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MILITARY STANDARD

INORGANIC ACIDS AND ACID ANHYDRIDES, TECHNICAL GRADE

DEPARTMENT OF DEFENSE • UNITED STATES OF AMERICA

AMSC N/A

FSC 6810

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FOREWORD

Inorganic Acids and Acid Anhydrides, Technical Grade

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 Technical Director, U.S. Army Edgewood Research, Development and Engineering Center, Attn: SCBRD-ENE (STD/SPECS/PKG), Aberdeen Proving Ground, MD 21010-5423, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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

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LIST OF TABLES

1. SCOPE

1.1 Coverage. This standard is a presentation of nomenclature, Chemical Abstracts Service Registry Numbers, symbols, physical and chemical properties and requirements, military and typical commercial uses, directions for use, packaging data, labeling, general safety precautions, storage information, and shelf life of all military standard technical grade, inorganic acids and acid anhydrides. This standard does not necessarily include all classifications of the items represented by the title or those which are commercially available. It does contain items preferred for use in the selection of inorganic acids and acid anhydrides, for application by the Department of Defense.

1.2 Application. Inorganic acids and acid anhydrides, technical grade, are mainly used as chemical intermediates for the manufacture of other chemical compounds and explosives. Inorganic acids and acid anhydrides are also used in electrochemical applications, the treatment and cleaning of metal surfaces, and the formulation of chemical products for a variety of applications.

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

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS

FEDERAL

O-C-303	-	Chromium Trioxide, Technical
O-N-350	-	Nitric Acid, Technical
O-O-670	-	Othrophosphoric (Phosphoric) Acid, Technical
O-S-801	-	Sulfuric Acid, Electrolyte; For Storage Batteries
O-S-809	-	Sulfuric Acid, Technical
PPP-C-2020	-	Chemicals, Liquid, Dry and Paste; Packaging Of

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JAN-A-179	-	Acid, Sulfuric, and Oleum
JAN-A-183	-	Acid, Nitric (For Ordnance Use)
MIL-A-10840	-	Arsenic Trioxide, Technical
MIL-A-24641	-	Acid, Hydrofluoric, Technical
MIL-M-48146	-	Molybdenum Trioxide, Technical

STANDARDS

FEDERAL

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

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MIL-STD-12	-	Abbreviations For Use On Drawings, And In Specifications, Standards And Technical Documents

(Unless otherwise indicated, copies of Federal and military specifications, standards, and handbooks are available from (ATTN: DODSSP) - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

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 Administration (OSHA); General Industry Standards and Interpretations
Title 40 -	Environmental Protection Agency (EPA); Hazardous Waste And Consolidated Permit Regulations
Title 49 -	Department Of Transportation; Hazardous Materials Regulations (DOT)

DEPARTMENT OF DEFENSE (DOD) PUBLICATIONS

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

FEDERAL ACQUISITION REGULATION

Contractual acquisition of Material Safety Data Sheet information (paragraph 52.223-3)

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

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

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

Public Law 94-580 Management of items classified as hazardous waste.

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

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

AMERICAN CONFERENCE OF GOVERNMENT INDUSTRIAL HYGIENISTS (ACGIH)

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

Volume 13: Transactions of ACGIH Activities 1985 Conference.

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z358.1-1990 for Emergency Eyewash and Shower Equipment.

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

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM E 11	-	Standard Specification for Wire-Cloth Sieves For Testing Purposes
ASTM E 380	-	Standard For Metric Practice
ASTM E 1146	-	Standard Specification For Muriatic Acid (Technical Grade Hydrochloric Acid)

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

CHEMICAL ABSTRACTS SERVICE REGISTRY

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

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-B-703	-	Standard for Fluosilicic Acid

(Application for copies should be addressed to American Water Works Association, 6666 W. Quincy Avenue, Denver, Co 80235.)

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

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

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

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

Dangerous Goods Regulations

(Application for copies should be addressed to the Publications Assistant, International Air Transport Association, 2000 Peel Street, Montreal, Quebec, Canada H3A 2R4.)

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

Technical Instructions for the Safe Transport of Dangerous Goods by Air, DOC 9284-AN/905.

(Application for copies should be addressed to the Document Sales Unit, International Civil Aviation Organization, 1000 Sherbrooke Street West, Suite 400, Montreal, Quebec, Canada H3A 2R2.)

INTERNATIONAL MARITIME ORGANIZATION (IMO)

International Maritime Dangerous Goods Code (IMDG), Publication 200 89.10E, Vols. I-IV.

(Application for copies should be addressed to the International Maritime Organization, 4 Albert Embankment, London SEI 7SR.)

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.)

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. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Definitions of Technical Terms.

3.1.1 Baume. The Baume scale is an arbitrary hydrometer scale of specific gravities. For liquids lighter than water:

$$°\text{Baume} = [140 \div \text{Specific Gravity } (60°\text{F}/60°\text{F})] - 130$$

For liquids heavier than water:

$$°\text{Baume} = 145 - [145 \div \text{Specific Gravity } (60°\text{F}/60°\text{F})]$$

3.1.2 Decomposition - The chemical separation of a substance into two or more simpler substances, which differ from each other and from the original substance.

3.1.3 Explosive limits - When combustible vapor is mixed with air in the proper proportions, ignition will produce an explosion. This proper proportion is called the explosive range. The explosive range includes all concentrations of a mixture of flammable vapor or gas in air, in which a flash will occur or a flame will travel if the mixture is ignited. The lowest percentage at which this occurs is the lower explosive limit; and the highest percentage, the upper explosive limit. Explosive limits are expressed in percent by volume of vapor in air and, unless otherwise specified, under normal conditions of temperature and pressure.

3.1.4 Flash point - The temperature to which a substance must be heated under specific conditions to give off sufficient vapor to form a mixture with air that can be ignited momentarily by a specified flame.

3.1.5 Formula weight - The sum of the atomic weights of all the atoms appearing in a chemical formula. In this standard, it is computed according to international atomic weight values of 1961.

3.1.6 Hazardous substance - Any substance or mixture of substances which is (1) toxic; (2) corrosive; (3) an irritant; (4) a strong sensitizer; (5) flammable, or which (6) generates pressure through decomposition, heat or other means, if such substance or mixture of substances may cause substantial personal injury or substantial illness during or as a direct result of any customary or reasonably anticipated handling or use.

3.1.7 Melting point - The temperature at which the liquid and solid phases of a substance exist together in equilibrium, and transition from the solid to the liquid occurs.

3.1.8 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.

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

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

3.1.11 Technical grade - Denotes a quality of chemicals which are generally used for industrial, solvent, and manufacturing applications. Generally, specific processes are not employed by the manufacturer to limit all the impurities, aside from the normal precautions which are taken in the manufacturing process. A technical grade chemical may be specially processed to reduce specific impurities so as to suit the chemical to a given industrial application. In such cases, the identification of the items must be further expanded to indicate the specific impurities limitation.

