

METRIC

MIL-STD-1442

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MILITARY STANDARD
INORGANIC PEROXIDES, TECHNICAL GRADE



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DEPARTMENT OF DEFENSE
Washington, DC 20301

Inorganic Peroxides, Technical Grade

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2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Chemical Research, Development and Engineering Center, Attn: SMCCR-SPD-TS, Aberdeen Proving Ground, MD 21010-5423, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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FOREWORD

This standard is approved for use by all Departments and Agencies of the Department of Defense in the selection of items for application. It is intended to prevent the entry of unnecessary items (sizes, types, varieties) into the Department of Defense logistics system. This document is not intended to restrict any service in selecting new items resulting from state-of-the-art changes.

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1. SCOPE

1.1 Coverage. This standard is a presentation of nomenclature, formulas, physical and chemical properties, specification requirements, military and typical commercial uses, safety information, storage information and disposal information for inorganic peroxides, technical grade. This standard does not necessarily 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 inorganic peroxides, technical grade, for application by the Department of Defense.

1.2 Application. Inorganic metal peroxides, technical grade, are used mainly as oxidants for application in pyrotechnic mixtures, bleaching agents, and rubber curing agents. Hydrogen peroxide, technical grade, is mainly used for application in propulsion systems.

1.3 Classification. The items in this standard are classified on the basis of chemical composition as inorganic peroxides, technical grade.

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2. REFERENCED DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS

FEDERAL

PPP-C-2020 - Chemicals, Liquid, Dry and Paste, Packaging of

MILITARY

MIL-B-153 - Barium Peroxide
 MIL-S-612 - Strontium Peroxide
 MIL-H-22868 - Hydrogen Peroxide, E-Stabilized, 70% and 90% (For Torpedo Use).

STANDARDS

FEDERAL

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

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

CODE OF FEDERAL REGULATIONS (CFR)

Title 29 - Department Of Labor, Occupational Safety And Health Agency;
 General Industry Standards And Interpretations
 Title 40 - Environmental Protection Agency; Hazardous Waste And
 Consolidated Permit Regulations
 Title 49 - Department Of Transportation; Hazardous Materials Regulations

DEPARTMENT OF DEFENSE PUBLICATIONS

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

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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

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

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

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

AMERICAN CONFERENCE OF GOVERNMENT INDUSTRIAL HYGIENISTS (ACGIH)

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

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

ASTM

ASTM E 11 - Standard Specification for Wire-Cloth Sieves For Testing Purposes

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.)

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

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

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3. DEFINITIONS

3.1 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.

3.2 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.

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

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4. GENERAL REQUIREMENTS

4.1 Packaging data and labeling. All chemicals included in this standard shall be packaged in accordance with Federal Specification PPP-C-2020 and all applicable documents referenced therein. Shipping containers shall be labeled in accordance with current Department of Transportation (DOT) Hazardous Materials Regulations applicable to each chemical. When shipping by military aircraft the requirements of TM 38-250 shall apply. In addition, each item shall be packaged and labeled as specified in the applicable contract or order. All labels shall also comply with Hazard Communication Standard, 29 CFR 1910.1200 (f).

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

4.3 Safety.

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

4.3.1.1 Respiratory protection. Respirators, approved by the National Institute for Occupational Safety and Health (NIOSH) or the Mine Safety and Health Administration (MSHA) or by particular respiratory schedules of the Bureau of Mines (BM) for the compounds being used, may be employed for intermittent exposure or for supplementing other control measures (refer to TB MED 502 or DLAM 1000.2). Ventilation shall be adequate to remove hazardous concentrations.

4.3.1.2 Skin protection. Personnel using these compounds shall be provided with and required to use impervious gloves, sleeves, aprons, and boots whenever indicated. Protective creams and ointments commonly known as "barrier creams" may be of value in certain cases. However, barrier creams shall not be used to replace protective clothing. In case of contact with the skin, wash affected areas thoroughly with water. Eye lavages and emergency showers shall be located where there is a potential for direct contact with harmful chemicals.

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

4.3.1.4 Training. Employers shall provide employees with training and information including MSDSs on all chemical items in their work area, in accordance with 29 CFR 1910.1200 (h), to ensure that employees know potential

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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. Otherwise, the building shall conform to that required for storage of flammable materials. The building shall be waterproof, located on high ground, and separated from other storage areas.

*Refers only to materials that have become waste materials.

