. Diethylene glycol monomethyl ether - physical properties and characteristics	14
VI. Diethyl ether - physical properties and characteristics	15
VII. Diethyl ether - military specification physical and chemical requirements	15
VIII. 1,4-Dioxane - physical properties and characteristics	16
IX. Ethylene glycol monobutyl ether - physical properties and characteristics	17
X. Ethylene glycol monobutyl ether - federal specification physical and chemical requirements.	18
XI. 2-Butoxyethanol - ASTM specification requirements	18
XII. Ethylene glycol monoethyl ether - physical properties and characteristics.	19
XIII. Ethylene glycol monoethyl ether - federal specification physical and chemical requirements.	19
XIV. 2-Ethoxyethanol - ASTM specification requirements	20
XV. Ethylene glycol monomethyl ether - physical properties and characteristics	21
XVI. Ethylene glycol monomethyl ether - federal specification physical and chemical requirements.	21
XVII. 2-Methoxyethanol - ASTM specification requirements.	22
XVIII. Tetraethylene glycol dimethyl ether - physical properties and characteristics	23
XIX. Tetraethylene glycol dimethyl ether - manufacturer's requirements.	23
XX. Acetyl Peroxide Solution in dimethyl phthalate - chemical and physical requirements and typical properties.	25
XXI. Benzoyl Peroxide - chemical and physical requirements and typical properties.	26
XXII. Diisononanoyl Peroxide (75% solution in mineral spirits) - chemical and physical requirements and typical properties.	27
XXIII. Diisononanoyl Peroxide (75% solution) - typical properties.	27
XXIV. Lauroyl Peroxide - chemical and physical requirements and typical properties	28
XXV. Succinic Acid Peroxide (water mixture) - chemical and physical requirements and typical properties	29
XXVI. Acetyl Acetone Peroxide (2,4-pentanedione peroxide solution) - typical physical properties.	30
XXVII. Methyl Ethyl Ketone Peroxide (60 percent solution in dimethyl phthalate) - chemical and physical requirements.	31
XXVIII. Methyl Ethyl Ketone Peroxide (47 to 49 percent solutions in dimethyl phthalate)	32

MIL-STD-1447

TABLES (Continued)

	<u>Page</u>
XXIX. Di-sec-Butyl Peroxydicarbonate - commercial chemical and physical requirements.	33
XXX. Di(2-ethylhexyl)peroxydicarbonate - commercial chemical and physical requirements.	34
XXXI. Di-n-Propyl Peroxydicarbonate - commercial chemical and physical requirements.	35
XXXII. tert-Amyl Peroxybenzoate - chemical requirements and typical properties	36
XXXIII. tert-Amyl Peroxy-2-ethylhexanoate - chemical requirements and typical properties	37
XXXIV. tert-Butyl Peroxyacetate (50 percent solution in odorless mineral spirits) - chemical requirements and typical properties	38
XXXV. tert-Butyl Peroxybenzoate - chemical requirements and typical properties	39
XXXVI. tert-Butyl Peroxy-2-ethylhexanoate - chemical requirements and typical properties	40
XXXVII. tert-Butyl Peroxyisobutyrate Solution (75 percent in odorless mineral spirits) - chemical requirements and typical properties	41
XXXVIII. tert-Butyl Peroxymaleic Acid - chemical requirements and typical properties	42
XXXIX. tert-Butyl Peroxyneodecanoate - chemical requirements and typical properties	43
XL. tert-Butyl Peroxypivalate (75 percent solution in odorless mineral spirits) - chemical and physical requirements and typical properties	44
XLI. 2,5-Dimethyl-2,5-di(benzoylperoxy)hexane - chemical requirements and typical properties.	45
XLII. 2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane - chemical requirements and typical properties.	46
XLIII. ,'-Bis (tert-butylperoxy)difisopropylbenzene - chemical requirements and typical properties.	47
XLIV. tert-Butyl Cumyl Peroxide - chemical requirements and typical properties	48
XLV. Di(tert-butyl) Peroxide - chemical requirements and typical properties	49
XLVI. Dicumyl Peroxide - chemical requirements and typical properties	50
XLVII. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane - chemical requirements and typical properties.	51
XLVIII. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 - chemical requirements and typical properties.	52
XLIX. tert-Amyl Hydroperoxide - chemical requirements and typical properties	54
L. tert-Butyl Hydroperoxide - chemical requirements and typical properties	55
LI. Cumene Hydroperoxide - chemical requirements and typical properties	56

MIL-STD-1447

1. SCOPE

1.1 Scope. 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 ethers and organic peroxides, technical grade. 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 ethers and organic peroxides, technical grade, for application by the Department of Defense.

1.2 Application. Ethers, technical grade, have military uses as ingredients in solid propellants, and as solvents in the manufacture of smokeless powder. Commercial applications include use as solvents for resins in protective coating formulations and in printing inks. They are also used in textile dyeing formulations, in hydraulic fluids, in cleaning fluids, in liquid-liquid solvent extractions, in decontaminating agents, in fuel deicing additives, and in gas purification.

Organic peroxides, technical grade, have military uses in explosive formulations, and as hardening agents for plastics. Commercial applications include use as polymerization initiators, as crosslinking agents for elastomers, as curing agents for polyester and vinyl resins, and also as bleaching agents.

MIL-STD-1447

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

- | | |
|------------|---|
| O-E-780 | - Ethylene Glycol Monomethyl Ether, Technical |
| TT-E-776 | - Ethylene Glycol Monobutyl Ether (For Use in Organic Coatings) |
| TT-E-781 | - Ethylene Glycol Monoethyl Ether, Technical |
| PPP-C-2020 | - Chemicals, Liquid, Dry and Paste, Packaging of |

MILITARY

- | | |
|-------------|--|
| MIL-E-199 | - Ether, Diethyl, Technical |
| MIL-P-81351 | - Peroxide, Methyl Ethyl Ketone |
| DOD-D-82659 | - Diethylene Glycol Dibutyl Ether, Technical |
| MIL-P-87938 | - Peroxide, Methyl Ethyl Ketone, Technical |

STANDARDS

FEDERAL

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

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

CODE OF FEDERAL REGULATIONS (CFR)

- | | |
|--------------|--|
| Title 29 | - Department Of Labor, Occupational Safety And Health |
| Chapter XVII | Administration |
| Title 40 | - Protection of the Environment; Environmental Protection Agency |
| Title 49 | - Department Of Transportation; Hazardous Materials Regulations |

MIL-STD-1447

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
(DLAM 1000.2) Protection Program
- TB MED 506 - Occupational And Environmental Health Occupational Vision
- TM 38-250 - Packaging, Materials Handling - Preparation Of Hazardous Materials For Military Air Shipment

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 connect on with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

TLVs® Threshold Limit Values and Biological Exposure Indices Adopted by American Conference of Governmental Industrial Hygienists (ACGIH).

(Application for copies should be addressed to American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Bldg D-7, Cincinnati, OH 45211-4438.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM D 330 - Standard Specification for 2-Butoxyethanol
- ASTM D 331 - Standard Specification for 2-Ethoxyethanol
- ASTM D 3128 - Standard Specification for 2-Methoxyethanol

(Application for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103.)

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

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

MIL-STD-1447

(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.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

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

3. DEFINITIONS

3.1 Half-life (peroxide) - The time it takes for one-half of the original quantity of peroxide present to thermally decompose. The time is independent of the quantity of peroxide present, and is primarily dependent on temperature.

3.2 Oxidizing agent - A substance that gains electrons as a result of an oxidation-reduction reaction. It causes an increase in the oxidation state of another substance.

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

3.4 Reducing agent - A substance that loses electrons during an oxidation-reduction reaction. It causes a decrease in the oxidation state of another substance.

MIL-STD-1447

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 procurement documents. 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, nonroutine exposure (i.e., not exceeding 1 hour/day for 1 day/week), when the installation medical authority determines that there are no feasible engineering or work practice controls, during interim periods when engineering controls are being designed and/or installed, during emergencies, or for supplementing other control measures (refer to TB MED 502 or DLAM 1000.2). Ventilation containment, process controls, or other feasible engineering controls shall be adequate to remove hazardous concentrations. Respiratory protection shall not be used in place of feasible engineering controls.

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.)

MIL-STD-1447

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 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 100°F (37.8°C). A combustible liquid is defined, by DOT in the above reference, as one having a closed cup flash point at or above 100°F and below 200°F (93.3°C). A pyrophoric liquid is defined, by DOT in the above reference, as one that ignites spontaneously in dry or moist air at or below 130°F (54.5°C). Materials with flash points of 200°F 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 140°F (60°C) 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.

*Refers only to materials that have become waste materials.

MIL-STD-1447

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.

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 and Biological Exposure Indices, adopted by the American Conference of Governmental Industrial Hygienists (ACGIH); current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL), 29 CFR, Part 1910, Subpart Z; 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). The more stringent standard shall apply when there is a conflict between standards.

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.

*Refers only to materials that have become waste materials.

MIL-STD-1447

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

4.4.3 Disposal and storage of hazardous wastes. Items are classified and managed as hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA) (Public Law 94-580). Items have been identified as meeting the characteristics (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 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

MIL-STD-1447

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 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.

MIL-STD-1447

5. DETAILED REQUIREMENTS

5.1 Ethers. Ethers are compounds of the general formula R-O-R, Ar-O-R, Ar-O-Ar, where R is an aliphatic group and Ar is an aryl group. On standing in contact with air, most aliphatic ethers are converted slowly into unstable peroxides. Ethers are comparatively unreactive compounds. Ethers can undergo cleavage by concentrated acid at high temperatures. Cyclic ethers are similar in reaction properties to open aliphatic ethers. The glycol ethers are generally produced by reacting alcohols with ethylene oxide. The monoethers of the glycols have both an ether linkage (C-O-C) and an alcohol group (C-OH) in the same molecule. The monoethers of the glycols can be converted to monoether glycol esters. The dialkyl ethers of the glycols are stable chemically inert materials, but oxidize slowly to form peroxides on exposure to air. The symmetrical glycol diethers are referred to as glymes. They function as aprotic solvents and are very stable under basic condition, but are subject to cleavage by strong acids.

5.1.1 Name. Diethylene Glycol Dibutyl Ether

$\text{CH}_3(\text{CH}_2)_3\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{O}(\text{CH}_2)_3\text{CH}_3$ FW 218.34

Bis(2-butoxyethyl) ether
Butyl diglyme
Dibutoxyethylene glycol

5.1.1.1 Technical description. Diethylene glycol dibutyl ether (pure) is a colorless liquid with the physical properties and characteristics shown in Table I. It is very slightly soluble in water. It is soluble in ethyl alcohol, ethyl ether, acetone, benzene, and hydrocarbons.

TABLE I. Diethylene Glycol Dibutyl Ether - physical properties and characteristics.

Density (20°C), g/cm ³	0.8799
Refractive index (20°C)	1.4235
Viscosity (20°C), centipoise (mPa·s)	2.4
Freezing point, °C	-60.2
Boiling point (760 mm Hg), °C	256
Vapor pressure (20°C), mm Hg	<0.01
Flash point (closed cup), °F (°C)	245 (118)
Vapor density (air = 1)	7.54
Solubility in water, %	0.3

5.1.1.2 Specification. Military, DOD-D-82659, Diethylene Glycol Dibutyl Ether, Technical.

This specification covers a technical grade of diethylene glycol dibutyl ether with the physical and chemical properties conforming to the requirements shown in Table II. The product shall be in amber liquid form; free from contaminants and foreign material.

MIL-STD-1447

TABLE II. Diethylene Glycol Dibutyl Ether - military specification physical and chemical requirements.

Assay, vol %, min	95.0
Water content, wt %, max	0.30
pH, min	6.0
max	7.5
Color (Pt-Co Scale), No. max	4
Specific gravity (25°/25°C), min	0.960
max	0.980

5.1.1.3 Use. Diethylene glycol dibutyl ether is intended for military use as an ingredient in a solid propellant for an impulse cartridge and for other cartridge devices. Commercial applications include use in the purification of products, such as phosphoric acid, metal bromides, trivalent gold, and uranyl nitrate, by liquid-liquid extraction.

5.1.1.4 Safety. Diethylene glycol dibutyl ether is a burnable liquid. It can emit irritating and toxic fumes if heated to vaporization and decomposition. It can form peroxides in the presence of oxygen. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

5.1.1.5 Storage. Diethylene glycol dibutyl ether shall be stored in approved containers in a cool dry place, away from oxidizing agents. Nitrogen blanketing, under a slight positive pressure, can be used for bulk storage to prevent access by air.

5.1.1.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

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

5.1.2 Name. Diethylene Glycol Monobutyl Ether
 $\text{CH}_3(\text{CH}_2)_3\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH}$ FW 162.23
 Butoxydiethylene glycol
 2-(2-Butoxyethoxy) ethanol

5.1.2.1 Technical description. Diethylene glycol monobutyl ether (pure) is a colorless liquid with the physical properties and characteristics shown in Table III. It is miscible with water, acetone, ethyl alcohol, ethyl ether, benzene, and heptane. It can be esterified to a monoether glycol ester.

TABLE III. Diethylene Glycol Monobutyl Ether - physical properties and characteristics.

Density (20°C), g/cm ³	0.9553
Refractive index (20°C)	1.4321
Viscosity (20°C), centipoise (mPa·s)	6.5
Freezing point, °C	-68.1

MIL-STD-1447

TABLE III. Diethylene Glycol Monobutyl Ether - physical properties and characteristics (Continued).

Boiling point (760 mm Hg), °C	231
Vapor pressure (20°C), mm Hg	< 0.01
Flash point (closed cup), °F (°C)	214 (101)
Autoignition temperature, °F (°C)	400 (204)
Explosive limits, % by vol	
Lower	0.85
Upper	24.6
Vapor density (air = 1)	5.63

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

Diethylene glycol monobutyl ether is available from several chemical manufacturers. It is available from one chemical manufacturer with a typical boiling range of 230°C minimum and 235°C maximum. It is available from a second chemical manufacturer with a distillation range between 227° and 234°C.

5.1.2.3 Use. Diethylene glycol monobutyl ether is intended for use primarily a high boiling point solvent in baking enamels, lacquers, printing inks, and textile-dyeing formulations. Other applications include use in formulating hydraulic brake fluids, cleaners, cutting oils, waterborne coatings, detergents and soaps. It is also used as a chemical intermediate to produce a herbicide and an insecticide.