3.2 Definitions of abbreviations. 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.

Additional abbreviations are as follows:

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

4. GENERAL REQUIREMENTS

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

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

4.3 Safety.

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

4.3.1.1 Respiratory protection. Respirators, approved by the National Institute for Occupational Safety and Health (NIOSH) or the Mine Safety and Health Administration (MSHA) or by particular respiratory schedules of the Bureau of Mines (BM) for the compounds being used, may be employed for intermittent, non-routine exposure (i.e., not exceeding 1 hour/day for 1 day/week), when the installation medical authority determines that there are no feasible engineering or work practice controls, during interim periods when engineering controls are being designed and/or installed, during emergencies, or for supplementing other control measures (refer to TB MED 502 or DLAM 1000.2). Ventilation containment, process controls, or other feasible engineering controls shall be adequate to remove hazardous concentrations. Employees assigned to use respiratory protective equipment shall be included in a respiratory protection program that meets the minimal requirements as stipulated in AR 11-34, "The Army Respiratory Protection Program".

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

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

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

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

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

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

4.3.2.2 Water-sensitive fire and explosive hazardous materials. These materials include compounds that react violently or form explosive mixtures on contact with water or steam, or react with water to produce toxic gases. Such waste materials exhibit the characteristic of reactivity (R) as designated by the EPA in 40 CFR 261.23. 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

*Refers to materials that have become hazardous waste.

required for storage of flammable materials. The building shall be waterproof, located on high ground, separated from other storage areas and meet National Fire Codes.

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

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

Carcinogenic substances are listed by OSHA in Category I for confirmed carcinogens, and in Category II for suspected carcinogens. Category I substances have standard exposure limits set at the lowest possible levels. Category II substances have standard exposure limits set to prevent acute or chronic effects.

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

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

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

*Refers to materials that have become hazardous waste.

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

4.4 Pollution and disposal.

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

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

4.4.3 Disposal and storage of hazardous wastes. Items are classified and managed as hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA) (Public Law 94-580). Items have been identified as meeting the characteristics of a hazardous waste (i.e., ignitable, corrosive, reactive or are subject to Toxicity Characteristic Leaching Procedure (TCLP); or they are listed (e.g., toxic or acute hazardous wastes) according to Identification and Listing of Hazardous Waste, 40 CFR Part 261, or have been determined to be hazardous wastes by declaration of the Defense Reutilization and Marketing Service (DRMS) in accordance with procedures set forth in DOD 4160.21-M. Disposal of such items shall be managed in accordance with the Installation Environmental Office, the DRMO, or the Safety and Health Office to insure proper reporting of disposal and treatment actions to the US EPA and State, and shall be managed in accordance with Federal, State and local laws. The three main disposal methods are turn-in to the DRMO, on-post disposal by installation personnel, or disposal by commercial contract. Hazardous wastes that cannot be used 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 40 CFR 262.34. Long-term storage (greater than 90 days) requires permitting by the EPA or by the State under Public Law 94-580

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*Refers to materials that have become hazardous waste.

(RCRA), in compliance with the requirements of 40 CFR, Parts 264 and 265. Physical custody will be accomplished by the activity with conforming storage or most nearly conforming storage. When physical custody is in question, the Post Commander will make the final decision. In all cases where the wastes are to be collected, stored, transported and disposed of at a State or local permitted disposal facility, the identity and description of the waste shall be maintained and recorded in accordance with 40 CFR Part 262. Transportation of the waste must be in accordance with 40 CFR Part 263, Standards Applicable to Transporters of Hazardous Waste. State and/or local regulations may be more stringent than Federal requirements. It is essential that the Installation Environmental Office review all disposal actions for compliance with all applicable regulations.

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

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

4.4.4 DISCLAIMER. RECOMMENDED DISPOSAL INSTRUCTIONS ARE FORMULATED FOR USE BY ELEMENTS OF THE DEPARTMENT OF DEFENSE. THE UNITED STATES OF AMERICA IN NO MANNER WHATSOEVER, EITHER EXPLICITLY

OR IMPLICITLY, WARRANTS, STATES, OR INTENDS SAID INSTRUCTION TO HAVE ANY APPLICATION, USE OR VIABILITY BY OR TO ANY PERSON OR PERSONS CONTRACTING OUTSIDE THE DEPARTMENT OF DEFENSE OR ANY PERSON OR PERSONS CONTRACTING WITH ANY INSTRUMENTALITY OF THE UNITED STATES OF AMERICA, AND DISCLAIMS ALL LIABILITY FOR SUCH USE. ANY PERSON USING THESE INSTRUCTIONS WHO IS NOT A MILITARY OR CIVILIAN EMPLOYEE OF THE UNITED STATES OF AMERICA SHOULD SEEK COMPETENT PROFESSIONAL ADVICE TO VERIFY AND ASSUME RESPONSIBILITY FOR THE SUITABILITY OF THESE INSTRUCTIONS TO HIS PARTICULAR SITUATION, REGARDLESS OF SIMILARITY TO A CORRESPONDING DEPARTMENT OF DEFENSE OR OTHER GOVERNMENT SITUATION.

5. DETAILED REQUIREMENTS

5.1 Name. ARSENIC TRIOXIDE, TECHNICAL As_2O_3 FW 197.84
As_4O_6 FW 395.68

Arsenious acid anhydride
Arsenious oxide CAS 1327-53-3

5.1.1 Technical description. Arsenic trioxide (pure) is an amorphous or vitreous solid with a density of 3.738 g/cm^3, and a melting point of 315°C. Arsenic trioxide also exists in natural mineral forms. Its ordinary form consists of tetrahedral As_4O_6 molecules. Its solubility in water is 3.7 g/100 cm^3 at 20°C and 76.7 g/100 cm^3 at 100°C, forming solutions of arsenous acid ($As(OH)_3$) which is amphoteric. It is also soluble in alkaline solutions and in strong acid solutions. It can form arsine (AsH_3) gas by reaction with active metals in acid solutions, or by reaction with hydrogen gas.

5.1.2 Specification. Military, MIL-A-10840, Arsenic Trioxide, Technical.

5.1.2.1 Requirements. The Military Specification covers one technical grade of arsenic trioxide. The arsenic trioxide shall be a white powder, with an assay of not less than 98.0 percent by weight as As_2O_3, and a moisture content of not more than 0.10 percent by weight, when tested as specified.

Arsenic trioxide, technical grade, is commercially available without a stated assay.

5.1.3 Use. Arsenic trioxide is intended for military use in the manufacture of arsenic compounds. Commercial uses are in pigments and ceramic enamels, and as an insecticide, rodenticide and herbicide.

5.1.4 Safety. Arsenic trioxide is highly toxic. The acute symptoms of exposure, headache, dizziness, garlic odor breath, numbness, chills and tingling of hands and feet, are usually latent for about two days. The chronic symptoms usually appear one to six weeks after onset of exposure. The skin becomes discolored, dry and scaly. Other symptoms may include edema of eyelids, corneal necrosis, nasal irritation and dryness of throat. The central nervous system and gastrointestinal tract may also be affected. Inhalation of dust and mist of arsenic trioxide must be avoided. Wash thoroughly after handling. Arsenic trioxide must be used with adequate ventilation. Arsenic trioxide is a confirmed carcinogen. The TLV for arsenic and soluble compounds as As is 0.2 mg/m^3. The PEL is 10 mg/m^3. For personal protective measures, refer to section 4.3.1.

5.1.5 Storage. Arsenic trioxide must be stored in a cool, dry, well ventilated place in tightly closed containers away from food, food products and combustible materials. Protect container against physical damage. Refer to section 4.3.2.

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

Arsenic oxide is a listed acute hazardous waste in 40 CFR 261.33. The EPA hazardous waste number for arsenic oxide is P012 and the hazardous waste code H for acute toxicity. Arsenic oxide will also exhibit the toxicity characteristic for arsenic (EPA hazardous waste number D004, hazardous waste code E).