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4.3.2.3 Incompatible materials. Materials that are chemically incompatible shall be segregated in the storage of both serviceable and unserviceable items. The degree of segregation will depend upon DOD 4145.19-R-1 and local supplementary requirements that insure safe storage conditions. Hazardous storage compatibility codes are provided in the HMIS referred to in 4.2.

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

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

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

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

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

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

4.4 Pollution and disposal.

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

4.4.2 Disposal of excess or unserviceable material. To minimize disposal problems, it is recommended that no more than a one year's supply of each item listed in this standard be stocked. When stocks have been declared excess or unserviceable, they will be disposed of in accordance with the Defense Utiliza-

*Refers only to materials that have become waste materials.

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tion and Disposal Manual, DOD 4160.21-M, and applicable DOD Policy Memoranda. Guidance can be obtained from your servicing Defense Reutilization and Marketing Office (DRMO) on procedures required for proper reporting and turn-in.

4.4.3 Disposal and storage of hazardous wastes. Items are classified and managed as hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA) (Public Law 94-580). Items have been identified as meeting the characteristics (i.e., ignitable, corrosive, reactive or EP toxic) or are listed (i.e., toxic or acute hazardous) according to Identification and Listing of Hazardous Waste, Part 261; 40 CFR; or have been determined to be hazardous wastes by declaration of the Defense Reutilization and Marketing Service (DRMS) in accordance with procedures set forth in DOD 4160.21-M. Disposal of such items shall be managed in accordance with the Installation Environmental Office, the DRMO, or the Safety and Health Office to insure proper reporting of disposal and treatment actions to the US EPA and State; and shall be managed in accordance with Federal, State and local laws. The three main disposal methods are turn-in to the DRMO, on-post disposal by installation personnel, or disposal by commercial contract. Hazardous wastes that cannot be used, or disposed of as stated in 4.4.3.2, shall be stored under environmentally safe conditions until suitable methods of disposal are determined. Short-term storage (less than 90 days) requires proper containment (i.e., packaging and facilities) in accordance with Section 262.34, Part 262 of the above reference. Long-term storage (greater than 90 days) requires permitting by the EPA or by the state under Public Law 94-580 (RCRA), in compliance with the requirements of 40 CFR Parts 264 and 265. Physical custody will be accomplished by the activity with conforming storage or most nearly conforming storage. When physical custody is in question, the Post Commander will make the final decision. In all cases where the wastes are to be collected, stored, transported and disposed of at a state or local permitted disposal facility, the identity and description of the waste shall be maintained and recorded in accordance with Part 262 of the above reference. Transportation of the waste shall be in accordance with Part 263 of the above reference, Standards Applicable to Transporters of Hazardous Waste.

4.4.3.1 Cleanup of liquid spills. To control the migration of spilled or leaking liquids, dike around the item with an inert, dry absorbent (e.g., clay, sawdust or vermiculite) or follow installations spill plans (Spill Prevention Control and Countermeasure Plan and Installations Spill Contingency Plan). Control entry to the spill site and segregate salvageable materials away from the spill area. Initiate waste cleanup operations immediately in accordance with local procedures. The residue shall be safely handled and transported to an approved or permitted disposal or storage facility. Packaging, labeling, transportation and record-keeping requirements for this waste material are determined by the appropriate Federal and State agencies and local procedures. It is recommended that all activities involving disposal preparation and transportation to commercial facilities be properly coordinated with the appropriate Federal and State agencies responsible for health and environmental aspects of hazardous materials. It is imperative that the proper description of waste accompany the packaged item at all times. Final disposal of the waste item shall be accomplished by reutilization, transfer, donation or sales by DRMS in accordance with DOD 4160.21-M or by ultimate disposal as described in 4.4.3.2.

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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.

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5. DETAILED REQUIREMENTS

5.1 Name.	Barium Peroxide	BaO ₂	FW 169.34
	Barium binoxide	BaO ₀	
	Barium dioxide	□	
	Barium superoxide		

5.1.1 Technical description. Barium peroxide (pure) is a white-gray powder with a density of 4.96 g/cm³. It has a melting point of 450°C, and a boiling point of 800°C with decomposition and loss of oxygen. It is very slightly soluble in cold water and decomposes in hot water. It is insoluble in acetone. It decomposes by dilute acids with formation of hydrogen peroxide.