5.1.2.4 Safety. Diethylene glycol monobutyl ether is a burnable liquid. It can emit irritating and toxic fumes if heated to vaporization and decomposition. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

5.1.2.5 Storage. Diethylene glycol monobutyl ether shall be stored in approved containers in a cool dry place, away from oxidizing agents.

5.1.2.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent and place in containers for disposal. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

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

5.1.3 Name. Diethylene Glycol Monoethyl Ether
 $C_2H_5OCH_2CH_2OCH_2CH_2OH$ FW 134.18
 Ethoxydiethylene glycol
 2-(2-Ethoxyethoxy) ethanol

5.1.3.1 Technical description. Diethylene glycol monoethyl ether (pure) is a colorless liquid with the physical properties and characteristics shown in Table IV. It is miscible with water, ethyl alcohol, ethyl ether, acetone, and benzene. It can be esterified to a monoether glycol ester.

MIL-STD-1447

TABLE IV. Diethylene Glycol Monoethyl Ether - physical properties and characteristics.

Density (20°C), g/cm ³	0.9881
Refractive index (20°C)	1.4300
Freezing point, °C	-90
Boiling point (760 mm Hg), °C	195
Vapor pressure (20°C), mm Hg	0.1
Flash point (closed cup), °F (°C)	195 (91)
Autoignition temperature, °F (°C)	400 (204)
Explosive limits, % by vol	
Lower	2.1
Upper	23.5
Vapor density (air = 1)	4.62

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

Diethylene glycol monoethyl ether is available from several chemical manufacturers. It is available from one manufacturer with a boiling range of 198° to 204°C. It is available from a second manufacturer with a distillation range of 198° to 205°C.

5.1.3.3 Use. Diethylene glycol monoethyl ether is intended for use as a slow evaporating active solvent for cellulose acetate butyrate, nitrocellulose, epoxy resins, polyamide resins, and other coating materials. It is used as a coalescing aid in latex paints, as a major component in brake fluids, as a penetrating solvent in wood stains, and in printing inks.

5.1.3.4 Safety. Diethylene glycol monoethyl ether is a combustible liquid. It can emit irritating and toxic fumes if heated to vaporization and decomposition. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

5.1.3.5 Storage. Diethylene glycol monoethyl ether shall be stored in approved containers in a cool dry place, away from oxidizing agents.

5.1.3.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent, and place in containers for disposal. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

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

5.1.4 Name. Diethylene Glycol Monomethyl Ether
CH3OCH2CH2OCH2CH2OH FW 120.15
 Methoxydiethylene glycol
 2-(2-Methoxyethoxy) ethanol

5.1.4.1 Technical description. Diethylene glycol monomethyl ether (pure) is a colorless liquid with the physical properties and characteristics shown

MIL-STD-1447

slightly soluble in water. It is miscible with acetone, ethyl alcohol and benzene. It oxidizes slowly to form peroxides on contact with air. Absolute ether is diethyl ether that is free of traces of water and alcohol.

TABLE VI. Diethyl Ether - physical properties and characteristics.

Density (20°C), g/cm ³	0.71378
Refractive index (20°C)	1.3989
Freezing point, °C	-116.2
Boiling point (760 mm Hg), °C	34.51
Vapor pressure (17.9°C), mm Hg	400
Flash point (closed cup), °F (°C)	-49 (-45)
Autoignition temperature, °F (°C)	356 (180)
Explosive limits, % by vol	
Lower	1.85
Upper	48
Vapor density (air = 1)	2.55
Solubility in water, (20°C), g/100 g	7.5

5.1.5.2 Specification. Military, MIL-E-199, Ether, Diethyl, Technical.

This specification covers one grade of diethyl ether conforming to the physical and chemical requirements shown in Table VII. The diethyl ether shall be made from ethyl alcohol conforming to the requirements for grade 1 or 2 of MIL-A-463, or shall be made as a co-product in the manufacture of ethyl alcohol from ethylene.

TABLE VII. Diethyl Ether - military specification physical and chemical requirements.

Specific gravity (20°/20°C)	0.712 to 0.723
Nonvolatile residue, % by wt, max	0.002
Acidity, as acetic acid, %, max	0.006
Acetylene, %, max	0.001
Peroxides	None
Chlorides	None
Aldehydes ^{1/}	None
Color (Pt-Co Scale), No., max	20

^{1/} Not applicable when specified for use in the manufacture of smokeless powder.

5.1.5.3 Use. Diethyl ether is intended for military use in the manufacture of smokeless powder, in the cleaning of optical instruments, and where a high purity ether is required. Commercial applications include use as an industrial solvent and extractant, and as a denaturant for ethyl alcohol.

5.1.5.4 Safety. Diethyl ether is an extremely flammable and very volatile liquid that can readily form explosive vapor mixtures in air. It reacts with oxygen on exposure to air to form explosive peroxides. It is reactive with oxidizing agents. Diethyl ether is a central nervous system depressant and inhalation of vapor can cause drowsiness, stupor, and unconsciousness. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

MIL-STD-1447

5.1.5.5 Storage. Diethyl ether shall be stored in approved containers in a cool dry place, away from heat sources. Nitrogen blanketing, under a slight positive pressure, can be used for bulk storage to prevent access by air.

5.1.5.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent and place in containers for disposal. In case of large liquid spills, eliminate all ignition sources, and dike to prevent spreading. Water spray can be used to reduce the vapor ignition hazard. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Diethyl ether as an EPA Hazardous Waste Classification - Ignitable, Waste Number U117.

5.1.6 Name. 1,4-Dioxane CH₂CH₂-C-CH₂CH₂-C FW 88.12
 Diethylene dioxide
 Diethylene ether
 p-Dioxane

5.1.6.1 Technical description. 1,4-Dioxane (pure) is a colorless liquid with the physical properties and characteristics shown in Table VIII. It is miscible with water, ethyl alcohol, ethyl ether, acetone, and benzene. It is chemically stable, but can form peroxides on exposure to air.

TABLE VIII. 1,4-Dioxane - physical properties and characteristics.

Density (20°C), g/cm ³	1.0337
Refractive index (20°C)	1.4224
Viscosity (20°C), centipoise (mPa·s)	1.3
Freezing point, °C	-11.8
Boiling point (760 mm Hg), °C	101.3
Vapor pressure (20°C), mm Hg	17
Flash point (closed cup), °F (°C)	54 (12)
Autoignition temperature, °F (°C)	356 (180)
Explosive limits, % by vol	
Lower	2
Upper	22
Vapor density (air = 1)	3.1

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

1,4-Dioxane is available from three chemical manufacturer. It is available from one manufacturer with a boiling range of 99° to 104°C. It is available from a second manufacturer with a specified purity of 99.90 percent by weight minimum, and a typical purity of 99.97 percent by weight. It is available from a third manufacturer with a minimum purity of 99 mol percent.

5.1.6.3 Use. 1,4-Dioxane is intended for use as a solvent for cellulose and resins; as a solvent in paints and varnishes; and in paint and varnish removers; and as a solvent in dye baths.

MIL-STD-1447

5.1.6.4 Safety. 1,4-Dioxane is a flammable liquid. It reacts with oxygen on exposure to air to form explosive peroxides. The vapors are irritating to the eyes and respiratory tract. The liquid can be absorbed by the skin, and is irritating to the skin and eyes. Dioxane is listed as a suspected carcinogen by the International Agency for Research of Cancer (IARC). In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

5.1.6.5 Storage. 1,4-Dioxane shall be stored in approved containers in a cool dry place, away from oxidizing agents. Nitrogen blanketing, under a slight positive pressure, can be used for bulk storage to prevent access by air.

5.1.6.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent, and place in containers for disposal. In case of large liquid spills, eliminate all ignition sources, and dike to prevent spreading. Water spray can be used to reduce the vapor ignition hazard. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

1,4-Dioxane has an EPA Hazardous Waste Classification - Ignitable, Toxic, Waste Number U108.

5.1.7 Name. Ethylene Glycol Monobutyl Ether
2-Butoxyethanol $\text{CH}_3(\text{CH}_2)_3\text{OCH}_2\text{CH}_2\text{OH}$ FW 118.18

5.1.7.1 Technical description. Ethylene glycol monobutyl ether (pure) is a colorless liquid with the physical properties and characteristics shown in Table IX. It is miscible with water, acetone, ethyl alcohol, ethyl ether, benzene, and heptane. It can be esterified to a monoether glycol ester.

TABLE IX. Ethylene Glycol Monobutyl Ether - physical properties and characteristics.

Density (20°C), g/cm ³	0.9015
Refractive index (20°C)	1.4198
Viscosity (20°C), centipoise (mPa·s)	6.4
Freezing point, °C	-70.4
Boiling point (760 mm Hg), °C	171
Vapor pressure (20°C), mm Hg	0.6
Flash point (closed cup), °F (°C)	143 (62)
Autoignition temperature, °F (°C)	460 (238)
Explosive limits, % by vol	
Lower	1.1
Upper	12.7
Vapor density (air = 1)	4.1

5.1.7.2 Specifications.

(1) Federal, TT-E-776, Ethylene Glycol Monobutyl Ether (For Use in Organic Coatings).

This specification covers one type and one grade of ethylene glycol monobutyl ether with the physical and chemical properties conforming to

MIL-STD-1447

the requirements shown in Table X. The product shall be clear and free from sediment and suspended matter. It shall leave no residual odor after drying.

TABLE X. Ethylene Glycol Monobutyl Ether - federal specification physical and chemical requirements.

	Min	Max
Specific gravity (20°/20°C)	0.900	0.905
Nonvolatile matter, g/100 mL	---	0.005
Acidity, mg KOH/g	---	0.1
Sulfur (as H ₂ S and SO ₂)	---	None
Distillation:		
Initial boiling point (760 mm Hg), °C	165	---
Distillate below 167°C, % by vol	---	5
Dry point (760 mm Hg), °C	---	173
Distillate below 171°C, % by vol	95	---
Color (Pt-Co Scale), No.	---	15

(2) ASTM D 330, Standard Specification for 2-Butoxyethanol

This specification covers one grade of 2-Butoxyethanol with properties that conform to the requirements shown in Table XI.

TABLE XI. 2-Butoxyethanol - ASTM specification requirements.

Apparent specific gravity (20°/20°C)	0.901 to 0.904
Color (Pt-Co Scale), No., max	15
Distillation range	
Below 168°C	None
Above 173°C	None
Water, wt %, max	0.1
Acidity (free acid as acetic), wt %, max	0.01
equivalent to mg KOH/g, max	0.093

5.1.7.3 Use. Ethylene glycol monobutyl ether is intended for military use as a solvent in organic protective coatings, particularly cellulosic lacquers and lacquer thinners, and in quick drying varnishes and enamels. Commercial applications include use as an evaporation retarder solvent for alkyd, phenolic, maleic, epoxy and nitrocellulose resins in lacquers; and as a cosolvent in water-borne coatings, latexes, emulsions and dispersions. It is also used in formulating household and industrial cleaners to couple oil-soluble components with water.

5.1.7.4 Safety. Ethylene glycol monobutyl ether is a combustible liquid. It can emit irritating and toxic fumes if heated to vaporization and decomposition. High vapor concentrations are irritating to the respiratory tract. The liquid can be irritating to the skin and eyes. It can be absorbed through the skin, and can cause corneal injury to the eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

MIL-STD-1447

5.1.7.5 Storage. Ethylene glycol monobutyl ether shall be stored in approved containers in a cool dry place, away from oxidizing agents.

5.1.7.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent and place in containers for disposal. In case of large liquid spills, dike to prevent spreading. Water spray can be used to reduce the vapor ignition hazard. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

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

5.1.8 Name. Ethylene Glycol Monoethyl Ether $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH}$ FW 90.12
2-Ethoxyethanol (IUPAC)

5.1.8.1 Technical description. Ethylene glycol monoethyl ether (pure) is a colorless liquid with the physical properties and characteristics shown in Table XII. It is miscible with water, ethyl alcohol, ethyl ether, acetone, and benzene. It can be esterified to a monoether glycol ester.

TABLE XII. Ethylene Glycol Monoethyl Ether - physical properties and characteristics.

Density (20°C), g/cm ³	0.9297
Refractive index (20°C)	1.4080
Viscosity (20°C), centipoise (mPa·s)	2.5
Freezing point, °C	<-90 (sets to glass)
Boiling point (760 mm Hg), °C	135
Vapor pressure (20°C), mm Hg	4
Flash point (closed cup), °F (°C)	110 (43)
Autoignition temperature, °F (°C)	460 (238)
Explosive limits, % by vol	
Lower	1.7
Upper	15.6
Vapor density (air = 1)	3.10

5.1.8.2 Specifications.

(1) Federal, TT-E-781, Ethylene Glycol Monoethyl Ether, Technical.

This specification covers a technical grade of ethylene glycol monoethyl ether (EGMEE) that conforms to the physical and chemical characteristics shown in Table XIII. The EGMEE shall be clear, uniform, and free from foreign matter. It shall leave no stain or oily spots when tested as specified. The odor shall be mild and nonresidual.

TABLE XIII. Ethylene Glycol Monoethyl Ether - federal specification physical and chemical requirements.

Specific gravity (20°/20°C)	0.929 to 0.932
Color (Pt-Co Scale), No., max	15
Distillation range:	
Below 134.0°C	None
Above 136.0°C	None
Nonvolatile matter, g/100 mL, max	0.005

MIL-STD-1447

TABLE XIII. Ethylene Glycol Monoethyl Ether - federal specification physical and chemical requirements (Continued).

Water, % by wt, max	0.1
Acidity (free acid as acetic), % by wt, max	0.01
Sulfur (any form)	None
Flash point (Tag closed cup), °C, min	38
Evaporation rate (n-butyl acetate = 1), max	0.34

(2) ASTM D 331, Standard Specification for 2-Ethoxyethanol.

This specification covers one grade of 2-ethoxyethanol with properties that conform to the requirements shown in Table XIV.

TABLE XIV. 2-Ethoxyethanol - ASTM specification requirements.