5.2 Name. BORIC ACID, TECHNICAL H_3BO_3 or $B(OH)_3$ FW 61.83
Boracic acid CAS 10043-35-3
Orthoboric acid

5.2.1 Technical description. Boric acid (pure) is a colorless solid with a triclinic crystal structure and a density o 1.435 g/cm^3. Its solubility in water is 6.35 g/100 cm^3 at 20°C and 27.6 g/100 cm^3 at 100°C. It is also soluble in glycerol (28 g/100 cm^3 at 20°C), and methyl alcohol (209 g/100 cm^3 at 25°C). Aqueous solutions of H_3BO_3, have approximate pHs of 5.4 at 0.5%, 5.1 at 1.0%, 4.6 at 2.0%, 4.2 at 3.0%, 3.9 at 4.0%, and 3.7 at 4.65% by weight concentrations. On heating to 169° to 175°C, H_3BO_3 loses water to form metaboric acid HBO_2. Further heating forms $H_2B_4O_7$, and the oxide B_2O_3.

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

5.2.2.1 Requirements. Boric acid, technical grade is commercially available in granular and powdered form with a minimum assay, as H_3BO_3, of 99.8 percent.

5.2.3 Use. Boric acid is used in the manufacture of zinc borate for fireproofing military clothing, boron oxide, borosilicate glass, glass fibers, and porcelain enamels. It is also used in nickel electroplating baths for buffering action. An insulation grade product is used as a fire-retardant for cellulose insulation.

5.2.4 Safety. Boric acid is not considered to be an industrial poison. It is not absorbed through intact skin, but is absorbed through mucous membranes, burned or wounded skin area, or if ingested. Death has occurred from < 5 gm in infants and from 5-20 gm in adults. Absorption will produce pathological changes. No PEL or TLV is referenced for boric acid, but respiratory protection shall be worn in the presence of dust. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.2.5 Storage. Boric acid shall be stored in tightly sealed containers in a cool dry space, away from heat sources. (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.) An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.3 Name. CHLOROSULFONIC ACID, TECHNICAL $ClSO_2OH$ FW 116.52
Chlorosulfuric acid CAS 7790-94-5

5.3.1 Technical description. Chlorosulfonic acid (pure) is a colorless liquid with a refractive index of 1.437 at 14°C, and a density of 1.766 g/cm^3 at 18°C. It has a melting point of -80°C and a boiling point of 151-152°C. It fumes in moist air and decomposes to H_2SO_4 and HCl in water. It reacts with alcohols to form alkyl sulfates. It engages in sulfamation reactions with fatty acids and aromatic compounds. It engages in sulfamation reactions with aliphatic and aromatic amines. Hydrogen chloride is formed as a result of all these reactions.

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

5.3.2. Requirements. Chlorosulfonic acid, technical grade, is commercially available with a specified assay, as $ClSO_2OH$, of 98.5 percent minimum.

5.3.3 Use. Chlorosulfonic acid is intended for military use as a chemical intermediate.. Commercial applications include use in chemical processes for the production of organic sulfates, sulfonates and sulfamates as intermediates in the manufacture of dyes, pigments, pesticides, surface active agents, and chemical blowing agents.

5.3.4 Safety. Chlorosulfonic acid is a corrosive liquid and contact with skin, eyes and clothing shall be avoided. Breathing of mists, fumes or vapors resulting from atmospheric exposure of the acid shall be prevented. Chlorosulfonic acid is stable but reacts violently with water to form hydrochloric and sulfuric acids. Hazardous exothermic reactions can result by contact with organic and combustible materials, nitrates, chlorates, carbides, sulfides and metallic powders. Upon heating, chlorosulfonic acid releases hazardous chlorine and sulfur dioxide gases, and sulfuric acid. Exposure limits for chlorosulfonic acid have not been established, but the PEL and TLV for sulfuric acid and hydrogen chloride fumes, resulting from reaction with moisture, are applicable. In case of contact with the skin, wash affected areas thoroughly with water. For eyes, immediately irrigate with copious amounts of water for at least 20 minutes, and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.3.5 Storage. Chlorosulfonic acid shall be stored, preferably in glass lined steel tanks or stainless steel containers, in a cool dry area away from sunlight and incompatible materials. (Refer to 4.3.2.)

5.3.6 Disposal. In case of small spills, control with dry nonreactive absorbent. In case of large spills in closed areas, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. In case of large spills in open areas, control by covering with foam or water fog. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4) Chlorosulfonic acid has EPA Hazardous Waste Classifications - Corrosive, Waste Number D002; Reactive, Waste Number D003.

5.4 Name. CHROMIUM TRIOXIDE, TECHNICAL CrO_3 FW 99.99
Chromic acid CAS 1332-82-0
Chromic anhydride

5.4.1 Technical description. Chromium trioxide (pure) exists as a red rhombic crystalline solid with a density of 2.70 g/cm^3, and a melting point of 196°C. It decomposes above 196°C to yield Cr_2O_3 and O_2. Its solubility in water is 61.7 g/100 cm^3 at 0°C and 67.45 g/100 cm^3 at 100°C. It is soluble in alcohol, ether, sulfuric acid and nitric acid. It is deliquescent, and by reaction with water forms mainly H_2CrO_4 and $H_2Cr_2O_7$, which are oxidizing agents. The yellow chromate ion (CrO_4^{2-}) exists in basic solutions, and it is converted to the orange dichromate ion ($Cr_2O_7^{2-}$) in acid solutions. Acid solutions of the dichromate ion are powerful oxidizing agents.

5.4.2 Specification. Federal, O-C-303, Chromium Trioxide, Technical (Chromic Acid).

5.4.2.1 Requirements. The Federal Specification covers a flake form of technical grade chromium trioxide that conforms to the chemical and physical requirements shown in Table I. The material shall be free-flowing reddish-brown flakes, and free from lumps.

TABLE I. Chromium trioxide, technical - federal specification requirements.

Assay, as CrO_3, % by wt, min	99.0
Sulfate, as SO_4, % by wt, max	0.20
Chloride, as Cl, % by wt, max	0.10
Insoluble matter, % by wt, max	0.10
† Particle size, pass through US Standard Sieve No. 30 (600 μm), % by wt, max	30

† Standard sieve designation in accordance with ASTM E 11.

Chromium trioxide is commercially available as a dark-red amorphous solid in flake or powered forms, with a purity of 99.9 percent by weight, that meet federal specification requirements.

5.4.3 Use. Chromium trioxide is intended for military use in the surface treatment of metals, in chromium plating, and in the anodic oxidation process for aluminum and aluminum alloys. Commercial uses include "decorative" chrome plating; "hard" chrome plating; solderless cans; anodizing baths; chromate conversion coatings on aluminum, cadmium, magnesium and zinc; stripping copper plating from steel parts; and in the manufacture of dyes and other organic chemicals.

5.4.4 Safety. Chromium trioxide, as an oxidizer, is reactive with combustible materials and reducing agents, and can cause fire and explosion. Decomposition by heating liberates oxygen to support combustion. Chromium trioxide is a strong irritant of the eyes, skin and mucous membranes, and it is a confirmed carcinogen. The PEL is 0.5 mg/m^3, as Cr, for a water soluble Cr (VI) compound. In case of contact with the skin, wash affected areas thoroughly with water. For eyes, irrigate with water for at least 20 minutes, and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.4.5 Storage. Chromium trioxide shall be stored in nonreactive containers in a cool dry place away from heat sources and combustible materials. (Refer to 4.3.2.)