5.1.2 Specification. Military, MIL-B-153, Barium Peroxide.

5.1.2.1 Requirements. The military specification describes Grade A, Classes 1 and 2; and Grade B barium peroxide. The barium peroxide shall be grayish-white or tan-white in color. The Grade A barium peroxide shall be manufactured by a dry process to be an anhydrous material consisting essentially of barium peroxide with some barium monoxide and barium carbonate. Grade B barium peroxide shall be manufactured by a wet precipitation method and shall consist of anhydrous barium peroxide. The chemical and physical requirements are shown in Table I. The granulation requirements are shown in Table II.

TABLE I. Barium peroxide - chemical and physical requirements.

REQUIREMENTS	GRADE A		GRADE B
	CLASS 1	CLASS 2	
Moisture, % max	--	--	0.3
Apparent density, g/cm ³ , min	--	--	1.3
Available oxygen, % min	8.5	8.5	8.8
Total iron, % max	--	--	0.03
Strontium, % max	--	--	0.85
Calcium, % max	--	--	0.15
Magnesium, % max	--	--	0.02
Sodium, % max	--	--	0.05
Aluminum, % max	--	--	0.05
Chlorides (as barium chloride), % max	--	--	0.1
Nitrate (as barium nitrate), % max	1/	1/	0.1
Insoluble matter, % max	2.0	2.0	--
Grit, % max	0.005	--	--
Barium content, % min	76.0	76.0	--

1/ To be specified by interested agency.

TABLE II. Barium peroxide - granulation requirements.

US STANDARD SIEVES †	GRADE A		GRADE B
	CLASS 1	CLASS 2	
Passing through	Percent by weight, min		
No. 100 (150 micrometer)	99.9	--	100
No. 140 (106 micrometer)	--	--	95
No. 170 (90 micrometer)	98.0	--	--
No. 200 (75 micrometer)	--	99.9	--
No. 325 (45 micrometer)	90.0	--	--

† Standard sieve designations in accordance with ASTM E 11.

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5.1.3 Use. Barium peroxide is used as an oxidizer (oxidizing agent). Grade A is intended for use in pyrotechnic mixtures. Grade B is intended for use in ignition and tracer compositions. Commercial uses are as a bleaching agent for materials of vegetable and animal origin. It is used for the production of hydrogen peroxide by reaction with sulfuric acid. A byproduct of this reaction is barium sulfate (blanc fixe).

5.1.4 Safety. Barium peroxide is a strong oxidizer. Mixtures with reducing agents or combustible organic material are explosive and can be ignited easily by friction or contact with a small amount of water. It reacts with water to generate heat. As a soluble barium compound, barium peroxide is toxic when ingested. The PEL and TLV is 0.5 mg/m^3 , as Ba, and breathing of dust shall be avoided. It is an irritant to skin, eyes, mucous membranes, and respiratory tract. In case of contact with the skin, flush affected areas with water for at least 20 minutes and obtain medical attention. (Refer to 4.3.1)

5.1.5 Storage. Barium peroxide shall be stored in tightly sealed containers in a cool dry place away from heat sources, direct sunlight, and oxidizable materials. (Refer to 4.3.2)

5.1.6 Disposal. In case of spills, recover in dry state. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

Barium peroxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001; and EP Toxic, Waste No. D005.

5.2 <u>Name</u> . Calcium Peroxide	CaO ₂	FW 72.00
Calcium binoxide	CaO	
Calcium dioxide	—	
Calcium superoxide		

5.2.1 Technical description. Calcium peroxide (pure) is in the form of white tetragonal crystals with a density of 2.92 g/cm^3 . It melts at 275°C with decomposition. It is slightly soluble in cold water and soluble in alcohol. It is decomposed by dilute acids with formation of hydrogen peroxide.

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

5.2.2.1 Requirements. The commercial specification requirements are for a material with a composition, as CaO₂, of 60 percent by weight minimum, and an active oxygen content of 13.3 percent by weight minimum.

5.2.3 Use. Calcium peroxide is used as a curing agent for certain rubber compounds, a starch modifier, a high temperature oxidant, and as a dough conditioner in the baking industry.