Apparent specific gravity (20°/20°) (25°/25°)	0.929 to 0.932 0.926 to 0.929
Color (Pt-Co Scale), No., max	15
Distillation range:	
Below 134.0°C	None
Above 136.0°C	None
Water, % by wt, max	0.1
Acidity (free acid as acetic), % by wt, max	0.01
equivalent to mg KOH/g, max	0.1
Odor	mild, nonresidual

5.1.8.3 Use. Ethylene glycol monoethyl ether is intended for military use as a solvent in the manufacture of organic protective coatings. Commercial applications include use as a solvent in thermoplastic and thermosetting coating systems, in epoxy coating systems, in cellulosic lacquers, and in baking enamels. Other applications include use as an aid in printing and dyeing of textiles and leathers, as a coupling agent in aqueous coating systems; and as a component in formulations of hydraulic fluids, varnish removers, and glass and metal cleaners.

5.1.8.4 Safety. Ethylene glycol monoethyl ether is a combustible liquid. It can emit irritating and toxic fumes if heated to vaporization and decomposition. High vapor concentrations are irritating to the eyes and respiratory tract. The liquid can be irritating to the skin and eyes, and can be absorbed through the skin. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

5.1.8.5 Storage. Ethylene glycol monoethyl ether shall be stored in approved containers in a cool dry place, away from oxidizing agents.

5.1.8.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent and place in containers for disposal. In case of large liquid spills, dike to prevent spreading. Water spray can be used to reduce the vapor ignition hazard. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

MIL-STD-1447

Ethylene glycol monoethyl ether has an EPA Hazardous Waste Classification - Ignitable, Waste Number D001; Toxic Waste Number U359.

5.1.9 Name. Ethylene Glycol Monomethyl Ether $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_2\text{OH}$ FW 76.11
2-Methoxyethanol

5.1.9.1 Technical description. Ethylene glycol monomethyl ether (pure) is a colorless liquid with the physical properties and characteristics shown in Table XV. It is miscible with water, ethyl alcohol, ethyl ether, acetone, and benzene. It can be esterified to a monoether glycol ester.

TABLE XV. Ethylene Glycol Monomethyl Ether - physical properties and characteristics.

Density (20°C), g/cm ³	0.9647
Refractive index (20°C)	1.4024
Viscosity (20°C), centipoise (mPa·s)	1.7
Freezing point, °C	-85.1
Boiling point (760 mm Hg), °C	125
Vapor pressure (20°C), mm Hg	6
Flash point (closed cup), °F (°C)	103 (39.4)
Autoignition temperature, °F (°C)	551 (288)
Explosive limits, % by vol	
Lower	2.5
Upper	14
Vapor density (air = 1)	2.62

5.1.9.2 Specifications.

(1) Federal, O-E-780, Ethylene Glycol Monomethyl Ether, Technical.

This specification covers a technical grade of ethylene glycol monomethyl ether with the physical and chemical characteristics conforming to the requirements shown in Table XVI. The product shall be clear, uniform, and free of suspended matter.

TABLE XVI. Ethylene Glycol Monomethyl Ether - federal specification physical and chemical requirements.

	Min	Max
Specific gravity (25°/25°C)	0.961	0.967
Viscosity (25°C), centipoise (mPa·s)	1.50	1.66
Water content, % by wt	---	0.1
Distillation, at 76 mm Hg		
Initial boiling point, °C	123.5	---
Dry point, °C	---	128
Distillate below 127°C, % by vol	99.0	---

(2) ASTM D 3128 - Standard Specification for 2-Methoxyethanol

This specification covers one grade of 2-methoxyethanol with properties that conform to the requirements shown in Table XVII.

MIL-STD-1447

TABLE XVII. 2-Methoxyethanol - ASTM specification requirements.

Apparent specific gravity (20°/20°C) or (25°/25°C)	0.961 to 0.967 0.960 to 0.964
Color (Pt-Co Scale), No., max	15
Distillation range:	
Below 123.0°C	None
Above 126.0°C	None
Water, wt %, max	0.2
Acidity (free acid as acetic), wt %, max	0.01
equivalent to mg KOH/g, max	0.093
Odor	Nonresidual

5.1.9.3 Use. Ethylene glycol monomethyl ether is intended for military use as a solvent and as an ingredient in Decontaminating Agent, DS2. Commercial applications include use in enamels, lacquers and varnishes as a solvent for nitrocellulose, cellulose acetate, and natural and synthetic resins. Other applications include use in formulating wood stains, fuel deicing additives; and for sealing moisture-proof cellophane.

5.1.9.4 Safety. Ethylene glycol monomethyl ether is a combustible liquid. It can emit irritating and toxic fumes if heated to vaporization and decomposition. High vapor concentrations are irritating to the eyes and respiratory tract. The liquid is irritating to the eyes and skin, and can be absorbed through the skin. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

5.1.9.5 Storage. Ethylene glycol monomethyl ether shall be stored in approved containers in a cool dry place, away from oxidizing agents.

5.1.9.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent and place in containers for disposal. In case of large liquid spills, dike to prevent spreading. Water spray can be used to reduce the vapor ignition hazard. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Ethylene glycol monomethyl ether has an EPA Hazardous Waste Classification - Ignitable, Waste Number D001.

5.1.10 Name. Tetraethylene Glycol Dimethyl Ether
 $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OCH}_3$ FW 222.29
 Bis[2-(2-methoxyethoxy) ethyl] ether
 Dimethoxytetraethylene glycol
 Tetraglyme

5.1.10.1 Technical description. Tetraethylene glycol dimethyl ether (pure) is a colorless liquid with the physical properties and characteristics shown in Table XVIII. It is miscible with water, ethyl alcohol, ethyl ether, acetone, and benzene.

MIL-STD-1447

TABLE XVIII. Tetraethylene Glycol Dimethyl Ether - physical properties and characteristics.

Density (20°C), g/cm ³	1.0114
Refractive index (20°C)	1.4330
Viscosity (20°C), centipoise (mPa·s)	4.1
Freezing point, °C	-29.7
Boiling point (760 mm Hg), °C	275.8
Vapor pressure (20°C), mm Hg	<0.01
Flash point (closed cup), °F (°C)	286 (141)
Autoignition temperature, °F (°C)	551 (288)
Vapor density (air = 1)	7.7

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

Tetraethylene glycol dimethyl ether is available from a chemical manufacturer with the specification and typical analysis shown in Table XIX.

TABLE XIX. Tetraethylene Glycol Dimethyl Ether - manufacturer's requirements.

	Requirement	Typical Analysis
Purity, wt %, min	98.0	99.0
Acidity (as acetic acid), ppm, max	150	25
Water content, ppm, max	500	100
Peroxide content, ppm, max	15	5
Appearance	clear, colorless	---
Odor	nonresidual	---

5.1.10.3 Use. Tetraethylene glycol dimethyl ether is intended for military use as a solvent in specialized applications. Commercial applications include use in a reaction media for the accelerated polymerization of acrylonitrile; and in separation processes for gas purification, such as removal of water and formic acid from formaldehyde, separation of cycloparaffins from paraffins, and removal of sulfur dioxide from stack gases. It is also used as an inert additive for the fixation of resins in durable-press cotton and cellulosic fabrics.

5.1.10.4 Safety. Tetraethylene glycol dimethyl ether is a burnable liquid. It can emit irritating and toxic fumes if heated to vaporization and decomposition. It can form peroxides in the presence of oxygen. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes, and obtain medical attention.

5.1.10.5 Storage. Tetraethylene glycol dimethyl ether shall be stored in approved containers in a cool dry place, away from oxidizing agents. Nitrogen blanketing, under a slight positive pressure, can be used for bulk storage to prevent access by air.

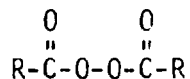
5.1.10.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent and place in containers for disposal. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

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

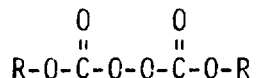
MIL-STD-1447

5.2 Organic Peroxides. Organic peroxides are compounds containing the -O-O- linkage.

Diacyl peroxides have the general formula:

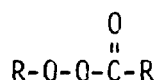


Peroxydicarbonates have the general formula:

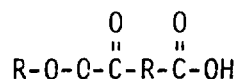


Peroxyesters have the following general formulas:

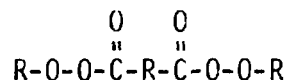
Alkyl ester of peroxydicarboxylic acid:



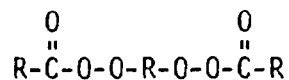
Alkyl ester of monoperoxydicarboxylic acid:



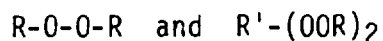
Dialkyl esters of diperoxydicarboxylic acids:



Alkalene bis(esters) of peroxydicarboxylic acids:

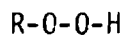


Dialkyl peroxides have the following general formulas:



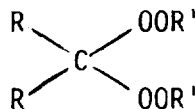
where R' and R are alkyl or substituted alkyl groups.

Hydroperoxides have the general formula:



where R is a tertiary alkyl group.

Peroxyketals have the general formula:



NOTE: A general formula for ketone peroxides is not shown because they are mixtures of peroxides and hydroperoxides.

MIL-STD-1447

Peroxides thermally cleave to produce free oxy radicals. Oxy radicals are very reactive and can initiate polymerization of vinyl monomers, and can abstract hydrogen atoms from polymer chains to form crosslinks between chains.

The half-life of a peroxide at any specified temperature is the time required at that temperature to result in a loss of one-half of the peroxide's active oxygen content. Because the efficiency of a free radical initiator depends upon its rate of decomposition, half-life data can be useful in selecting an initiator for a specific application.

5.2.1 Diacyl Peroxides

5.2.1.1 Name. Acetyl Peroxide $\text{CH}_3\text{COOCCOCH}_3$ FW: 118.09
 Diacetyl peroxide
 Ethanoyl peroxide

5.2.1.1.1 Technical description. Acetyl peroxide is in the form of needles or leaf crystals with a melting point of 30°C and a boiling point of 63°C at 21 mm Hg. It is slightly soluble in water. It is soluble in alcohol, acetone, ether (hot), and benzene. The theoretical active oxygen content is 13.5 percent. Acetyl peroxide in the pure solid state is extremely shock and friction sensitive.

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

Acetyl peroxide is available from a chemical manufacturer as a 25 percent solution in dimethyl phthalate with the requirements and typical properties shown in Table XX.

TABLE XX. Acetyl Peroxide Solution in dimethyl phthalate - chemical and physical requirements and typical properties.

Acetyl peroxide, wt %	23 to 25
Active oxygen, wt %	3.12 to 3.39
Density (25°C), g/mL	1.17
Viscosity (20°C), centipoise (mPa·s)	76
Half-life temperature (10 hr), $^\circ\text{C}$ (0.2M-solution in benzene)	69

5.2.1.1.3 Use. Acetyl peroxide is intended for use as a polymerization initiator, and as a curing agent for polyester resins.

5.2.1.1.4 Safety. Acetyl peroxide solution in dimethyl phthalate is a burnable liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. The solution can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.1.1.5 Storage. Acetyl peroxide solution in dimethyl phthalate shall be stored in approved containers between 0° and 5°C to maintain activity. Storage below 0°C can cause formation of shock sensitive crystals at -8°C .

MIL-STD-1447

5.2.1.1.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Acetyl peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.1.2 Name. Benzoyl Peroxide $C_6H_5COOOCOC_6H_5$ FW: 242.23
Dibenzoyl peroxide

5.2.1.2.1 Technical description. Benzoyl peroxide is in the form of rhombic crystals or prisms with a refractive index of 1.545. On heating, it starts to decompose slowly at 38°C until 68°C. Above 68°C, its decomposition can be explosive. The theoretical oxygen content is 6.62 percent. It is insoluble in water. It is slightly soluble in alcohol. It is soluble in acetone and benzene, and moderately soluble in ether.

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

Benzoyl peroxide is available from a chemical manufacturer as a granular solid conforming to the requirements shown in Table XXI.

TABLE XXI. Benzoyl Peroxide - chemical and physical requirements and typical properties.

Benzoyl peroxide, wt %	98.5 ± 1.0
Active oxygen, wt %	6.50 ± 0.07
Bulk density, g/cm ³	0.52
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	73

Benzoyl peroxide is also available in solid forms wetted with water containing 70 to 80 percent of peroxide; as granules; wetted with plasticizer; as pastes in plasticizers and silicone oils; and as powders with inert fillers.

5.2.1.2.3 Use. Benzoyl peroxide is intended for use as a polymerization initiator for vinyl monomers, and as a curing agent for unsaturated polyester resins. It is also used as a bleaching agent.

5.2.1.2.4 Safety. Benzoyl peroxide is a flammable solid and an oxidizer. It can decompose violently if heated above 66°C, or if subjected to heavy shock or friction. It can also ignite spontaneously and burn rapidly. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.1.2.5 Storage. Benzoyl peroxide shall be stored in approved containers in a cool place at a temperature not to exceed 100°F (38°C). The forms wetted with water shall be stored in tightly sealed containers to prevent

MIL-STD-1447

evaporation of the water. Storage shall be away from heat sources and combustible material.

5.2.1.2.6 Disposal. In case of solid spills, gather up and place in containers for disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Benzoyl peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.1.3 Name. Diisononanoyl Peroxide
 $(\text{CH}_3\text{-C}(\text{CH}_3)_2\text{-CH}_2\text{-CH}(\text{CH}_3)\text{-CH}_2\text{-COO-})_2$ FW: 314.45
 Bis(3,5,5-trimethylhexanoyl) peroxide
 Di(3,5,5-trimethylhexanoyl) peroxide

5.2.1.3.1 Technical description. No data is available for the pure compound. It is insoluble in water. It is soluble in most organic solvents, including methyl alcohol, acetone, and toluene. The theoretical active oxygen content is 5.08 percent.

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

Diisononanoyl peroxide is available from a manufacturer as a 75 percent solution in odorless mineral spirits conforming to the requirements shown in Table XXII.

TABLE XXII. Diisononanoyl Peroxide (75% solution in mineral spirits) - chemical and physical requirements and typical properties.

Diisononanoyl peroxide, wt %	75 to 77
Active oxygen, wt %	3.82 to 3.92
Density (25°C), g/mL	0.87
Viscosity (16°C), centipoise (mPa·s)	32
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	58

Diisononanoyl peroxide is available from a second manufacturer as a 75 percent solution in a high-boiling hydrocarbon solvent with the typical properties shown in Table XXIII.