5.4.6 Disposal. In case of dry spills, gather up and place in nonreactive containers. In case of small solution spills, control with nonreactive absorbent. In case of large solution spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Chromium is listed in 40 CFR 261.24, Table 1 for toxicity characteristics. Chromium trioxide will exhibit the characteristics of toxicity for chromium. Specific State and local regulations may treat chromium trioxide as a corrosive waste. Designations of toxic and corrosive hazardous waste apply only to material declared as waste.

5.5 Name. FLUOBORIC ACID, TECHNICAL HBF_4 FW 87.81
Borofluoric acid CAS 16872-11-0
Fluoroboric acid
Hydrofluoboric acid

5.5.1 Technical description. Fluoboric acid (pure) is a colorless liquid with a density of approximately 1.84 g/cm^3. It decomposes on heating to 130°C. It is soluble in hot water and miscible with cold water and alcohol. Fluoboric acid is a strong acid. It undergoes limited hydrolysis in water to form hydroxyfluoborate ions; major product is Bf_3OH^-, and slowly forms boric acid and hydrofluoric acid. It is reactive with metals.

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

5.5.2.1 Requirements. Fluoboric acid is commercially available as purified and special purified types with a specified assay, as HBF_4, of 48 to 50 percent. The special purified type contains lower concentrations of ionic impurities.

5.5.3 Use. Fluoboric acid is intended for military use in metal plating processes. Commercial applications include use in the production of fluoborates, and as a specially purified solution for electrolytic brightening of aluminum. It is used as a solute in electrolytes for electroplating of metals. It is also used as a metal cleaner, by dissolving metal oxides and silicate-type cleaner residues from metal surfaces.

5.5.4 Safety. Fluoboric acid is highly toxic and is a corrosive irritant to the eyes, skin and mucous membranes. In case of contact with the skin, wash affected areas thoroughly with water. For eyes, irrigate with water for at least 20 minutes, and obtain medical attention. No PEL or TLV is referenced for this acid, but the PEL and TLV are 2.5 mg/m^3, as F, for hydrogen fluoride or fluoride resulting from reaction with moisture. Inhalation of vapors or mists shall be avoided. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.5.5 Storage. Fluoboric acid shall be stored in lined corrosion-resistant containers, in a cool dry place away from heat sources and incompatible materials. (Refer to 4.3.2.)

5.5.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Fluoboric acid has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002.

5.6 Name. FLUOSILICIC ACID, TECHNICAL $H_2SiF_6 \cdot xH_2O$ FW Variable
$H_2SiF_6 \cdot 2H_2O$ FW 180.12
CAS 1696-83-4

Fluorosilicic acid
Hexafluorosilicic acid
Hydrofluorosilicic acid
Hydrofluosilicic acid
Silicofluoric acid

5.6.1 Technical description. The dihydrate of fluosilicic acid is a white crystalline deliquescent solid that decomposes on heating. It is soluble in cold and hot water, and in alkaline solutions. The variable hydrate is a colorless fuming corrosive liquid, with a density of 1.463 g/cm^3 at 25°C as a 60.75% solution. The solution decomposes on heating to boiling to yield HF and SiF_4. Fluosilicic acid is a very strong acid.

5.6.2 Specification. AWWA B 703 - Standard for Fluosilicic Acid.

5.6.2.1 Requirements. Fluosilicic acid, that meets the specification requirements of AWWA B 703, is commercially available with an assay, as H_2SiF_6, of 23 to 30 percent; with a heavy metals concentration of less than 200 ppm, as Pb; and shall not contain any harmful soluble mineral or organic substances in quantities capable of affecting health.

5.6.3 Use. Fluosilicic acid is primarily used as an additive to fluoridate water supplies. It is also used as a wood preservative, in the pickling of non-ferrous metals, and in electroplating.

5.6.4 Safety. Fluosilicic acid is corrosive and a strong irritant to the eyes, skin and mucous membranes. It emits corrosive and toxic fumes of HF and SiF_4 if heated to decomposition. In case of contact with the skin, wash affected areas with water. For eyes, irrigate with water for at least 20 minutes, and obtain medical attention. No PEL or TLV is referenced for this acid, but the PEL and TLV are 2.5 mg/m^3 for fluoride as F. Inhalation of vapors or mists shall be avoided. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.6.5 Storage. Fluosilicic acid shall be stored in lined corrosion-resistant containers in a cool, dry place away from heat sources. (Refer to 4.3.2.)

5.6.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Fluosilicic acid has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002.

5.7 Name. HYDROBROMIC ACID, TECHNICAL HBr FW 80.92
Hydrogen bromide CAS 10035-10-6

5.7.1 Technical description. Hydrogen bromide exists as an anhydrous gas, and a dihydrate liquid. Hydrogen bromide has a boiling point of -67°C, and a vapor density of 2.8 (air = 1). Its solubility in water is 221 g/100 cm^3 at 0°C and 130 g/100 cm^3 at 100°C. Hydrobromic acid is an aqueous solution of hydrogen bromide. Hydrogen bromide forms a constant boiling solution at a 47% concentration in water. This solution is a colorless liquid with a density of 1.49 g/cm^3, a melting point of 126°C. Hydrobromic acid solutions are completely miscible with water.

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

5.7.2.1 Requirements. Hydrobromic acid, technical grade, is commercially available in 48% and 62% concentrations which are colorless to yellow fuming solutions. These products have specific gravities (25°/25°C) of 1.487 and 1.723, and vapor pressure (20°C) of 80 to 90 mm Hg respectively.

5.7.3 Use. Hydrobromic acid, technical grade, is used in the manufacture of inorganic bromides and alkyl bromide compounds, and as an alkylation catalyst.

5.7.4 Safety. Hydrobromic acid is reactive with easily oxidizable metals to produce flammable hydrogen gas, and with strong oxidizing agents to produce corrosive bromine. Hydrobromic acid is corrosive and can cause severe irritation and burns to eyes and skin, and the vapors or fumes can cause severe irritation of the respiratory tract. The PEL and TLV for hydrogen bromide are 3 ppm or 10 mg/m^3. In case of contact with the skin, wash affected areas thoroughly with water. For eyes, immediately irrigate with water for at least 20 minutes, and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.7.5 Storage. Hydrobromic acid shall be stored in acid resistant containers in a cool, dry place away from heat sources and direct sunlight. (Refer to 4.3.2.)

5.7.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Hydrobromic acid has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002.

5.8 Name. HYDROCHLORIC ACID, TECHNICAL HCl FW 36.45

Hydrogen chloride CAS 7647-01-0
Muriatic acid

5.8.1 Technical description. Hydrogen chloride (pure) exists as an anhydrous gas, a monohydrate liquid, a dihydrate liquid, and a trihydrate liquid. Hydrogen chloride has a boiling point of -84.9°C, and a vapor density of 1.3 (air = 1). It fumes in moist air. Its solubility in water is 82.3 g/100cm^3 at 0°C and 56.1 g/100 cm^3 at 60°C. Hydrogen chloride forms a constant boiling solution at a 20.24% concentration in water. This solution is a colorless liquid with a density of 1.097 g/cm^3 and a boiling point of 110°C.