5.2.4 Safety. Calcium peroxide is a strong oxidizer. Mixtures with reducing agents or combustible organic material are explosive and can be ignited easily by friction or contact with a small amount of water. Contact with catalytically active metals shall be avoided. There is no PEL or TLV referenced for this compound. Calcium peroxide is an irritant to the skin, eyes, mucous membranes, and respiratory tract, and breathing of dust shall be avoided. In

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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. (Refer to 4.3.1)

5.2.5 Storage. Calcium peroxide shall be stored in tightly sealed containers in a cool dry place away from heat sources, direct sunlight, and oxidizable material. (Refer to 4.3.2)

5.2.6 Disposal. In case of spills, recover in dry state. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.3 <u>Name</u> . Hydrogen Peroxide	H ₂ O ₂	FW 34.01
Hydrogen dioxide	HOOH	

5.3.1 Technical description. Hydrogen peroxide (pure) is a colorless liquid with a slightly acid odor. It has a density of 1.422 g/cm³ at 25°C and an index of refraction of 1.414 at 22°C. It has a melting point of -0.41°C, and a boiling point of 150.2°C at 760 mm Hg. It is miscible with water, alcohol, and ether. Hydrogen peroxide is an active oxidizing agent with strong reducing agents, and is reduced to water by such reactions. Hydrogen peroxide is also a reducing agent with strong oxidizing agents, and evolves oxygen by such reactions. Hydrogen peroxide is a weak acid in aqueous solutions. Hydrogen peroxide is thermally unstable, and decomposes to water and oxygen with evolution of heat. The decomposition is catalyzed by bases and heavy metal ions. Hydrogen peroxide decomposition can be slowed by means of stabilizer compounds.

5.3.2 Specification. Military, MIL-H-22868, Hydrogen Peroxide, E-Stabilized, 70 percent and 90 percent (For Torpedo Use).

5.3.2.1 Requirements. The military specification covers aqueous solutions of hydrogen peroxide in which additives have been dissolved to impart a low decomposition rate, to repress the effect of accidental catalytic contamination, and to prevent corrosion of aluminum containers. Such hydrogen peroxide solutions are designated as "E" stabilized. The stabilized hydrogen peroxide shall be of two grades:

- Grade 70E - 70 percent hydrogen peroxide by weight
- Grade 90E - 90 percent hydrogen peroxide by weight

Both grades shall be clear, colorless solutions of hydrogen peroxide and additives in water. The concentrations specified shall not vary by more than plus 1.0 or minus 0.5 percent. The stabilized solutions shall contain the following additives:

- Sodium stannate (Na₂SnO₃·3H₂O) to provide a tin (Sn) concentration of 32₋₄⁺⁴ mg/L.
- Sodium phosphate, dibasic (Na₂HPO₄·12H₂O) to provide a phosphate (PO₄) concentration of 29₋₄⁺⁴ mg/L.
- Sodium nitrate (NaNO₃) and nitric acid to provide a nitrate (NO₃) concentration of 110₋₂₀⁺²⁰ mg/L, and for pH adjustment.

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The acidity (apparent pH) of the stabilized hydrogen peroxide solution shall be 1.4 ± 0.2 for Grade 70E and 0.2 ± 0.2 for Grade 90E. If necessary, pH adjustment is made by the use of either pure nitric acid or pure sodium hydroxide solutions in pure water. The stability of the stabilized hydrogen peroxide solutions shall be such that the active oxygen content loss shall be not more than 2 percent by weight (maximum) when tested as specified at 100°C for 24 hours. The surface tension of the stabilized hydrogen peroxide solutions shall be no less than 72 dynes/cm for Grade 70E and 74 dynes/cm for Grade 90E at 20°C when tested as specified. Objectionable impurities and evaporation residue shall be limited to the chemical requirements shown in Table III when tested as specified.

TABLE III. Stabilized hydrogen peroxide - chemical requirements.

	GRADE 70E	GRADE 90E
Impurities		
Chloride (as Cl), mg/L, max	1	1
Sulfate (as SO ₄), mg/L, max	10	10
Evaporation residue, mg/L, max	325	325

5.3.3 Use. The E-stabilized hydrogen peroxide solutions are intended for military use as oxidizers in the propulsion systems of chemically powered torpedoes. These solutions are also useful in the propulsion systems of rockets and missiles, and in space vehicle attitude control systems. As monopropellants they catalytically decompose to generate steam; and as bipropellant components, they are oxidants for liquid fuels. Commercial uses include use as a blowing agent for foam rubber, as a bleaching agent for a variety of materials, and as an oxidant in organic synthesis.