TABLE XXIII. Diisononanoyl Peroxide (75% solution) - typical properties.

Purity (nominal), wt %	75.0
Active oxygen, wt %	3.82
Specific gravity (20°C)	0.915
Freezing point, °C	<20
Flash point (closed cup), °F(°C)	130 (54)
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	60

5.2.1.3.3 Use. Diisononanoyl peroxide is intended for use as a polymerization initiator for vinyl monomers, and as a curing agent for vinyl chloride and styrenated alkyd resins.

MIL-STD-1447

5.2.1.3.4 Safety. Diisononanoyl peroxide solution in mineral spirits is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.1.3.5 Storage. Diisononanoyl peroxide solution in mineral spirits shall be stored in approved containers at a temperature not to exceed 32°F (0°C).

5.2.1.3.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Diisononanoyl peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.1.4 Name. Lauroyl Peroxide $\text{CH}_3(\text{CH}_2)_{10}\text{COOOCO}(\text{CH}_2)_{10}\text{CH}_3$ FW: 398.63
Didodecanoyl peroxide

5.2.1.4.1 Technical description. Lauroyl peroxide is in the form of white plates with a melting point of 54°C, at which temperature it starts to decompose mildly. The theoretical oxygen content is 4.02 percent. It is insoluble in water and alcohol. It is soluble in benzene and ether, and moderately soluble in acetone.

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

Lauroyl peroxide is available from a chemical manufacturer as a flaked solid with the requirements and typical properties shown in table XXIV.

TABLE XXIV. Lauroyl Peroxide - chemical and physical requirements and typical properties.

Lauroyl peroxide, wt %, min	98.0
Active oxygen, wt %, min	3.93
Density (25°C), g/mL	0.93
Melting point, °C	54.1
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	62

5.2.1.4.3 Use. Lauroyl peroxide is intended for use as a polymerization initiator, and curing agent for polyester resins.

5.2.1.4.4 Safety. Lauroyl peroxide is a burnable solid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

MIL-STD-1447

5.2.1.4.5 Storage. Lauroyl peroxide shall be stored in approved containers in a cool dry place at a maximum temperature of 80°F (27°C), away from combustible materials.

5.2.1.4.6 Disposal. In case of solid spills, gather up and place in container for disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Lauroyl peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.1.5 Name. Succinic Acid Peroxide (HOOCCH₂CH₂CO)₂O₂ FW: 234.16
Butanedioic peroxide
Disuccinyl peroxide

5.2.1.5.1 Technical description. Succinic acid peroxide is in the form of a white crystalline powder. It decomposes on heating to 65.6°C. The theoretical oxygen content is 6.825 percent. It is moderately soluble in water, alcohol, and acetone. It is insoluble in benzene and ether.

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

Succinic acid peroxide is available from a manufacture as a solid with a melting point of 69.4°C, a typical assay of 95.0 percent and an active oxygen content of 6.45 percent. It is also available as a frozen water mixture conforming to the requirements shown in Table XXV.

TABLE XXV. Succinic Acid Peroxide (water mixture) - chemical and physical requirements and typical properties.

Succinic acid peroxide, wt %	58 to 71
Active oxygen, wt %, min	3.96
Bulk density, g/cm ³	0.80
Half-life temperature (10 hr), °C (0.2M-solution in acetone)	66

5.2.1.5.3 Use. Succinic acid peroxide is intended for use as a polymerization initiator for acrylates.

5.2.1.5.4 Safety. Succinic acid peroxide (anhydrous) is a combustible solid and an oxidizer. The frozen water mixture is an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.1.5.5 Storage. Succinic acid peroxide (anhydrous) shall be stored in approved containers in a cool dry place at a maximum temperature of 80°F (27°C). The frozen water mixture shall be stored at a maximum temperature of 32°F (0°C).

MIL-STD-1447

5.2.1.5.6 Disposal. In case of solid spills, gather up and place in containers for disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Succinic acid peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.2 Ketone Peroxides

5.2.2.1 Name. Acetyl Acetone Peroxide $\text{CH}_3\text{C}(\text{OH})\text{CH}_2\text{C}(\text{OH})\text{CH}_3$ FW: 134.13
2,4-Pentanedione peroxide

$$\begin{array}{c} \text{O} \quad \text{O} \\ | \quad | \\ \text{O} \text{ --- } \text{O} \end{array}$$

5.2.2.1.1 Technical description. The characteristics of the pure compound are not available. The theoretical active oxygen content is 11.94 percent. It is soluble in methyl ethyl ketone, ethyl acetate, dimethyl phthalate and other phthalate esters.

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

Acetyl acetone peroxide is available from a manufacturer as a fire-resistant solution of 2,4-pentanedione peroxide with an active oxygen content of 4.0 percent minimum. The typical physical properties of the solution are shown in Table XXVI.

TABLE XXVI. Acetyl Acetone Peroxide (2,4-pentanedione peroxide solution) - typical physical properties.

Form	clear liquid
Specific gravity (25°/25°C)	1.0672
Refractive index (25°C)	1.4330
Viscosity, centipoise (mPa·s)	
At 25°C	16.0
At 30°C	12.1
At 35°C	9.0
Freezing point, °C	approx -20
Flash point (closed cup), °F(°C)	214 (101)

Acetyl acetone peroxide is available from two additional manufacturers as solutions with active oxygen contents of 4.0 percent.

5.2.2.1.3 Use. Acetyl acetone peroxide is intended for use as a curing agent for polyester resins and vinyl ester resins.

5.2.2.1.4 Safety. Acetyl acetone peroxide solution is a burnable liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. The solution can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.2.1.5 Storage. Acetyl acetone peroxide solution shall be stored in approved containers at a temperature of 65° to 85°F (18.3° to 29.4°C) away from heat sources and combustible materials.

MIL-STD-1447

5.2.2.1.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

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

5.2.2.2 <u>Name</u> . Methyl Ethyl Ketone Peroxide		
2-Butanone peroxide	$\text{CH}_3\text{C}(\text{OOH})_2\text{C}_2\text{H}_5$	FW: 122.12
	$\text{CH}_3\text{C}(\text{OOH})\text{C}_2\text{H}_5$	
	 O	FW: 210.23
	 O	
	$\text{CH}_3\text{C}(\text{OOH})\text{C}_2\text{H}_5$	

5.2.2.2.1 Technical description. Methyl ethyl ketone peroxide is a mixture of peroxides and hydroperoxides. Two of the formulas are shown above. The characteristics of the individual compounds are not available. The undiluted compound mixture is extremely shock sensitive, and dilution with a plasticizer or other solvent is necessary to reduce the hazard. The compounds are soluble in methyl ethyl ketone, ethyl acetate, dimethyl phthalate and other phthalate esters. The compound solutions are insoluble in water.

5.2.2.2.2 Specification. Military, MIL-P-81351, Peroxide, Methyl Ethyl Ketone.

This specification covers one grade of methyl ethyl ketone peroxide as a 60 percent solution in dimethyl phthalate. The methyl ethyl ketone peroxide solution shall conform to the chemical and physical requirements shown in Table XXVII.

TABLE XXVII. Methyl Ethyl Ketone Peroxide (60 percent solution in dimethyl phthalate) - chemical and physical requirements.

Active oxygen, wt %, min	11.0
Specific gravity (25°C), min	1.1020
Refractive index (25°C, min	1.4550
Viscosity (25°C), centipoise (mPa·s)	19 to 24
Color	Water white
Flash point (Cleveland open cup), min, °F (°C)	200 (93.3)

Military, MIL-P-87938, Peroxide, Methyl Ethyl Ketone, Technical.

This specification covers three grades of methyl ethyl ketone peroxide solutions in dimethyl phthalate. The three grades shall be 47 to 49 percent solutions. The solutions shall be clear and colorless, and shall conform to the chemical and physical requirements shown in Table XXVIII.

MIL-STD-1447

TABLE XXVIII. Methyl Ethyl Ketone Peroxide (47 to 49 percent solutions in dimethyl phthalate).

	Grade A	Grade B	Grade C
Active oxygen, wt %	8.8 ^{+0.1}	8.9 ^{+0.1}	8.9 ^{+0.1}
Specific gravity (25°/25°C), min	1.0815	1.157	1.150
Refractive index (21°C)	1.4615	1.4748	1.4714
Viscosity, centipoise (mPa·s)			
At 25°C, max	14.8	11.1	11.0
At 30°C, max	11.5	8.8	8.6
At 35°C, max	9.4	7.2	6.9
Freezing point, °C, max	-30	-35	-35
Flash point (open cup), °F(°C), min	137 (58)	140 (60)	140 (60)

5.2.2.2.3 Use. Methyl ethyl ketone peroxide, as a 60 percent solution in dimethyl phthalate, is intended for military use in explosives. Methyl ethyl ketone peroxide, as 47 to 49 percent solutions in dimethyl phthalate, is intended for military use as a catalyst hardening agent for plastics, and as a curing agent for polyester resins.

5.2.2.2.4 Safety. Methyl ethyl ketone peroxide solutions, with more than 9 percent by weight active oxygen, are forbidden for commercial transportation by DOT in accordance with section 172.101 of 49 CFR. Methyl ethyl ketone peroxide solutions in dimethyl phthalate are combustible or burnable liquids, and oxidizers. The solutions can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

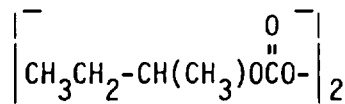
5.2.2.2.5 Storage. Methyl ethyl ketone peroxide solutions in dimethyl phthalate shall be stored in approved containers in a cool dry place, at a temperature range of 65° to 85°F (18.3° to 29.4°C), away from heat sources and combustible materials.

5.2.2.2.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Methyl ethyl ketone peroxide has an EPA Hazardous Waste Classification - Reactive and Toxic, Waste No. U160. Dimethyl phthalate has an EPA Hazardous Waste Classification - Toxic, Waste No. U102.

5.2.3 Peroxydicarbonates

5.2.3.1 Name. Di-sec-Butyl Peroxydicarbonate FW: 234.2
sec-Butyl percarbonate



5.2.3.1.1 Technical description. The characteristics of the pure compound are not available. The liquid compound is insoluble in water. It is miscible

MIL-STD-1447

with most aliphatic and aromatic hydrocarbons, esters, ketones and chlorinated hydrocarbons. The theoretical active oxygen content is 6.83 percent.

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

Di-sec-butyl peroxydicarbonate is available from two manufacturers with chemical and physical requirements shown in Table XXIX.

TABLE XXIX. Di-sec-Butyl Peroxydicarbonate - commercial chemical and physical requirements.

Assay, wt %, min	98.0	98.5
Active oxygen, wt %	6.69 min	6.83
Density (0°C), g/mL	1.07	----
Specific gravity (4°/4°C)	----	1.067
Freezing point, °C	<-50	<-80
Refractive index (20°C)	----	1.4132
Flash point (SETA), °F (°C)	>100 (37.8)	----
Half-life temperature (10 hr), °C (0.2-M solution in decane)	43	----

Di-sec-butyl peroxydicarbonate is also available in solution form at several concentrations.

5.2.3.1.3 Use. Di-sec-butyl peroxydicarbonate is intended for use as a polymerization initiator for unsaturated monomers.

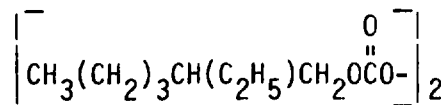
5.2.3.1.4 Safety. Di-sec-butyl peroxydicarbonate is a combustible liquid and an oxidizer. It is thermally unstable above -18°C. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.3.1.5 Storage. Di-sec-butyl peroxydicarbonate shall be stored in approved containers, under refrigeration at a temperature below 0°F (-18°C), away from combustible materials.

5.2.3.1.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Di-sec-butyl peroxydicarbonate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; Reactive, Waste No. D003.

5.2.3.2 Name. Di(2-ethylhexyl) Peroxydicarbonate FW: 346.0
 Bis(2-ethylhexyl) peroxydicarbonate
 2-Ethylhexylpercarbonate



MIL-STD-1447

5.2.3.2.1 Technical description. The characteristics of the pure compound are not available. The theoretical active oxygen content is 4.63 percent. The liquid compound is insoluble in water. It is miscible with most aliphatic and aromatic hydrocarbons, esters, ketones, and chlorinated hydrocarbons.

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

Di(2-ethylhexyl) peroxydicarbonate is available from two manufacturers with the chemical and physical requirements shown in Table XXX.

TABLE XXX. Di(2-ethylhexyl) Peroxydicarbonate - commercial chemical and physical requirements.

Assay, wt %, min	97	98
Active oxygen, wt %	4.50 min	4.50
Density (-17.8°C), g/mL	0.96	----
Density (20°C), g/mL	----	0.972
Freezing point, °C	<-50	<-78
Viscosity, centistokes (mm ² /s)		
20°F (-6.7°C)	----	71.5
45°F (7.2°C)	----	32.1
Flash point (SETA), °F (°C)	>100 (37.8)	----
Half-life temperature (10 hr), °C (0.2-M solution in decane)	40	----

Di(2-ethylhexyl) peroxydicarbonate is also available in solution forms at 40 and 75 percent concentrations in odorless mineral spirits, and at a 70 percent concentration in toluene.

5.2.3.2.3 Use. Di(2-ethylhexyl) peroxydicarbonate is intended for use as a polymerization initiator for unsaturated monomers.

5.2.3.2.4 Safety. Di(2-ethylhexyl) peroxydicarbonate is a combustible liquid and an oxidizer. It is thermally unstable above -18°C. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.3.2.5 Storage. Di(2-ethylhexyl) peroxydicarbonate shall be stored in approved containers, under refrigeration at a temperature below 0°F (-18°C), away from combustible materials.

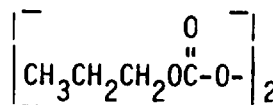
5.2.3.2.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Di(2-ethylhexyl) peroxydicarbonate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; Reactive, Waste No. D003.