5.8.2 Specification. ASTM Standard Specification for Muriatic acid (Technical grade hydrochloric acid) E1146.

5.8.2.1 Requirements. The ASTM Specification covers Technical grade of hydrochloric acid (20° Baume) that conforms to the chemical and physical requirements shown in Table II.

TABLE II. Hydrochloric acid, technical (20° Baume) - specification requirements.

Total acidity (as HCl), % by wt, min	31.45
Specific gravity (60/60°F) (15.6°/15.6°C) min	1.1600
Total sulfur, (as H_2SO_4), % by wt, max	0.02
Iron (Fe), % by wt, max	0.0005
Arsenic (As), % by wt, max	0.0001

Hydrochloric acid, technical grade, is commercially available in two density (gravity) types corresponding to two solution concentrations: 20° Baume (31.5% HCl), and 22° Baume (35.2% HCl). These products have minimum assays of 31.45 and 35.21 percents by weight as HCl.

5.8.3 Use. Hydrochloric acid, technical grade, is intended for military use in the formulation of a rust removal compound and the treatment and pickling of metals for electroplating and galvanizing. Commercial applications include pickling and cleaning of metals, chemical manufacture, leaching minerals, and descaling pipe and boiler tubing. Anhydrous hydrogen chloride is used in the production of vinyl chloride from acetylene, and alkyl chlorides from olefins.

5.8.4 Safety. Hydrochloric acid is reactive with easily oxidizable metals to produce flammable hydrogen gas. Hydrochloric acid is corrosive and can cause severe irritation and burns to eyes and skin, and the vapors or fumes can cause severe irritation of the respiratory tract. The PEL and TLV for hydrogen chloride fumes are 5 ppm or 7 mg/m^3 which are ceiling limits. In case of contact with the skin, wash affected areas thoroughly with water. For eyes, immediately irrigate with water for at least 20 minutes and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.8.5 Storage. Hydrochloric acid shall be stored in acid resistant containers in a cool, dry place away from heat sources and direct sunlight. (Refer to 4.3.2.)

5.8.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Hydrochloric acid has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002.

5.9 Name. HYDROFLUORIC ACID, TECHNICAL HF FW 20.01
Hydrogen fluoride CAS 7664-39-3

5.9.1 Technical description. Hydrogen fluoride is a colorless gas or liquid with a boiling point of 19.54°C. It has a liquid density of 0.988 g/cm^3 at 13.6°C and vapor density of 0.7 (air = 1) calculated as HF. Hydrogen fluoride fumes in moist air. It is soluble in cold water in all proportions, and very soluble in hot water. Hydrofluoric acid is an aqueous solution of hydrogen fluoride. Hydrogen fluoride molecules are associated into $(HF)_2$ and $(HF)_3$ at 26°C, while at 88°C, the vapor density corresponds to (HF). Hydrofluoric acid (HF) is a weak acid. In concentrated solutions, the dimer $(HF)_2$ forms, which is a stronger acid than (HF). $(HF)_2$ yields hydrogen difluoride ion (HF_2^-), which can form hydrogen difluoride salts such as $NaHF_2$ and KHF_2. Hydrofluoric acid reacts with silicon dioxide and silicates to produce SiF_4 gas.

5.9.2 Specification. Military, MIL-A-24641, Acid, Hydrofluoric, Technical.

5.9.2.1 Requirements. The Military Specification covers a technical grade of hydrofluoric acid that contains not less than 60% by weight of anhydrous hydrogen fluoride (HF) in water solution. Technical grade hydrofluoric acid is commercially available as a 70% aqueous solution of HF, and as anhydrous HF at 100 percent concentration.

5.9.3 Use. Hydrofluoric acid, technical grade, is intended for military use in removing sand particles from metallic castings and for etching glass. Commercial applications for the acid solution include production of fluoride compounds; polishing, etching and frosting of glass; and electropolishing of metals. Applications of the anhydrous acid include production of uranium tetrafluoride, aluminum fluoride and cryolite; and electrolytic production of elemental fluorine. It is also used as a fluorinating agent for the preparation of organic fluorides.

5.9.4 Safety. Hydrofluoric acid is reactive with easily oxidizable metals to produce flammable hydrogen gas. Hydrofluoric acid is reactive with silicates to produce toxic SiF_4 gas. The acid is corrosive and can cause severe irritation and burns to eyes and skin with extensive deep tissue destruction. The vapors or fumes can cause ulcers of the upper respiratory tract. The PEL for fluoride (as F) is 2.5 mg/m^3, and the TLV for hydrogen fluoride (as F) is 3 ppm or 2.5 mg/m^3. In case of contact with the skin, wash affected parts with water and obtain medical attention. For eyes, irrigate with water for at least 20 minutes, and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer 4.3.1.

5.9.5 Storage. Hydrofluoric acid shall be stored in acid resistant unreactive containers, such as polyethylene, in a cool, dry place away from heat sources and direct sunlight. (Refer to 4.3.2.)

5.9.6 Disposal. In case of small spills, control with dry sodium carbonate or soda ash. In case of large spills, dike with nonreactive materials, such as polyethylene, to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Hydrofluoric acid has an EPA Hazardous Waste Classification - Corrosive and Toxic, Waste Number U134.

5.10 Name. HYPOPHOSPHOROUS ACID, TECHNICAL FW 66.00
H_3PO_2 or $H(H_2PO_2)$ CAS 6303-21-5

5.10.1 Technical description. Hypophosphorous acid (pure) is a colorless oily liquid or deliquescent crystals with a density of 1.493 g/cm^3, and a melting point of 26.5°C. It decomposes at 130°C. It is soluble in cold water, and very soluble in hot water, alcohol and ether. Hypophosphorous acid is a moderately strong monoprotic acid and only forms mono-basic salts, because the two nonacidic hydrogen atoms are linked directly to the phosphorous atom. Hypophosphorous acid and its salts are strong reducing agents.

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

5.10.2.1 Requirements. Technical grade hypophosphorous acid is commercially available as a clear, colorless aqueous solution in a 50% by weight concentration. The product has a specified assay of 50 to 52% by weight calculated as H_3PO_2 based on total acidity.

5.10.3 Use. Hypophosphorous acid is intended for use as a reducing agent and antioxidant, in the preparation of hypophosphite salts, and in organic synthesis for replacement of NH_2 group by H.

5.10.4 Safety. Hypophosphorous acid is violently reactive with strong oxidizing agents. It can produce irritating and toxic fumes of oxides of phosphorous when heated to decomposition. Hypophosphorous acid (50%) can cause irritation to eyes, skin and mucous membranes. In case of contact with the skin, wash affected parts with water. For eyes, irrigate with water for at least 20 minutes and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.10.5 Storage. Hypophosphorous acid shall be stored in acid resistant containers in a cool, dry place away from heat sources and direct sunlight. (Refer to 4.3.2.)

5.10.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Hypophosphorous acid has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002.