5.3.4 Safety. Hydrogen peroxide is an oxidizer that is very reactive. In concentrations of 65 percent or greater, it can cause fires on contact with combustible material. Explosive compositions can be formed by dissolving certain combustible materials in concentrated hydrogen peroxide that can detonate violently under the proper stimulus. Concentrated hydrogen peroxide solutions, above 30 percent, must be protected against contamination to prevent decomposition at a dangerously high rate. Concentrated hydrogen peroxide is not considered to be an explosive, but small amounts of materials containing catalysts (silver, lead, copper, chromium, mercury, and iron rust) can cause decomposition and explosive rupture of a containing vessel if it is not properly vented. Alkaline substances can also react violently with concentrated hydrogen peroxide. Fires caused by hydrogen peroxide can be controlled by using large quantities of water. Hydrogen peroxide solutions are irritating to the skin, eyes, mucous membranes, and respiratory tract. The solutions at moderate concentrations can cause whitening of the skin which gradually returns to normal without any damage. Highly concentrated solutions can cause blistering if left on the skin and can cause severe eye damage. The PEL for hydrogen peroxide (90 percent) is 1 ppm (1.4 mg/m³), and the TLV for hydrogen peroxide is 1 ppm (1.5 mg/m³). The vapor causes discomfort of the eyes and nose. 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. (Refer to 4.3.1)

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5.3.5 Storage. Hydrogen peroxide solutions shall be stored only in approved original containers or in containers of compatible materials which have been properly designed and thoroughly passivated. All containers shall be properly vented and stored in a cool place protected from direct sunlight and away from heat sources, combustible materials, and powdered metals. The storage area shall be well ventilated, fireproof, and provided with a source of water to wash away spillage. Hydrogen peroxide solutions, once removed from the original containers, shall not be returned to them. (Refer to 4.3.2)

5.3.6 Disposal. In case of spills or leaks, dilute with a large quantity of water and flush into drains. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.4 Name. Lithium Peroxide, Anhydrous Li₂O₂
LiOOLi FW 45.88

5.4.1 Technical description. Lithium peroxide (pure) is a fine white powder with a density of 2.14 to 2.36 g/cm³ at 20°C. It decomposes to Li₂O and O₂ at 340°C. It is moderately soluble in water (8 percent at 20°C and 9 percent at 25°C). It is insoluble in absolute alcohol. Its theoretical active oxygen yield is 34.87 percent.

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

5.4.2.1 Requirements. The commercial specification requirements are for a light yellow or tan powder with a typical analysis composition for Li₂O₂ of 94 to 96 percent by weight, and an active oxygen content of 33 percent by weight. The impurities are LiOH and Li₂CO₃.

5.4.3 Use. Lithium peroxide is used as an atmosphere regenerant and chemical oxidant.

5.4.4 Safety. Lithium peroxide is a strong oxidizer and mixtures with organic material are explosive, and can be ignited by friction or contact with a small amount of water. As a soluble lithium compound, lithium peroxide is toxic when ingested since the lithium ion has a high central nervous system toxicity. There is no PEL or TLV referenced for lithium peroxide, but it is an irritant to skin, eyes, mucous membranes, and respiratory tract in low concentrations. After reaction with water, the lithium hydroxide that is formed is very caustic, and can cause chemical burns at high concentrations. 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. (Refer to 4.3.1)

5.4.5 Storage. Lithium peroxide shall be stored in tightly sealed containers in a cool dry place away from heat sources, direct sunlight, and oxidizable material. (Refer to 4.3.2)

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5.4.6 Disposal. In case of spills, recover in dry state. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.5 Name. Strontium Peroxide, Anhydrous SrO_2 FW 119.62
Strontium dioxide SrO
|—|

5.5.1 Technical description. Strontium peroxide (pure) is a white powder with a density of 4.56 g/cm^3 . It has a melting point of 215°C at 760 mm Hg with decomposition. Its solubility in water is 0.018 g/100 mL at 20°C , and it decomposes in hot water. It is very soluble in alcohol and in ammonium chloride solution. It is insoluble in acetone. It is decomposed by dilute acids with formation of hydrogen peroxide.

5.5.2 Specification. Military, MIL-S-612, Strontium Peroxide.

5.5.2.1 Requirements. The military specification describes Grade B and C strontium peroxide in the form of free-flowing white powders. The Grade B strontium peroxide shall be manufactured by the wet precipitation method and shall consist of anhydrous strontium peroxide. The Grade C strontium peroxide shall be manufactured by the wet precipitation method and shall consist of anhydrous strontium peroxide of a definite hygroscopicity requirement to control the stability of the material. The chemical and physical requirements are shown in Table IV, and the granulation requirements are shown in Table V.