MIL-STD-1447

5.2.3.3 Name. Di-n-propyl Peroxydicarbonate
n-Propyl percarbonate

FW: 206.18



5.2.3.3.1 Technical description. The characteristics of the pure compound are not available. The liquid compound is insoluble in water. It is miscible with most aliphatic and aromatic hydrocarbons, esters, ketones, and chlorinated hydrocarbons. The theoretical active oxygen content is 7.77 percent.

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

Di-n-propyl peroxydicarbonate is available from two manufacturers with the chemical and physical requirements shown in Table XXXI.

TABLE XXXI. Di-n-Propyl Peroxydicarbonate - commercial chemical and physical requirements.

Assay, wt %, min	99.0	98.5
Active oxygen, wt %	7.68 min	7.8
Density (0°C), g/mL	1.08	----
Specific gravity (4°/4°C)	----	1.1161
Freezing point, °C	----	<-70
Refractive index (20°C)	----	1.4016
Flash point (SETA), °F (°C)	>100 (37.8)	----
Half-life temperature (10 hr), °C (0.2-M solution in decane)	40	----

Di-n-propyl peroxydicarbonate is also available in solution form at an 85 percent concentration in odorless mineral spirits and methylcyclohexane.

5.2.3.3.3 Use. Di-n-propyl peroxydicarbonate is intended for use as a polymerization initiator for unsaturated monomers.

5.2.3.3.4 Safety. Di-n-propyl peroxydicarbonate is a combustible liquid and an oxidizer. It is thermally unstable above -23°C. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.3.3.5 Storage. Di-n-propyl peroxydicarbonate shall be stored in approved containers, under refrigeration at a temperature below -10°F (-23°C), away from combustible material.

5.2.3.3.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

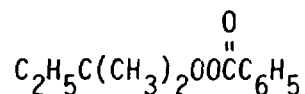
MIL-STD-1447

Di-n-propyl peroxydicarbonate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; Reactive, Waste No. D003.

5.2.4 Peroxyesters

5.2.4.1 Name. tert-Amyl Peroxybenzoate
tert-Amylperbenzoate

FW: 208.2



5.2.4.1.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at room temperature. The theoretical active oxygen content is 7.69 percent. It is insoluble in water. It is soluble in organic solvents including hydrocarbons and chlorinated hydrocarbons.

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

tert-Amyl peroxybenzoate is available from a manufacturer in neat form with the specification requirements and typical properties shown in Table XXXII.

TABLE XXXII. tert-Amyl Peroxybenzoate - chemical requirements and typical properties.

tert-Amyl peroxybenzoate, wt %, min	95
Active oxygen, wt %, min	7.3
Flash point (closed cup), °F(°C)	110 (43)
Half-life temperature (10 hr), °C (0.2M-solution in dodecane)	100

5.2.4.1.3 Use. tert-Amyl peroxybenzoate is intended for use as a polymerization initiator, and as a curing agent for polyester resins.

5.2.4.1.4 Safety. tert-Amyl peroxybenzoate is a combustible liquid and oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

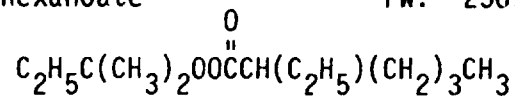
5.2.4.1.5 Storage. tert-Amyl peroxybenzoate shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.4.1.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Amyl peroxybenzoate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

MIL-STD-1447

5.2.4.2 Name. tert-Amyl Peroxy-2-ethylhexanoate FW: 230.3
 tert-Amyl peroctoate



5.2.4.2.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at room temperature. The theoretical active oxygen content is 6.96 percent. It is insoluble in water. It is soluble in organic solvents including hydrocarbons and chlorinated hydrocarbons.

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

tert-Amyl peroxy-2-ethylhexanoate is available from a manufacturer in neat form with specification requirements and typical properties shown in Table XXXIII.

TABLE XXXIII. tert-Amyl Peroxy-2-ethylhexanoate - chemical requirements and typical properties.

tert-Amyl peroxy-2-ethylhexanoate, wt %, min	95
Active oxygen, wt %, min	6.6
Freezing point, °C	<-62
Flash point (closed cup), °F (°C)	160 (71)
Half-life temperature (10 hr), °C (0.2M-solution in dodecane)	75

tert-Amyl peroxy-2-ethylhexanoate is also available as 75 percent solutions in odorless mineral spirits and in phthalate ester plasticizers with active oxygen contents of 5.2 percent.

5.2.4.2.3 Use. tert-Amyl peroxy-2-ethylhexanoate is intended for use as a polymerization initiator, and as a curing agent for polyester resins.

5.2.4.2.4 Safety. tert-Amyl peroxy-2-ethylhexanoate is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

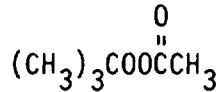
5.2.4.2.5 Storage. tert-Amyl peroxy-2-ethylhexanoate shall be stored in approved containers, under refrigeration at a maximum temperature of 50°F (10°C), away from combustible materials.

5.2.4.2.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Amyl peroxy-2-ethylhexanoate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

MIL-STD-1447

5.2.4.3 Name. tert-Butyl Peroxyacetate FW: 132.2
tert-Butyl peracetate



5.2.4.3.1 Technical description. The characteristics of the pure compound are not available. The compound is very shock sensitive in its pure form. The theoretical active oxygen content is 12.1 percent. It is insoluble in water. It is soluble in organic solvents including hydrocarbons and chlorinated hydrocarbons.

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

tert-Butyl peroxyacetate is available from three manufacturers as solutions in odorless mineral spirit. A 50 percent solution, from one of the manufacturers, has the specification requirements and typical properties shown in Table XXXIV. It is also available from this manufacturer as 74.0 percent and 59.0 to 61.0 percent solutions, with active oxygen contents of 8.95 to 9.20 percent and 7.14 to 7.38 percent.

TABLE XXXIV. tert-Butyl Peroxyacetate (50 percent solution in odorless mineral spirits) - chemical requirements and typical properties.

tert-Butyl peroxyacetate, wt %	49.0 to 51.0
Active oxygen, wt %	5.93 to 6.17
Acetic anhydride, %, max	0.35
t-Butyl hydroperoxide, %, max	0.15
Color	water white
Specific gravity (25°/25°C)	0.838
Refractive index (25°C)	1.410
Flash point (closed cup), °F (°C)	96 (35.5)
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	101

tert-Butyl peroxyacetate is available from a second manufacturer as 75, 60, and 50 weight percent solutions in odorless mineral spirits with active oxygen contents of 9.1, 7.3, and 6.0 weight percent.

5.2.4.3.3 Use. tert-Butyl peroxyacetate is used as a polymerization initiator for vinyl monomers, including the synthesis of polyethylene and polystyrene, and as a curing agent for polyester resins.

5.2.4.3.4 Safety. tert-Butyl peroxyacetate solutions in mineral spirits are flammable liquids and oxidizers. They can emit irritating and toxic fumes if heated to decomposition. They can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

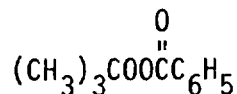
5.2.4.3.5 Storage. tert-Butyl peroxyacetate solutions in mineral spirits shall be stored in a cool dry place, away from combustible material. The maximum storage temperature shall be 100°F (38°C).

MIL-STD-1447

5.2.4.3.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl peroxyacetate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.4.4 Name. tert-Butyl Peroxybenzoate FW: 194.2
tert-Butyl perbenzoate



5.2.4.4.1 Technical description. The characteristics of the pure compound are not available. The compound is in liquid form at room temperature. The theoretical active oxygen content is 8.24 percent. It is insoluble in water. It is soluble in most organic solvents, including alcohols, esters, ethers, ketones, hydrocarbons, and chlorinated hydrocarbons.

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

tert-Butyl peroxybenzoate is available from three manufacturers in neat form. The specification requirements and typical properties of the products of the manufacturers are shown in Table XXXV.

TABLE XXXV. tert-Butyl Peroxybenzoate - chemical requirements and typical properties.

tert-Butyl peroxybenzoate, %, min	98.0	98	98.0
Active oxygen, %, min	8.07	8.1	8.07
tert-Butyl hydroperoxide, %, min	0.15	---	---
Chloride (inorganic), ppm, max	60	---	---
Viscosity (20°C), centipoise (mPa·s)	---	7.7	---
Specific gravity (25°/25°C)	1.039	---	---
(20°C)	---	---	1.04
Refractive index (25°C)	1.498	---	1.497
Freezing point, °C	8.5	8.3	7
Flash point (closed cup), °F (°C)	213 (101)	192 (89)	>200 (93)
Half-life temperature (10 hr), °C (0.2-M solution in benzene)	107	---	104

5.2.4.4.3 Use. tert-Butyl peroxybenzoate is used as a polymerization initiator for vinyl monomers, including the synthesis of polyethylene, polystyrene, and polyacrylates. It is also used as a curing agent for elastomers and polyester resins.

5.2.4.4.4 Safety. tert-Butyl peroxybenzoate is a burnable liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

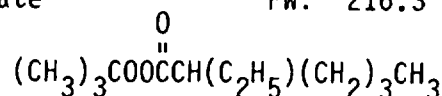
MIL-STD-1447

5.2.4.4.5 Storage. tert-Butyl peroxybenzoate shall be stored in approved containers in a cool dry place, away from combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.4.4.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl peroxybenzoate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.4.5 Name. tert-Butyl Peroxy-2-ethylhexanoate FW: 216.3
tert-Butylperoctoate



5.2.4.5.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at room temperature. The theoretical active oxygen content is 7.4 percent. It is insoluble in water, and soluble in most organic solvents.

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

tert-Butyl peroxy-2-ethylhexanoate is available from three manufacturers in neat form. The specification requirements and typical properties of the products of these manufacturers are shown in Table XXXVI.

TABLE XXXVI. tert-Butyl Peroxy-2-ethylhexanoate - chemical requirements and typical properties.

tert-Butyl peroxy-2-ethylhexanoate, %, min	97.0	97	97
Active oxygen, %, min	7.18	7.2	7.17
tert-Butyl hydroperoxide, %, min	0.15	---	---
Chloride (inorganic), ppm, max	90	---	---
Color	colorless	---	clear
Specific gravity (25°/25°C)	0.897	---	---
(25°C)	---	---	0.89
Refractive index (25°C)	1.427	---	1.426
Freezing point, °C	---	-22	<-30
Flash point (closed cup), °F (°C)	180(82)	147(64)	>180(82)
Viscosity, (20°C), centipoise (mPa·s)	---	3.8	---
Viscosity, (25°C), centipoise (mPa·s)	---	---	4
Half-life temperature (10 hr), °C	benzene	dodecane	---
(0.2-M solution)	72	77	---

t-Butyl peroxy-2-ethylhexanoate is also available from three manufacturers as 50 percent solutions in dioctyl phthalate and odorless mineral spirits with active oxygen contents of 37 percent.

MIL-STD-1447

5.2.4.5.3 Use. tert-Butyl peroxy-2-ethylhexanoate is used as a polymerization catalyst for vinyl monomers, and as a curing agent for polyester resins.

5.2.4.5.4 Safety. tert-Butyl peroxy-2-ethylhexanoate is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.4.5.5 Storage. tert-Butyl peroxy-2-ethylhexanoate shall be stored in approved containers in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 65°F (18°C).

5.2.4.5.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl peroxy-2-ethylhexanoate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.4.6 Name. tert-Butyl Peroxyisobutyrate FW: 160.2
tert-Butyl perisobutyrate

$$(CH_3)_3COOC\overset{O}{\parallel}CCH(CH_3)_2$$

5.2.4.6.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at room temperature. The theoretical active oxygen content is 10.0 percent. It is insoluble in water, and soluble in common organic solvents including hydrocarbons and chlorinated hydrocarbons.

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

tert-Butyl peroxyisobutyrate is available from two manufacturers as a 75 percent solution in odorless mineral spirits with the specification requirements and typical properties shown in Table XXXVII.

TABLE XXXVII. tert-Butyl Peroxyisobutyrate Solution (75 percent in odorless mineral spirits) - chemical requirements and typical properties.

tert-Butyl peroxyisobutyrate, wt %	74.0 to 76.0	75
Active oxygen, wt %	7.39 to 7.59	7.5
tert-Butyl hydroperoxide, %, max	0.10	----
Specific gravity (25°/25°C)	0.881	----
Refractive index (25°C)	1.410	----
Freezing point, °C	----	<-40
Flash point (closed cup), °F (°C)	113 (45)	110 (43)
Viscosity (20°C), centipoise (mPa·s)	----	1.4
Half-life temperature (10 hr), °C	80 (benzene)	82 (n-decane)

MIL-STD-1447

5.2.4.6.3 Use. tert-Butyl peroxyisobutyrate solution is intended for use as an initiator for the polymerization of vinyl monomers including vinyl acetate, styrene, and acrylic esters. It is also used as a curing agent for polyester resins.

5.2.4.6.4 Safety. tert-Butyl peroxyisobutyrate is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.4.6.5 Storage. tert-Butyl peroxyisobutyrate shall be stored in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 60°F (15°C).

5.2.4.6.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl peroxyisobutyrate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.4.7 Name. tert-Butyl Peroxymaleic Acid FW: 188.17
 tert-Butyl peroxy-cis-butenedioic acid
$$(CH_3)_3COOC\overset{O}{\parallel}C=CH\overset{O}{\parallel}COH$$

5.2.4.7.1 Technical description. The characteristics of the pure compound are not available. The compound is in solid form. The theoretical active oxygen content is 8.5 percent. It is insoluble in water, but it is soluble as an alkali metal salt. It is soluble in most alcohols, ketones and low molecular weight esters.

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

tert-Butyl peroxymaleic acid is available from a manufacturer in neat form with the specification requirements and typical properties shown in Table XXXVIII.

TABLE XXXVIII. tert-Butyl Peroxymaleic Acid - chemical requirements and typical properties.

t-Butyl peroxymaleic acid, wt %, min	98
Active oxygen, wt %, min	8.3
Melting point, °C	114
Half-life temperature (10 hr), °C (0.2M-solution in acetone)	87

tert-Butyl peroxymaleic acid is also available as dispersions, in paste form, at concentrations of 40 and 25 percent in phthalate ester plasticizers with active oxygen contents of 3.4 and 2.1 percent.

MIL-STD-1447

5.2.4.7.3 Use. tert-Butyl peroxy maleic acid is intended for use as a polymerization catalyst, and as a curing agent for polyester resins.