5.11 Name. MOLYBDENUM TRIOXIDE, TECHNICAL MoO_3 FW 143.94
Molybdic anhydride CAS 1313-27-5
Molybdic oxide

5.11.1 Technical description. Molybdenum trioxide (pure) is a colorless or white-yellow solid with a rhombic crystal structure and a density of 4.692 g/cm^3. It melts at 795°C and boils at 1155°C. Its solubility in water is 0.1066 g/100 cm^3 at 18°C and 2.055 g/100 cm^3 at 70°C. It is not attacked by acids, but dissolves in bases, including NH_4OH, to form molybdate solutions. Molybdenum trioxide is the anhydride of molybdic acid, but it does not form hydrates directly. The hydrates $MoO_3 \cdot 2H_2O$ and $MoO_3 \cdot H_2O$ can be precipitated from neutral solutions of molybdates. The theoretical molybdenum content of molybdenum trioxide is 66.8 percent.

5.11.2 Specification. Military, MIL-M-48146, Molybdenum Trioxide (For Use in Ammunition).

5.11.2.1 Requirements. The Military Specification covers one grade of molydbenum trioxide that meets the chemical requirements shown in Table III.

TABLE III. Molybdenum trioxide - military specification requirements.

Assay, %, min	99.5
Insoluble in NH_4OH, %, max	0.010
Chloride, as Cl, %, max	0.002
Nitrate, as NO_3, %, max	0.003
Arsenate, phosphate, and silicate, as SiO_2, %, max	0.001
Sulfate, as SO_4, %, max	0.020
Ammonium, as NH_4, %, max	0.002
Heavy metals, as Pb, %, max	0.005

The material shall be free-flowing, and free of lumps, dirt, chips and other foreign material. The average particle size shall be 8_4 micrometers when determined as specified.

Technical grade molybdenum trioxide is commercially available as a screened product with a molybdenum content of 57.0% by weight minimum, which corresponds to 85.5% molybdic oxide. This product contains 8 to 12% alkaline insoluble residue, mainly silica. Its contained molybdenum has a minimum solubility of 97% in alkaline solutions such as sodium or ammonium hydroxide.

5.11.3 Use. Molybdenum trioxide is intended for military use in igniter compositions for ammunition. Commercial applications include use in ceramics, and as an intermediate for the preparation of molybdate compounds. It is also used in the preparation of alloy steels.

5.11.4 Safety. As a relatively insoluble compound, the TLV of molybdenum trioxide is 10 mg/m^3 as Mo, and the PEL is 15 mg/m^3. It may be a local irritant for eyes, skin and mucous membranes, and contact shall be avoided. In case of contact with the skin, wash affected areas with water. For eyes, irrigate with water for at least 20 minutes, and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.11.5 Storage. Molybdenum trioxide shall be stored in tightly sealed containers in a cool, dry area. (Refer to 4.3.2.)

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

5.12 Name. NITRIC ACID, TECHNICAL HNO_3 FW 63.01
Azotic acid CAS 7697-37-2
Hydrogen nitrate

5.12.1 Technical description. Nitric acid (pure) is a colorless liquid with a refractive index of 1.397 at 16.4°C, a density of 1.5027 g/cm^3 at 25°C, a melting point of -42°C and a boiling point of 83°C. It is miscible with water, and forms a constant boiling solution at a concentration of 68% with a density of 1.41 g/cm^3 at 20°C, and a boiling point of 120.5°C. Nitric acid decomposes on heating to produce nitrogen oxides, predominantly nitrogen dioxide. Nitric acid is stable in aqueous solution exhibiting the properties of a strong acid and a strong oxidizing agent. It is reactive with metallic and nonmetallic elements, and organic compounds.

5.12.2 Specifications. Federal, O-N-350, Nitric Acid Technical. Military, JAN-A-183, Acid, Nitric (For Ordnance Use).

5.12.2.1 Requirements. The Military Specification covers five classes of nitric acid conforming to the requirements shown in Table IV. The acid shall be clear and free from sediment, suspended matter and separated material. It shall be no darker than a specified color standard.

TABLE IV. Nitric acid (for ordnance use) - military specification requirements.

	Class A	Class B	Class C	Class D	Class E
Nitric acid, %, min (uncorrected) 1/	2/	3/ 98.0	2/	4/	2/
Nitrobodies	None	None	None	None	2/ None
Chlorides, as HCl, %, max	0.01	None	0.20	0.01	0.10
Sulfates, as SO_4, %, max	0.01	0.05	----	0.25	0.20
Oxides of nitrogen, as NO_2, %, max	0.02	0.15	0.50	1.0	----
Lead salts, %, max	0.01	None	None	0.01	0.10
Ash, %, max	0.01	0.01	0.01	0.01	0.10

1/ Uncorrected for acidic impurities or oxides of nitrogen.

2/ Not applicable to recovered nitric acid used only in the manufacture of trinitrotoluene, dinitrotoluene or tetryl.

3/ The titration method as described shall be used to determine nitric acid content.

4/ As specified in the contract or order.

The Federal Specification covers one technical grade of nitric acid conforming to the requirements shown in Table V. The solution shall be free from sediment, suspended matter, and separated materials.

TABLE V. Nitric acid, technical - federal specification requirements.

Total acid content, as HNO_3,	
% by wt, min	61.0
% by wt, max	68.2
Residue acid, as H_2SO_4, % by wt, max	0.5
Chloride, as Cl, % by wt, max	0.5

Technical grade nitric acid is commercially available as weak and strong acids. Weak acid includes Baume gravity type 42° Be which corresponds to a 67 to 68% concentration. Strong acid includes 95 and 98% concentrations. Fuming nitric acid is also available as a strong acid of low water content in two types: white fuming nitric acid containing less than 2% water and less than 0.5% oxides of nitrogen, and more than 97.5% HNO_3; and red fuming nitric acid (RFNA) containing less than 5% water, 6 to 15% oxides of nitrogen as NO_2, and more than 86% HNO_3.

5.12.3 Use. Nitric acid, technical grade, is intended for military use in the manufacture of metals and chemicals; in the nitrating of agents; and in the cleaning of a variety of materials. Nitric acid, for ordnance use, is intended for the following applications.

Class A - The manufacture of mercury fulminate.
Class B - The manufacture of pentaerythritol tetranitrate (PETN) and nitramines.
Class C - The manufacture of picric acid.
Class D - The manufacture of ammonium nitrate.
Class E - The manufacture of mixed acids, and for other purposes.

Commercial applications include metal finishing, and the manufacture of organic nitrates, dye intermediates, explosives and nitrate fertilizers.

Fuming nitric acids are used as oxidizers in liquid rocket propellant systems.

5.12.4 Safety. Nitric acid is a strong oxidizer and can cause ignition of wood, paper and cloth items. It is reactive with metals. It decomposes on heating to produce toxic nitric oxide fumes. Nitric acid is corrosive and can cause severe irritation and burns to eyes and skin, and the vapors or fumes can cause severe irritation of the respiratory tract. The PEL and TLV for nitric acid are 2 ppm or 5 mg/m^3. In case of contact with the skin, wash affected areas with water. For eyes, irrigate with water for at least 20 minutes and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.12.5 Storage. Nitric acid shall be stored in acid resistant nonreactive containers in a cool, dry place away from heat sources, direct sunlight, and oxidizable material. (Refer to 4.3.2.)

5.12.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Nitric acid (over 40%) has EPA Hazardous Waste Classifications - Ignitable, Waste Number D001; Corrosive, Waste Number D002. Nitric acid (40% or less) has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002.