TABLE IV. Strontium peroxide - chemical and physical requirements.

REQUIREMENTS	GRADE B	GRADE C
Available oxygen, % min	12.3	12.3
Moisture, % max	--	0.1
Hygroscopicity, % max	--	0.25
Apparent density, g/mL min	1.30-2.00	0.85
Barium, % max	1.0	0.45
Calcium, % max	0.3	0.15
Magnesium, % max	0.05	0.02
Sodium, % max	0.1	0.05
Iron, % max	0.09	0.03
Aluminum, % max	0.1	0.05
Nitrate, calculated as $\text{Sr}(\text{NO}_3)_2$, % max	0.1	0.05
Chloride, calculated as SrCl_2 , % max	0.1	0.10
Total impurities other than SrO , % max	--	--

TABLE V. Strontium peroxide - granulation requirements.

US STANDARD SIEVES †	GRADE B	GRADE C
Passing through	Percent by Weight	
No. 80 (180 micrometer)	--	100
No. 100 (150 micrometer), min	98	98
No. 140 (100 micrometer), min	80	80

† Standard sieve designations in accordance with ASTM E 11.

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5.5.3 Use. Strontium peroxide is intended for military use primarily in tracer igniters and to a lesser extent in basic tracer formulations. Commercial uses as a bleaching agent, and in fireworks compositions.

5.5.4 Safety. Strontium peroxide is a strong oxidizer. Mixtures with reducing agents or combustible organic materials are explosive and can be ignited easily by friction or contact with a small amount of water. It reacts with water to generate heat. There is no PEL or TLV referenced for strontium peroxide, but it is an irritant to eyes, skin, mucous membranes, 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. (Refer to 4.3.1)

5.5.5 Storage. Strontium peroxide shall be stored in tightly sealed containers in a cool dry place away from heat sources, direct sunlight, and oxidizable material. (Refer to 4.3.2)

5.5.6 Disposal. In case of spills, recover in dry state. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

5.6 <u>Name</u> . Zinc Peroxide, Anhydrous	ZnO ₂	FW 97.38
	ZnO	
Zinc dioxide	—	

5.6.1 Technical description. Zinc peroxide, anhydrous, (pure) is a yellowish powder with a density of 1.57 g/cm³. It decomposes explosively at 212°C. It is very slightly soluble in cold water (0.0022 g/100 mL). It dissolves in acid solutions with decomposition and formation of hydrogen peroxide.

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

5.6.2.1 Requirements. The commercial specification requirements are for a yellow-white powder with a composition, as ZnO₂, of 55 percent minimum, and an active oxygen content of 9.0 percent by weight minimum.

5.6.3 Use. Zinc peroxide is used as a curing agent for certain rubber compounds.

5.6.4 Safety. Zinc peroxide is a strong oxidizer. Mixtures with reducing agents or combustible organic material can be ignited by friction or grinding. Contact with catalytically active metals shall be avoided, and apparatus and equipment for handling shall be made of catalytically inactive materials such as aluminum, stainless steel, ceramics, and glass. There is no PEL or TLV referenced for zinc peroxide, but it is an irritant to eyes, skin, mucous membranes, 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. (Refer to 4.3.1)

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5.6.5 Storage. Zinc peroxide shall be stored in tightly sealed containers in a cool dry place away from heat sources, direct sunlight, and oxidizable material. (Refer to 4.3.2)

5.6.6 Disposal. In case of spills, recover in dry state. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4)

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

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6. NOTES

6.1 Subject term (key word) listing.

Barium peroxide
Calcium peroxide
Disposal, hazardous chemicals
Exposure limits, hazardous chemicals
Hydrogen peroxide
Lithium peroxide, anhydrous
Safety, hazardous chemicals
Strontium peroxide, anhydrous
Zinc peroxide, anhydrous

6.2 The use of abbreviations shall be in accordance with MIL-STD-12 where applicable. Metric system abbreviations and symbols shall be in accordance with ASTM E 380.

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Preparing activity: Army - EA

Project Number 6810-1003

Custodians:

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Navy - SH
Air Force - 68

Review activities:

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User activities:

Army - AV, MI
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1. DOCUMENT NUMBER

MIL-STD-1442

2. DOCUMENT TITLE

INORGANIC PEROXIDES, TECHNICAL GRADE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

VENDOR

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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

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