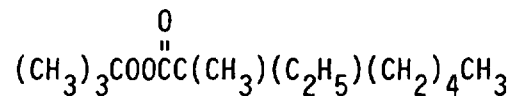
5.2.4.7.4 Safety. tert-Butyl peroxy maleic acid is a burnable solid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.4.7.5 Storage. tert-Butyl peroxy maleic acid shall be stored in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 100°F (38°C).

5.2.4.7.6 Disposal. In case of solid spills, gather up and place in containers for disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl peroxy maleic acid has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.4.8 Name. tert-Butyl Peroxyneodecanoate FW: 244.4
tert-Butyl peroxy-2-ethyl-2-methylheptanoate



5.2.4.8.1 Technical description. The characteristics of the pure compound are not available. The formula shown is for the major isomer of the compound. The theoretical active oxygen content is 6.55 percent. The compound is a liquid at room temperature. It is insoluble in water, and soluble in hydrocarbons and chlorinated hydrocarbons.

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

tert-Butyl peroxyneodecanoate is available in neat form from a manufacturer with specification requirements and typical properties shown in Table XXXIX.

TABLE XXXIX. tert-Butyl Peroxyneodecanoate - chemical requirements and typical properties.

tert-Butyl peroxyneodecanoate, wt %, min	95
Active oxygen, wt %, min	6.2
Freezing point, °C	<-61
Flash point (closed cup), °F (°C)	140 (60)
Half-life temperature (10 hr), °C (0.2M-solution in trichloroethylene)	49

tert-Butyl peroxyneodecanoate is also available from three manufacturers as a 75 percent solution in odorless mineral spirits with an active oxygen content of 4.9 percent.

MIL-STD-1447

5.2.4.8.3 Use. tert-Butyl peroxyneodecanoate is intended for use as an initiator for the polymerization of ethylene, acrylates, and vinyl chloride and its copolymers. It is also used as a curing agent for polyester resins.

5.2.4.8.4 Safety. tert-Butyl peroxyneodecanoate is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.4.8.5 Storage. tert-Butyl peroxyneodecanoate shall be stored in approved containers in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 100°F (38°C).

5.2.4.8.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl peroxyneodecanoate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.4.9 Name. tert-Butyl Peroxypivalate FW: 174.2
 tert-Butyl peroxy-2,2-dimethylpropionate
$$(\text{CH}_3)_3\text{COOCC}(\overset{\text{O}}{\parallel})\text{CH}_2\text{CH}_3$$

5.2.4.9.1 Technical description. The characteristics of the pure compound are not available. It is not stable at room temperature. The theoretical active oxygen content is 9.2 percent. It is insoluble in water, and soluble in most organic solvents.

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

tert-Butyl peroxypivalate is available from three manufacturers as a 75 percent solution in odorless mineral spirits. The specification requirements and typical properties of the products of these manufacturers are shown in Table XL.

TABLE XL. tert-Butyl Peroxypivalate (75 percent solution in odorless mineral spirits) - chemical and physical requirements and typical properties.

tert-Butyl peroxypivalate, wt %	74.0 to 76.0	75	75+1
Active oxygen, %	6.79 to 6.97	6.8	6.8 (nominal)
tert-Butylhydroperoxide, %, max	0.10	---	---
Chloride (inorganic), ppm, max	60	---	---
Color	colorless to	---	colorless
Specific gravity (25°/25°C)	0.857	---	0.850
Refractive index (25°C)	1.412	---	1.41
Flash point (closed cup) °F(°C)	118 (48)	130 (39)	155 (68)
Half-life temperature (10 hr) °C (0.2M-solution)	49 (benzene)	58 (trichloro- ethylene)	---

MIL-STD-1447

5.2.4.9.3 Use. tert-Butyl peroxyvalate is intended for use as a polymerization initiator for ethylene-type monomers, and as a curing agent for acrylic resins.

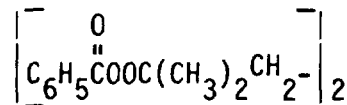
5.2.4.9.4 Safety. tert-Butyl peroxyvalate solution in mineral spirits is a combustible liquid and oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.4.9.5 Storage. tert-Butyl peroxyvalate solution shall be stored in approved containers, under refrigeration at a temperature below 40°F (4°C), away from combustible materials.

5.2.4.9.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl peroxyvalate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.4.10 Name. 2,5-Dimethyl-2,5-di(benzoylperoxy)hexane FW: 386.43
2,5-Dimethyl-2,5-bis(benzoylperoxy)hexane



5.2.4.10.1 Technical description. The characteristics of the pure compound are not available. The compound is in solid form at room temperature. The theoretical active oxygen content is 8.28 percent. The compound is insoluble in water. It is soluble in hydrocarbons.

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

2,5-Dimethyl-2,5-di(benzoylperoxy)hexane is available from two manufacturers in neat form with specification requirements and typical properties shown in Table XLI.

TABLE XLI. 2,5-Dimethyl-2,5-di(benzoylperoxy)hexane - chemical requirements and typical properties.

Assay, wt %, min	92	75.0
Active oxygen, wt %, min	7.6	6.2
Melting point, °C	113.9	115
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	100	98

5.2.4.10.3 Use. 2,5-Dimethyl-2,5-di(benzoylperoxy)hexane is intended for use as a polymerization initiator, as a curing agent for elastomers, and for the high temperature molding of unsaturated polyester resins.

MIL-STD-1447

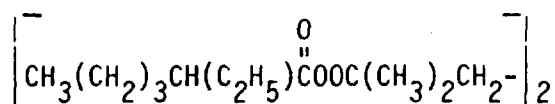
5.2.4.10.4 Safety. 2,5-Dimethyl-2,5-di(benzoylperoxy)hexane is a burnable solid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.4.10.5 Storage. 2,5-Dimethyl-2,5-di(benzoylperoxy)hexane shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.4.10.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

2,5-Dimethyl-2,5-di(benzoylperoxy)hexane has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.4.11 Name. 2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane
2,5-Dimethyl-2,5-bis(2-ethylhexanoylperoxy)hexane FW: 430.60



5.2.4.11.1 Technical description. The characteristics of the pure compound are not available. The compound is in liquid form at room temperature. The theoretical active oxygen content is 7.44 percent. The compound is insoluble in water. It is soluble in hydrocarbons.

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

2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane is available from two manufacturers in neat form with the specification requirements and typical properties shown in Table XLII.

TABLE XLII. 2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane - chemical requirements and typical properties.

Assay, wt %, min	90	90
Active oxygen, wt %, min	6.7	6.7
Specific gravity (20°/4°C)	---	0.965
Refractive index (25°C)	---	1.449
Freezing point, °C	<-20	<-20
Viscosity (20°C), centipoise (mPa·s)	50.6	----
Flash point, °F (°C)	125 (52)	200 (93)
	(closed cup)	(open cup)
Half-life temperature (10 hr), °C (0.2M-solution in n-decane)	72	----

MIL-STD-1447

5.2.4.11.3 Use. 2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane is intended for use as a polymerization initiator, and as a high temperature curing agent for polyester resins.

5.2.4.11.4 Safety. 2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.4.11.5 Storage. 2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane shall be stored in approved containers in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 65°F (18°C).

5.2.4.11.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane has an EPA Hazardous Waste Classification - Ignitable Waste No. D001.

5.2.5 Dialkyl Peroxides

5.2.5.1 Name. α, α' -Bis(tert-butylperoxy)diisopropylbenzene FW: 338.43
 α, α' -Di(tert-butylperoxy)diisopropylbenzene
 $(\text{CH}_3)_3\text{COO}(\text{CH}_2)_2\text{C}_6\text{H}_4\text{C}(\text{CH}_2)_2\text{OOC}(\text{CH}_3)_3$

5.2.5.1.1 Technical description. The compound, α, α' -bis(tert-butylperoxy)diisopropylbenzene, exists as meta and para isomers. The melting point of the meta isomer is 50°C, and the melting point of the para isomer is 80°C. The theoretical active oxygen content is 9.47 percent. It is insoluble in water. It is very soluble in aliphatic and aromatic hydrocarbons and ketones, and less soluble in alcohols.

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

α, α' -Bis (tert-butylperoxy)diisopropylbenzene is available from three manufacturers with the specification requirements and typical properties shown in Table XLIII.

TABLE XLIII. α, α' -Bis (tert-butylperoxy)diisopropylbenzene - chemical requirements and typical properties.

Assay, as active peroxide, wt %	96 to 100	95 min	96
Meta:para ratio	1.5:1 to 2:1	---	---
Active oxygen, wt %	---	8.75 min	9.26
Specific gravity (25°/25°C)	0.930	---	---
Melting point, °C	45 to 55	40 (approx)	---
Flash point, closed cup, °F (°C)	170 (76)	---	---
Half-life temperature (10 hr), °C	---	121	117

MIL-STD-1447

5.2.5.1.3 Use. α, α' -Bis (tert-butylperoxy)diisopropylbenzene is intended for use as a crosslinking and curing agent for elastomers and polyester resins where scorch resistance is required. It is also used at a 20 percent concentration, supported on polypropylene, to add to polypropylene resin in order to reduce the molecular weight thereby lowering the melt viscosity and increasing the melt flow rate.

5.2.5.1.4 Safety. α, α' -Bis (tert-butylperoxy)diisopropylbenzene is an oxidizer. It is a combustible liquid after melting. It decomposes rapidly above 65°C, and can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.5.1.5 Storage. α, α' -Bis (tert-butylperoxy)diisopropylbenzene shall be stored in approved containers in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 110°F (43°C) to prevent melting, and 125°F (52°C) to prevent decomposition.

5.2.5.1.6 Disposal. In case of solid spills, gather up and place in containers for disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

α, α' -Bis (tert-butylperoxy)diisopropylbenzene has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.5.2 Name. tert-Butyl Cumyl Peroxide $(\text{CH}_3)_3\text{COO}(\text{CH}_3)_2\text{C}_6\text{H}_5$ FW: 208.29

5.2.5.2.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at 25°C. The theoretical active oxygen content is 7.68 percent. It is insoluble in water. It is soluble in organic solvents, including aliphatic and aromatic hydrocarbons, and ketones.

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

tert-Butyl cumyl peroxide is available from two manufacturers with the specification requirements and typical properties shown in Table XLIV.

TABLE XLIV. tert-Butyl Cumyl Peroxide - chemical requirements and typical properties.

tert-Butyl cumyl peroxide, wt %	90.0 to 95.0	90.0 to 95.0
Active oxygen, %	---	6.91 to 7.30
Specific gravity (20°/20°C)	0.94	---
Density (25°C), g/mL	---	0.945
Refractive index (20°C)	---	1.4819
Freezing point, °C	15	---
Flash point (closed cup), °F (°C)	157 (69)	174 (79)
Viscosity (20°C), centipoise (mPa·s)	---	466
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	---	121

MIL-STD-1447

5.2.5.2.3 Use. tert-Butyl cumyl peroxide is intended for use as a polymerization catalyst, and also as a crosslinking and curing agent for elastomers and polyester resins.

5.2.5.2.4 Safety. tert-Butyl cumyl peroxide is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.5.2.5 Storage. tert-Butyl cumyl peroxide shall be stored in approved containers in a cool dry place, away from heat sources and combustible material. The maximum storage temperature is 100°F (38°C).

5.2.5.2.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl cumyl peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.5.3 Name. Di(tert-butyl) Peroxide $(\text{CH}_3)_3\text{COOC}(\text{CH}_3)_3$ FW: 146.23
tert-Butyl peroxide

5.2.5.3.1 Technical description. Di(tert-butyl) peroxide (pure) is a liquid with a density of 0.794 g/cm³ and a refractive index of 1.3890 at 20°C, a freezing point of -40°C, and a boiling point of 111°C at 760 mm Hg. The theoretical active oxygen content is 10.95 percent. It is insoluble in water, and soluble in most organic solvents.

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

Di(tert-butyl) peroxide is available from two manufacturers with the specification requirements and typical properties shown in Table XLV.

TABLE XLV. Di(tert-butyl) Peroxide - chemical requirements and typical properties.

Di(tert-butyl) peroxide, wt %, min	98.5	99
Active oxygen, wt %, min	10.8	10.8
tert-Butyl hydroperoxide, %, max	---	0.10
Specific gravity (20°/20°C)	---	0.791
(25°/25°C)	0.785 to 0.790	---
Refractive index (25°C)	1.3850 to 1.3900	1.386
Freezing point, °C	<-40	---
Boiling point (760 mm Hg), °C	111	111
Flash point (closed cup), °F (°C)	76 (24.4)	50 (10)
Viscosity (20°C), centipoise (mPa.s)	85	---
Half-life temperature (10 hr), °C		
(0.2M-solution in benzene)	126	126

MIL-STD-1447

5.2.5.3.3 Use. Di(tert-butyl) peroxide is intended for use as a polymerization initiator for the production of low density polyethylene, polyacrylates, polystyrene, polyisoprene, allyl polymers, and acrylonitrile-butadiene-styrene resins. It can be dispersed in monomers up to 90°C without initiating a reaction. It is also used for curing elastomers.

5.2.5.3.4 Safety. Di(tert-butyl) peroxide is a flammable liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.5.3.5 Storage. Di(tert-butyl) peroxide shall be stored in approved containers in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 100°F (38°C).

5.2.5.3.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Di(tert-butyl) peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.5.4 Name. Dicumyl Peroxide $C_6H_5C(CH_3)_2OO(CH_3)_2CC_6H_5$ FW: 270.37

5.2.5.4.1 Technical description. The characteristics of the pure compound are not available. The compound is a crystalline solid at 25°C. The theoretical active oxygen content is 5.92 percent. It is insoluble in water. It is soluble in a variety of organic solvents, such as aromatic hydrocarbons, alcohols, ethers, esters, and chlorinated hydrocarbons.

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

Dicumyl peroxide is available from two manufacturers as a recrystallized grade, with the specification requirements and typical properties shown in Table XLVI.

TABLE XLVI. Dicumyl Peroxide - chemical requirements and typical properties.