5.13 Name. ORTHOPHOSPHORIC ACID, TECHNICAL H_3PO_4 FW 98.00
$2H_3PO_4 \cdot H_2O$ FW 214.01
Phosphoric acid CAS 7664-38-2

5.13.1 Technical description. Orthophosphoric acid, anhydrous (pure), is a colorless liquid or rhombic crystalline solid with a density of 1.834 g/cm^3 at 18°C, a melting point of 42.35°C, and a boiling point of 213°C with loss of H_2O. It is soluble in cold water (548 g/100 cm^3), very soluble in hot water, and soluble in alcohol. The hydrated compound exists as colorless hexagonal prisms with a melting point of 29.32°C, and it decomposes on heating. It is very soluble in cold water. The crystalline forms are deliquescent. Orthophosphoric acid is triprotic and can form primary, secondary and tertiary salts. The ionization of orthophosphoric acid in successive steps becomes less extensive with each step, and the successive ionization constants differ by about 10^5.

5.13.2 Specification. Federal, O-O-670, Orthophosphoric (Phosphoric) Acid, Technical.

5.13.2.1 Requirements. The Federal Specification covers two classes of orthophosphoric acid:

Class 1 - 85% acid
Class 2 - 75% acid

The orthophosphoric acid shall be clear, water-white, odorless, free from sediment and suspended matter, and shall not be separated into layers. The acid shall conform to the requirements shown in Table VI.

TABLE VI. Orthophosphoric acid - federal specification requirements.

	Class 1	Class 2
Specific gravity (20°/4°C), min	1.690	1.580
Total acid content, as H_3PO_4, % by wt, min	85	75
Sulfates, as SO_4, % by wt, max	0.35	---
Arsenic, as As, % by wt, max	0.001	0.06
Alkali and other phosphates, % by wt, max	0.25	---
Heavy metals, as Pb, % by wt, max	0.005	---
Volatile acids, as acetic, % by wt, max	---	0.10

Technical grade orthophosphoric acid is commercially available in three concentrations: 75%, 80%, and 85% by weight maximum for the three concentrations.

5.13.3 Use. Orthophosphoric acid is intended for military use in metal treating processes, in the cleaning of a variety of materials, and in the production of phosphate compounds. Commercial applications include the above, the manufacture of fertilizers, the manufacture of phosphate cleaning compounds, boiler water treatment compounds, and flame-retardant compounds.

5.13.4 Safety. Orthophosphoric acid can react with easily oxidizable metals to release flammable hydrogen gas. Phosphoric acid is corrosive, and can cause burns and severe irritation of the eyes and skin. The inhalation of fumes can cause severe irritation of the respiratory tract. The PEL and TLV for phosphoric acid are 1 mg/m^3. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.13.5 Storage. Orthophosphoric acid shall be stored in tightly sealed acid resistant containers in a cool, dry place. (Refer to 4.3.2.)

5.13.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Orthophosphoric acid has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002.

5.14 Name. PHOSPHORUS PENTOXIDE, TECHNICAL P_2O_5 FW 141.94
P_4O_{10} FW 283.89
Phosphoric anhydride CAS 1314-56-3
Phosphoric oxide

5.14.1 Technical description. Phosphorus pentoxide (pure) is a white powder with a density of 2.39 g/cm^3 that exists in several forms and sublimes at 300°C. On sublimation, the hexagonal crystal form is obtained consisting of P_4O_{10} molecules. P_4O_{10} is the actual molecular formula. P_2O_5 is the empirical formula. Phosphorus pentoxide dissolves in water with evolution of heat, and by successive reactions first forms metaphosphoric acid (HPO_3) and then orthophosphoric acid (H_3PO_4). Phosphorus pentoxide is very deliquescent, and its attraction for water enables it to extract water from many other compounds. It can convert HNO_3 to N_2O_5, H_2SO_4 to SO_3 and amides to nitriles. It is reactive with alcohols to produce esters of phosphoric esters depending on reaction conditions.

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

5.14.2.1 Requirements. The technical grade phosphorus pentoxide is commercially available with a specified assay, as P_4O_{10}, of 98% minimum, and a typical assay of 99.5 percent.

5.14.3 Use. Phosphorus pentoxide, technical grade, is used in the manufacture of phosphorus compounds including the preparation of phosphoric acid and organic phosphates. It is also used as a catalyst and as a condensing agent in organic synthesis, and as a desiccant and dehydrating agent.

5.14.4 Safety. Phosphorus pentoxide produces corrosive fumes when heated to its sublimination temperature. It reacts violently with water or steam to produce corrosive fumes. The heat evolved by reaction can ignite combustible materials. Phosphorus pentoxide is corrosive and can cause burns and severe irritation of eyes and skin. Inhalation of fumes can cause severe irritation of the respiratory tract. There is no PEL or TLV referenced for phosphorus pentoxide, but the PEL and TLV for orthophosphoric acid are 1 mg/m^3. In case of contact with the skin, wash affected areas with water. For eyes, irrigate with water for at least 20 minutes, and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.14.5 Storage. Phosphorus pentoxide shall be stored in tightly sealed containers in a cool, dry place away from reactive materials. (Refer to 4.3.2.)

5.14.6 Disposal. In case of dry spills, gather up and place in container. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Phosphorus pentoxide has an EPA Hazardous Waste Classification - Reactive, Waste Number D003.

5.15 Name. SULFAMIC ACID, TECHNICAL NH_2SO_3H FW 97.09
Amidosulfuric acid CAS 5329-14-6
Aminosulfonic acid

5.15.1 Technical description. Sulfamic acid (pure) is a colorless solid of rhombic crystalline form with a density of 2.126 g/cm^3 at 25°C. It decomposes on heating above 200°C. Its solubility in cold water is 14.68 g/100 cm^3 and 47.08 g/100 cm^3 at 60°C. It is not hydroscopic. It is very slightly soluble in alcohol, ether and acetone. Sulfamic acid is monoprotic and forms strongly acid aqueous solutions. Dilute aqueous solutions are stable at room temperature but hydrolyze rapidly at elevated temperatures.

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

5.15.2.1 Requirements. Technical grade sulfamic acid is commercially available as a granular, dry, stable product with a specified assay of 91.0% by weight minimum, and a typical assay of 92.2 percent.

5.15.3 Use. Sulfamic acid, technical grade, for military application, is used in the formulation of a boiler scale removal compound. Commercial applications include the preparation of chlorosulfamates for use in paper pulp bleaching, as a sulfation-fulfamation agent, in the processing of dyes and pigments, in the preparation of metal sulfamate salts for electroplating, and in the preparation of ammonium sulfamate for use as a flame retardant for cellulosic materials.

5.15.4 Safety. Dry sulfamic acid decomposes when heated to release irritating and toxic fumes of sulfur dioxide, sulfur trioxide and ammonia. Aqueous sulfamic acid solutions can react with easily oxidizable metals to produce flammable hydrogen gas. Sulfamic acid can cause irritation of the respiratory tract. No PEL or TLV is referenced for sulfamic acid, but the manufacturer's 8-hour time-weighted average exposure limit is 1 mg/m^3 in air. In case of contact with the skin, wash affected areas with water. For eyes, irrigate with water for at least 20 minutes and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.15.5 Storage. Sulfamic acid shall be stored in tightly sealed acid resistant nonreactive containers in a cool, dry place away from reactive materials. (Refer to 4.3.2.)

5.15.6 Disposal. In case of dry spills, gather up and place in containers. In case of small solution spills, control with nonreactive absorbent. In case of large solution spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Sulfamic acid has an EPA Hazardous Waste Classification (Aqueous solutions).