Dicumyl peroxide, wt %	98 to 100 active	99 min
Active oxygen, wt %, min	---	5.87
Specific gravity		
Solid (25°/25°C)	1.02	---
Liquid (50°/50°C)	1.014	---
Liquid (40°C)	---	1.00
Refractive index (43°C)	---	1.5280
Melting point, °C	38	38
Viscosity, centipoise (mPa·s)		
(40°C)	19.1	---
(50°C)	10.6	---
Flash point (closed cup), °F (°C)	260 (127)	200 (93)
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	---	115

MIL-STD-1447

Dicumyl peroxide is also available from these manufacturers as a semi-crystalline solid, technical grade, with a purity of 94 to 97 percent. It is also available with an assay 91.0 to 93.0 weight percent, and an active oxygen content of 5.40 to 5.45 percent.

5.2.5.4.3 Use. Dicumyl peroxide is intended for use as a polymerization catalyst, and also as a crosslinking and curing agent for elastomers and polyester resins.

5.2.5.4.4 Safety. Dicumyl peroxide is a burnable solid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.5.4.5 Storage. Dicumyl peroxide shall be stored in approved containers in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 100°F (38°C).

5.2.5.4.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Dicumyl peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.5.5 Name. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane
 $(\text{CH}_3)_3\text{COOC}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{C}(\text{CH}_3)_2\text{OOC}(\text{CH}_3)_3$ FW: 290.45

5.2.5.5.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at 25°C. The theoretical active oxygen content is 11.0 percent. It is insoluble in water. It is soluble in most organic solvents including aliphatic and aromatic hydrocarbons, and chlorinated hydrocarbons.

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

2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane is available from two manufacturers with the specification requirements and typical properties shown in Table XLVII.

TABLE XLVII. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane - chemical requirements and typical properties.

2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane, wt %, min	90.0	90.0
Active oxygen, wt %, min	9.92	9.92
Specific gravity (25°/25°C)	0.877	---
Density (25°C), g/mL, min	---	0.8650
Refractive index (25°C)	1.424	1.4160 (min)
Freezing point, °C	---	<8

MIL-STD-1447

TABLE XLVII. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane - chemical requirements and typical properties (Continued).

Boiling point (760 mm Hg), °C	---	249
Flash point (closed cup), °F (°C)	106 (41)	110 (43)
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	120	119

5.2.5.5.3 Use. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane is intended for use as a crosslinking and curing agent for elastomers and polyester resins, and as a melt flow modifier for polyolefins.

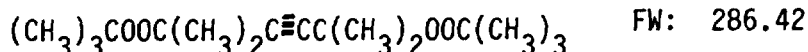
5.2.5.5.4 Safety. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.5.5.5 Storage. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane shall be stored in approved containers in a cool dry place, away from heat sources and combustible material. The maximum storage temperature shall be 100°F (38°C).

5.2.5.5.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.5.6 Name. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3



5.2.5.6.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at 25°C. The theoretical active oxygen content is 11.18 percent. It is insoluble in water. It is soluble in most organic solvents, including aliphatic and aromatic hydrocarbons, and chlorinated hydrocarbons.

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

2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 is available from two manufacturers with the specification requirements and typical properties shown in Table XLVIII.

TABLE XLVIII. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 - chemical requirements and typical properties.

2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3, wt %, min	90.0 to 95.0	90.0 to 95.0
Active oxygen, wt %	10.05 to 10.61	10.05 to 10.61
Specific gravity (25°/25°C)	0.888	0.886 to 0.890

MIL-STD-1447

TABLE XLVIII. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 - chemical requirements and typical properties (Continued).

Refractive index (25°C)	1.431	1.4260 to 1.4300
Freezing point, °C	---	<8
Boiling point (760 mm Hg), °C	---	243
Flash point, (closed cup), °F (°C)	>140 (60)	188 (87)
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	130	128

5.2.5.6.3 Use. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 is intended for use as a crosslinking and curing agent for elastomers and polyester resins, and in the crosslinking of high density polyethylene.

5.2.5.6.4 Safety. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.5.6.5 Storage. 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.5.6.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3 has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.6 Hydroperoxides

5.2.6.1 Name. tert-Amyl Hydroperoxide $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{OOH}$ FW: 104.15
1,1-Dimethylpropyl hydroperoxide

5.2.6.1.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at 25°C. The theoretical active oxygen content is 15.38 percent. It is insoluble in water. It is very soluble in alcohols, esters, ketones, and aliphatic hydrocarbons. It is insoluble in toluene.

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

tert-Amyl hydroperoxide is available from a manufacturer with the specification requirements and typical properties shown in Table XLIX.

MIL-STD-1447

TABLE XLIX. tert-Amyl Hydroperoxide - chemical requirements and typical properties.

tert-Amyl hydroperoxide, wt %, min	85.0
Active oxygen, wt %, min	13.1
Specific gravity (25°/25°C)	0.91
Refractive index (25°C)	1.4107
Freezing point, °C	15
Flash point (closed cup), °F (°C)	109 (43)
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	165
Diluents:	Water, tert-amyl alcohol, di-tert- amyl peroxide

It is available from a second manufacturer as 50 percent (minimum) solutions in odorless mineral spirits and dioctylphthalate with an active oxygen content of 7.7 percent (minimum).

5.2.6.1.3 Use. tert-Amyl hydroperoxide is intended for use as a polymerization initiator, and as a chemical intermediate for the epoxidation of olefins, and the formation of peroxyesters from acyl chlorides.

5.2.6.1.4 Safety. tert-Amyl hydroperoxide is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.6.1.5 Storage. tert-Amyl hydroperoxide shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.6.1.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Amyl hydroperoxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.6.2 Name. tert-Butyl Hydroperoxide (CH₃)₃COOH FW: 90.12

5.2.6.2.1 Technical description. tert-Butyl hydroperoxide (pure) is a liquid with a freezing point of 6°C, a density of 0.8960 g/cm³ at 20°C, and a refractive index of 1.4015, and a boiling point of 35° to 37°C at 17 mm Hg. The pure compound is very shock sensitive. The theoretical active oxygen content is 17.78 percent. It is soluble in water and ether. It is very soluble in alcohols, esters, ketones, and hydrocarbons.

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

MIL-STD-1447

tert-Butyl hydroperoxide is available from a manufacturer with the specification requirements and typical properties shown in Table L.

TABLE L. tert-Butyl Hydroperoxide - chemical requirements and typical properties.

tert-Butyl hydroperoxide, wt %, max	90.0
Active oxygen, wt %	15.98 to 16.88
Specific gravity (25°/25°C)	0.90
Refractive index (25°C)	1.3750
Flash point (closed cup), °F (°C)	95 (35)
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	172
Diluents:	t-Butanol, water

tert-Butyl hydroperoxide is also available as a 70 percent solution in water with an active oxygen content of 12.4 percent, and at a 70 percent concentration with the remainder consisting of di-tert-butyl peroxide, tert-butyl alcohol and water.

5.2.6.2.3 Use. tert-Butyl hydroperoxide is intended for use as a polymerization initiator for various vinyl monomers.

5.2.6.2.4 Safety. tert-Butyl hydroperoxide (90 percent maximum) is a flammable liquid and oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.6.2.5 Storage. tert-Butyl hydroperoxide shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.6.2.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

tert-Butyl hydroperoxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.6.3 Name. Cumene Hydroperoxide $C_6H_5C(CH_3)_2OOH$ FW: 152.18
 α, α -Dimethylbenzyl hydroperoxide
 Isopropylbenzene hydroperoxide

5.2.6.3.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at 25°C. The theoretical active oxygen content is 10.5 percent. It is very slightly soluble in water. It is soluble in most organic solvents, including alcohols, ethers, ketones, and hydrocarbons.

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

MIL-STD-1447

Cumene hydroperoxide is available from two manufacturers with the specification requirements and typical properties shown in Table LI.

TABLE LI. Cumene Hydroperoxide - chemical requirements and typical properties.

Cumene hydroperoxide, wt %	82.0 to 85.0	78.0 min 78 to 85 (typical)
Active oxygen, wt %, typical	8.7 to 8.8	8.7
pH value (water extract), min	4.0	---
Specific gravity (25°/25°C)	1.05	1.10
Refractive index (25°C)	---	1.5185
Flash point (closed cup), °F (°C)	162 (72)	170 (77)
Viscosity (15.6°C), centipoise (mPa.s)	24	---
Half-life temperature (10 hr), °C (0.2M-solution in benzene)	---	158
Half-life temperature (10 hr), °C (0.1M-solution in benzene)	157	---
Nonperoxidic content:	Cumene and its alcohol and ketone derivatives	

5.2.6.3.3 Use. Cumene hydroperoxide is intended for use as a polymerization initiator, and as a curing agent for polyester resins. It can also be used in the styrenation and vinylation of oils and alkyds.

5.2.6.3.4 Safety. Cumene hydroperoxide is a combustible liquid and an oxidizer. It can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

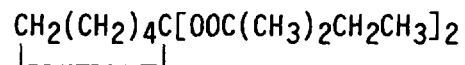
5.2.6.3.5 Storage. Cumene hydroperoxide shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.6.3.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Cumene hydroperoxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.7 Peroxyketals

5.2.7.1 Name. 1,1-Di(tert-amylperoxy)cyclohexane FW: 288.4
1,1-Bis(tert-amylperoxy)cyclohexane



5.2.7.1.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at 25°C. The theoretical active oxygen content is 11.1 percent. It is insoluble in water. It is soluble in most organic solvents.

MIL-STD-1447

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

1,1-Di(tert-amylperoxy)cyclohexane is available from a manufacturer as a 79.0 to 81.0 percent solution in butyl benzyl phthalate with an active oxygen content of 8.77 to 8.99 percent. The compound is available from a second manufacturer as a 70 percent solution in a phthalate ester with an active oxygen content of 7.76 percent. The half-life temperature (10 hour) of the compound is 93°C (0.2-M solution in benzene).

5.2.7.1.3 Use. 1,1-Di(tert-amylperoxy)cyclohexane is intended for use as a polymerization initiator of vinyl monomers such as styrene and ethylene. It is also used for the crosslinking of various elastomers, and for the high temperature curing of unsaturated polyester resins.

5.2.7.1.4 Safety. 1,1-Di(tert-amylperoxy)cyclohexane solutions in butylbenzyl phthalate and phthalate ester plasticizer are combustible liquids and an oxidizer. They can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.7.1.5 Storage. 1,1-Di(tert-amylperoxy)cyclohexane shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.7.1.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

1,1-Di(tert-amylperoxy)cyclohexane has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.7.2 Name. 1,1-Di(tert-butylperoxy)cyclohexane FW: 260.36
 1,1-Bis(tert-butylperoxy)cyclohexane $\text{CH}_2(\text{CH}_2)_4\text{C}[\text{OOC}(\text{CH}_3)_3]_2$

5.2.7.2.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at room temperature. The theoretical active oxygen content is 12.28 percent. It is insoluble in water. It is soluble in most organic solvents.

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

1,1-Di(tert-butylperoxy)cyclohexane is available from a manufacturer as 79.0 to 81.0 percent solutions in butylbenzyl phthalate and odorless mineral spirits with an active oxygen content of 9.70 to 9.95 percent. The compound is available from a second manufacturer as a 75 percent solution in a phthalate ester with a nominal active oxygen content of 9.09 percent. The half-life temperature (10 hour) of the compound is 93°C (0.2-M solution in benzene).

MIL-STD-1447

5.2.7.2.3 Use. 1,1-Di(tert-butylperoxy)cyclohexane is intended for use as a polymerization initiator, as a crosslinking agent, and for the high temperature curing of polyester resins.

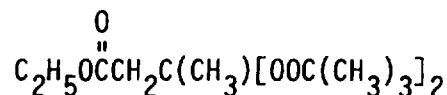
5.2.7.2.4 Safety. 1,1-Di(tert-butylperoxy)cyclohexane solutions in butyl benzyl phthalate and odorless mineral spirits are combustible liquids and oxidizers. They can emit irritating and toxic fumes if heated to decomposition. It can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.7.2.5 Storage. 1,1-Di(tert-butylperoxy)cyclohexane shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.7.2.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

1,1-Di(tert-butylperoxy)cyclohexane has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.2.7.3 Name. Ethyl-3,3-di(tert-butylperoxy)butyrate FW: 292.36
Ethyl-3,3-bis(tert-butylperoxy)butyrate



5.2.7.3.1 Technical description. The characteristics of the pure compound are not available. The compound is a liquid at 25°C. The theoretical active oxygen content is 10.95 percent. It is insoluble in water. It is soluble in most organic solvents.

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

Ethyl-3,3-di(tert-butylperoxy)butyrate is available from a manufacturer as a 75.0 to 77.0 percent solution in odorless mineral spirits with an active oxygen content of 8.21 to 8.42 percent. The compound is available from a second manufacturer as a 75 percent (minimum) solution in a phthalate ester plasticizer with an active oxygen content of 8.20 percent (minimum). The half-life temperature (10 hour) of the compound is 111°C (0.2-M solution in benzene).

5.2.7.3.3 Use. Ethyl-3,3-di(tert-butylperoxy)butyrate is intended for use as a high temperature vinyl polymerization initiator, and as a high temperature crosslinking agent for curing unsaturated polyesters, butadiene-styrene resins, polyacrylates, low density polyethylene, and copolymers of ethylene.

5.2.7.3.4 Safety. Ethyl-3,3-di(tert-butylperoxy)butyrate solutions in odorless mineral spirits and phthalate ester plasticizer are combustible liquids and oxidizers. They can emit irritating and toxic fumes if heated to de-

MIL-STD-1447

composition. They can be irritating to the eyes, skin, and respiratory tract. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.7.3.5 Storage. Ethyl-3,3-di(tert-butylperoxy)butyrate shall be stored in approved containers in a cool dry place, away from heat sources and combustible materials. The maximum storage temperature shall be 100°F (38°C).

5.2.7.3.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent. In case of large liquid spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Ethyl-3,3-di(tert-butylperoxy)butyrate has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

MIL-STD-1447

NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This standard is intended to cite nomenclature, formulas, physical and chemical properties, specification requirements, military and typical commercial uses, safety information, storage information and disposal information for Ethers and Organic Peroxides, Technical Grade preferred for application by the Department of Defense.

6.2 Issue of DODISS. When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1, and 2.2).

6.3 Subject term (key word) listing.

Acetyl acetone peroxide
 Acetyl peroxide
 tert-Amyl hydroperoxide
 tert-Amyl peroctoate
 tert-Amyl peroxy-2-ethylhexanoate
 tert-Amyl peroxybenzoate
 tert-Amylperbenzoate
 Benzoyl peroxide
 1,1-Bis(tert-amylperoxy)cyclohexane
 Bis(2-butoxyethyl) ether
 1,1-Bis(tert-butylperoxy)cyclohexane
 α, α' -Bis(tert-butylperoxy)diisopropylbenzene
 Bis(2-ethylhexyl) peroxydicarbonate
 Bis[2-(2 methoxyethoxy) ethyl] ether
 Bis(3,5,5-trimethylhexanoyl) peroxide
 Butanedioic peroxide
 2-Butanone peroxide
 Butoxydiethylene glycol
 2-Butoxyethanol
 2-(2-Butoxyethoxy) ethanol
 tert-Butyl cumyl peroxide
 Butyl diglyme
 tert-Butyl hydroperoxide
 tert-Butyl peracetate
 tert-Butyl perbenzoate
 sec-Butyl percarbonate
 tert-Butyl perisobutyrate
 tert-Butyl peroxide
 tert-Butyl peroxyacetate
 tert-Butyl peroxybenzoate
 tert-Butyl peroxy-cis-butenedioic acid
 tert-Butyl peroxy-2,2-dimethylpropionate
 tert-Butyl peroxy 2-ethylhexanoate
 tert-Butyl peroxy-2-ethyl-2-methylheptanoate
 tert-Butyl peroxyisobutyrate
 tert-Butyl peroxy maleic acid
 tert-Butyl peroxyneodecanoate

MIL-STD-1447

tert-Butyl peroxyvalate
 tert-Butylperoctoate
 Cumene hydroperoxide
 Diacetyl peroxide
 Diacyl peroxides
 Dialkyl peroxides
 1,1-Di(tert-amylperoxy)cyclohexane
 Dibenzoyl peroxide
 Dibutoxydiethylene glycol
 Di(tert-butyl) peroxide
 1,1-Di(tert-butylperoxy)cyclohexane
 Di-sec-butyl peroxydicarbonate
 α, α' -Di(tert-butylperoxy)diisopropylbenzene
 Dicumyl peroxide
 Didodecanoyl peroxide
 Diethyl ether
 Diethylene dioxide
 Diethylene ether
 Diethylene glycol dibutyl ether
 Diethylene glycol monobutyl ether
 Diethylene glycol monoethyl ether
 Diethylene glycol monomethyl ether
 Di(2-Ethylhexyl)peroxydicarbonate
 Diisononanoyl peroxide
 Dimethoxytetraethylene glycol
 α, α' -Dimethylbenzyl hydroperoxide
 2,5-Dimethyl-2,5-bis(benzoylperoxy)hexane
 2,5-Dimethyl-2,5-bis(2-ethylhexanoylperoxy)hexane
 2,5-Dimethyl-2,5-di(benzoylperoxy)hexane
 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane
 2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3
 2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane
 1,1-Dimethylpropyl hydroperoxide
 1,4-Dioxane
 p-Dioxane
 Di-n-propyl peroxydicarbonate
 Disuccinyl peroxide
 Di(3,5,5-Trimethylhexanoyl) peroxide
 Ethanoyl peroxide
 Ethers
 Ethoxydiethylene glycol
 Ethoxyethane (IUPAC)
 2-Ethoxyethanol (IUPAC)
 2-(2-Ethoxyethoxy) ethanol
 Ethyl ether
 Ethyl-3,3-bis(tert-butylperoxy)butyrate
 Ethyl-3,3-di(tert-butylperoxy)butyrate
 Ethylene glycol monobutyl ether
 Ethylene glycol monoethyl ether
 Ethylene glycol monomethyl ether
 2-Ethylhexylpercarbonate
 Exposure limits, hazardous chemicals
 Hazardous wastes, disposal and storage of
 Hydroperoxides

MIL-STD-1447

Information, hazardous chemicals
Isopropylbenzene hydroperoxide
Ketone peroxides
Lauroyl peroxide
Methoxydiethylene glycol
2-Methoxyethanol
2-(2-Methoxyethoxy) ethanol
Methyl ethyl ketone peroxide
Organic peroxides
2,4-Pentanedione peroxide
Peroxides, organic
Peroxydicarbonates
Peroxyesters
Peroxyketals
n-Propyl percarbonate
Safety, hazardous chemicals
Succinic acid peroxide
Tetraethylene glycol dimethyl ether
Tetraglyme

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

MIL-STD-1447

INDEX

	<u>PARAGRAPH NUMBERS</u>	<u>PAGE</u>
Abbreviations	6.3	62
Acetyl acetone peroxide	5.2.2.1	30
Acetyl peroxide	5.2.1.1	25
tert-Amyl hydroperoxide.	5.2.6.1	53
tert-Amyl peroctoate	5.2.4.2	37
tert-Amyl peroxy-2-ethylhexanoate.	5.2.4.2	37
tert-Amyl peroxybenzoate	5.2.4.1	36
tert-Amylperbenzoate	5.2.4.1	36
Application	1.2	1
Benzoyl peroxide	5.2.1.2	26
1,1-Bis(tert-amylperoxy)cyclohexane.	5.2.7.1	56
Bis(2-butoxyethyl) ether	5.1.1	10
1,1-Bis(tert-butylperoxy)cyclohexane	5.2.7.2	57
α, α' -Bis(tert-butylperoxy)diisopropylbenzene	5.2.5.1	47
Bis(2-ethylhexyl) peroxydicarbonate.	5.2.3.2	33
Bis[2-(2-methoxyethoxy) ethyl] ether	5.1.10	22
Bis(3,5,5-trimethylhexanoyl) peroxide.	5.2.1.3	27
Butanedioic peroxide	5.2.1.5	29
2-Butanone peroxide.	5.2.2.2	31
Butoxydiethylene glycol.	5.1.2	11
2-Butoxyethanol.	5.1.7	17
2-(2-Butoxyethoxy) ethanol	5.1.2	11
tert-Butyl cumyl peroxide.	5.2.5.2	48
Butyl diglyme.	5.1.1	10
tert-Butyl hydroperoxide	5.2.6.2	54
tert-Butyl peracetate.	5.2.4.3	38
tert-Butyl perbenzoate	5.2.4.4	39
sec-Butyl percarbonate	5.2.3.1	32
tert-Butyl perisobutyrate.	5.2.4.6	41
tert-Butyl peroxide.	5.2.5.3	49
tert-Butyl peroxyacetate	5.2.4.3	38
tert-Butyl peroxybenzoate.	5.2.4.4	39
tert-Butyl peroxy-cis-butenedioic acid	5.2.4.7	42
tert-Butyl peroxy-2,2-dimethylpropionate	5.2.4.9	44
tert-Butyl peroxy 2-ethylhexanoate	5.2.4.5	40
tert-Butyl peroxy-2-ethyl-2-methylheptanoate	5.2.4.8	43
tert-Butyl peroxyisobutyrate	5.2.4.6	41
tert-Butyl peroxy maleic acid	5.2.4.7	42
tert-Butyl peroxyneodecanoate.	5.2.4.8	43
tert-Butyl peroxy pivalate.	5.2.4.9	44
tert-Butylperoctoate	5.2.4.5	40
Chemical hazardous exposure limits	4.3.3	7
Cleanup of liquid spills	4.4.3.1	8
Cumene hydroperoxide	5.2.6.3	55
Definitions.	3	4
Detailed requirements.	5	10
Diacetyl peroxide.	5.2.1.1	25
Diacyl peroxides	5.2.1	25
Dialkyl peroxides	5.2.5	47

MIL-STD-1447

INDEX (Continued)

	<u>PARAGRAPH NUMBERS</u>	<u>PAGE</u>
1,1-Di(tert-amylperoxy)cyclohexane	5.2.7.1	56
Dibenzoyl peroxide	5.2.1.2	26
Dibutoxydiethylene glycol	5.1.1	10
Di(tert-butyl) peroxide	5.2.5.3	49
1,1-Di(tert-butylperoxy)cyclohexane	5.2.7.2	57
Di-sec-butyl peroxydicarbonate	5.2.3.1	32
α , α' -Di(tert-butylperoxy)diisopropylbenzene	5.2.5.1	47
Dicumyl peroxide	5.2.5.4	50
Didodecanoyl peroxide	5.2.1.4	28
Diethyl ether	5.1.5	14
Diethylene dioxide	5.1.6	16
Diethylene ether	5.1.6	16
Diethylene glycol dibutyl ether	5.1.1	10
Diethylene glycol monobutyl ether	5.1.2	11
Diethylene glycol monoethyl ether	5.1.3	12
Diethylene glycol monomethyl ether	5.1.4	13
Di(2-ethylhexyl)peroxydicarbonate	5.2.3.2	33
Diisononanoyl peroxide	5.2.1.3	27
Dimethoxytetraethylene glycol	5.1.10	22
α , α -Dimethylbenzyl hydroperoxide	5.2.6.3	55
2,5-Dimethyl-2,5-bis(benzoylperoxy)hexane	5.2.4.10	45
2,5-Dimethyl-2,5-bis(2-ethylhexanoylperoxy)hexane	5.2.4.11	46
2,5-Dimethyl-2,5-di(benzoylperoxy)hexane	5.2.4.10	45
2,5-Dimethyl-2,5-di(tert-butylperoxy)hexane	5.2.5.5	51
2,5-Dimethyl-2,5-di(tert-butylperoxy)hexyne-3	5.2.5.6	52
2,5-Dimethyl-2,5-di(2-ethylhexanoylperoxy)hexane	5.2.4.11	46
1,1-Dimethylpropyl hydroperoxide	5.2.6.1	53
1,4-Dioxane	5.1.6	16
p-Dioxane	5.1.6	16
Di-n-propyl peroxydicarbonate	5.2.3.3	35
Disclaimer	4.4.4	9
Disposal and storage of hazardous wastes	4.4.3	8
Disposal of excess or unserviceable material	4.4.2	8
Disuccinyl peroxide	5.2.1.5	29
Di(3,5,5-trimethylhexanoyl) peroxide	5.2.1.3	27
EPA acute hazardous toxicity (H)	4.3.4.2	7
EPA extraction procedure toxicity (EP toxicity) (E)	4.3.4.3	7
EPA toxic (T)	4.3.4.1	7
Ethanoyl peroxide	5.2.1.1	25
Ethers	5.1	10
Ethoxydiethylene glycol	5.1.3	12
Ethoxyethane (IUPAC)	5.1.5	14
2-Ethoxyethanol (IUPAC)	5.1.8	19
2-(2-Ethoxyethoxy) ethanol	5.1.3	12
Ethyl ether	5.1.5	14
Ethyl-3,3-bis(tert-butylperoxy)butyrate	5.2.7.3	58
Ethyl-3,3-di(tert-butylperoxy)butyrate	5.2.7.3	58
Ethylene glycol monobutyl ether	5.1.7	17
Ethylene glycol monoethyl ether	5.1.8	19

MIL-STD-1447

INDEX (Continued)

	<u>PARAGRAPH NUMBERS</u>	<u>PAGE</u>
Ethylene glycol monomethyl ether	5.1.9	21
2-Ethylhexylpercarbonate	5.2.3.2	33
Exercises	4.3.1.5	6
Face and eye protection	4.3.1.3	5
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	4.3.4.4	7
Hydroperoxides	5.2.6	53
Incompatible materials	4.3.2.3	7
Intended use	6.1	60
Isopropylbenzene hydroperoxide	5.2.6.3	55
Ketone peroxides	5.2.2	30
Lauroyl peroxide	5.2.1.4	28
Methoxydiethylene glycol	5.1.4	13
2-Methoxyethanol	5.1.9	21
2-(2-Methoxyethoxy) ethanol	5.1.4	13
Methyl ethyl ketone peroxide	5.2.2.2	31
Notes	6	60
Order of precedence	2.3	3
Organic Peroxides	5.2	24
Other Government documents, drawings, and publications .	2.1.2	2
Other publications	2.2	3
Packaging data and labeling	4.1	5
2,4-Pentanedione peroxide	5.2.2.1	30
Peroxydicarbonates	5.2.3	32
Peroxyesters	5.2.4	36
Peroxyketals	5.2.7	56
n-Propyl percarbonate	5.2.3.3	35
Personal protective measures	4.3.1	5
Pollution and disposal	4.4	7
Pollution potential	4.4.1	7
Purpose	1.1	1
Referenced documents	2	2
Respiratory protection	4.3.1.1	5
Safety	4.3	5
Scope	1	1
Skin protection	4.3.1.2	5
Specifications, standards, and handbooks	2.1.1	2
Storage conditions	4.3.2	6
Subject term (key word) listing	6.2	60
Succinic acid peroxide	5.2.1.5	29
Tetraethylene glycol dimethyl ether	5.1.10	22
Tetraglyme	5.1.10	22
Toxicity	4.3.4	7
Training	4.3.1.4	6
Ultimate disposal	4.4.3.2	9
Water-sensitive fire and explosive hazardous materials .	4.3.2.2	6

MIL-STD-1447

Custodians:

Army - EA
Navy - SH
Air Force - 68

Preparing activity: Army - EA

Agent: DLA - GS

Project Number: 6810-1096

Review activities:

Army - AR, AV, MD
Navy - AS, OS
DLA - DM, GS

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

(Fold along this line)

(Fold along this line)



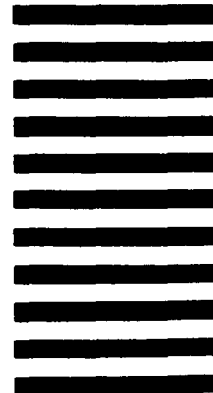
NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 4966 Alexandria, VA

POSTAGE WILL BE PAID BY

Commander
U.S. Army Chemical Research, Development
and Engineering Center
ATTN: SMCCR-SPT-S
Aberdeen Proving Ground, MD 21010-5423



STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

MIL-STD-1447

2. DOCUMENT TITLE

ETHERS AND ORGANIC PEROXIDES, TECHNICAL GRADE (METRIC)

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

 VENDOR USER MANUFACTURER OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)