5.16 Name. SULFURIC ACID, TECHNICAL, AND ELECTROLYTE FW 98.08
Dihydrogen sulfate H_2SO_4 CAS 7664-93-9

5.16.1 Technical description. Sulfuric acid, anhydrous (pure), is a colorless liquid with a melting point of 10.36°C. A 96 to 98% concentration has a density of 1.84 g/cm^3. Sulfuric acid decomposes when heated with loss of SO_3 until a concentration of 98.33% is reached which boils at 338°C without further change in concentration. It is soluble in water in all proportions with evolution of heat due to formation of hydrates. The concentrated acid is a strong dehydrating agent. Sulfuric acid is a diprotic acid which ionizes in two stages. In dilute solution, primary ionization is complete, while the secondary ionization is less complete. It can form both normal and hydrogen sulfate salts.

Hot concentrated sulfuric acid can act as an oxidizing agent depending on the strength of the reducing agent with which it reacts. Sulfur trioxide dissolved in concentrated sulfuric acid forms pyrosulfuric acid, $H_2S_2O_7$, which is also known as fuming sulfuric acid or oleum.

5.16.2 Specification. Federal, O-S-801, Sulfuric Acid, Electrolyte, For Storage Batteries; and Federal, O-S-809, Sulfuric Acid, Technical. Military, JAN-A-179, Acid, Sulfuric and Oleum.

5.16.2.1 Requirements. The Federal Specification for sulfuric acid, electrolyte, for storage batteries, covers four classes of acid:

Class 1 -	Concentrated sulfuric acid; minimum specific gravity 1.8354 at 60°/60°F.
Class 2 -	Dilute sulfuric acid; specific gravity 1.3945 to 1.4042 at 60°/60°F.
Class 3 -	Dilute sulfuric acid; specific gravity 1.2767 to 1.2853 at 60°/60°F.
Class 4 -	Dilute sulfuric acid; specific gravity 1.2085 to 1.2185 at 60°/60°F.

The sulfuric acid shall be nonfuming and free from sediment, and shall have a color no darker than that of a standard color solutions. The sulfuric acid shall conform to the acid content and specific gravity requirements shown in Table VII.

TABLE VII. Sulfuric acid, electrolyte - federal specification requirements - acid content and specific gravity.

Class	Acid Content, % by wt		Specific Gravity at 60°/60°F	
	Min	Max	Min	Max
1	93.2	---	1.8354	---
2	49.5	50.5	1.3945	1.4042
3	36.5	37.5	1.2767	1.2853
4	28.3	29.5	1.2085	1.2185

The sulfuric acid shall conform to the maximum limits of impurities shown in Table VIII.

TABLE VIII. Sulfuric acid, electrolyte - federal specification requirements - maximum limits of impurities.

IMPURITY	Class 1	Class 2	Class 3	Class 4
	(% by wt)	(% by wt)	(% by wt)	(% by wt)
Organic matter	1/	1/	1/	1/
Platinum	1/	1/	1/	1/
Fixed residue	0.03	0.016	0.012	0.009
Sulfurous acid	0.004	0.0022	0.0016	0.0013
Iron	0.005	0.0027	0.0020	0.0016
Copper	0.005	0.0027	0.0020	0.0016
Zinc	0.004	0.0022	0.0016	0.0013
Arsenic	0.0001	0.00005	0.00004	0.00003
Antimony	0.0001	0.00005	0.00004	0.00003
Selenium	0.002	0.0011	0.0008	0.0006
Nickel	0.0001	0.00005	0.00004	0.00003
Manganese	0.00002	0.000011	0.000008	0.000006
Nitrate	0.0005	0.00027	0.00020	0.00016
Ammonium	0.001	0.0005	0.0004	0.0003
Chloride	0.001	0.0005	0.0004	0.0003

1/ To pass test.

The Federal Specification for sulfuric acid, technical grade, covers two types and two classes of acid:

Type I - 66° Baume
Type II - 60° Baume
Class 1 - For galvanizing and plating
Class 2 - For general use

The sulfuric acid shall be an oily, clear to slightly cloudy liquid and shall conform to the requirements shown in Table IX.

TABLE IX. Sulfuric acid, technical - federal specification requirements.

	Type I		Type II	
	Class 1	Class 2	Class 1	Class 2
Specific gravity, (60°/60°F) (15.6°/15.6°C)	1.8347	1.8347	1.7040	1.7040
Sulfuric acid, % by wt, min	93.0	93.0	77.5	77.5
Nonvolatile matter, % by wt, max	0.025	0.025	0.05	0.05
Arsenic, ppm, max	3.0	---	3.0	---

The military specification for sulfuric acid and oleum covers two grades that shall conform to the chemical requirements shown in Table X.

TABLE X. Sulfuric acid and oleum - military specification requirements.

	Grade I	Grade II
Total acidity, as H_2SO_4, %	As specified ±0.5	As specified ±0.5
Nitrobodies	none	none
Ash, %, max	0.80	0.65
Arsenic, as As_2O_3, %, max	0.01	0.025
Suspended matter, %, max	0.06	0.10

Technical grade sulfuric acid is commercially available as 60°Be, 66°Be electrolyte types, and 98% and 100% concentrations. The 60° and 66°Be types have typical analyses for H_2SO_4 of 77.67 and 93.19 percent. Technical grade oleum is commercially available with SO_3 concentrations ranging from 15 to 65 percent.

5.16.3 Use. Sulfuric acid, technical grade, is intended for military use as follows:

Class 1 is for use in galvanizing and plating of ferrous metals.
Class 2 is for general purposes, and
Class 2 of Type I is for use in soda-acid fire extinguishers.

Sulfuric acid electrolyte is intended for military use in lead storage batteries.

Sulfuric acid and oleum are intended for military use as follows:

Grade I is for use in mixture with nitric acid in the manufacture of various explosives, in various sulfonating processes, and for other chemical processes.

Grade II is for use in the manufacture of nitric acid and thionyl chloride, and for special purposes.

Commercial applications for sulfuric acid include the manufacture of detergents, fertilizers, pigments, dyes, and rayons; and for the drying of gases, the leaching of ores, and other chemical processes.

5.16.4 Safety. Sulfuric acid can release irritating and toxic fumes when heated. It can react with easily oxidizable metals to release flammable hydrogen gas. Concentrated sulfuric acid, as an oxidizer, can cause ignition of combustible material. Sulfuric acid is corrosive. Concentrated acid can cause burns, and dilute acid can cause severe irritation of eyes and skin. Inhalation of fumes can cause severe irritation of the respiratory tract. The PEL and TLV for sulfuric acid are 1 mg/m^3. In case of contact with skin, wash affected areas with water. For eyes, irrigate with water for at least 20 minutes, and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.16.5 Storage. Sulfuric acid shall be stored in tightly sealed acid resistant nonreactive containers in a cool, dry place away from heat sources and combustible material. (Refer to 4.3.2.)

5.16.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Sulfuric acid has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002; Reactive, Waste Number D003.

5.17 Name. SULFUR TRIOXIDE, TECHNICAL SO_3 FW 80.06
Sulfuric acid anhydride CAS 7446-11-9

5.17.1 Technical description. Sulfur trioxide (pure) is a liquid with a density of 1.970 g/cm^3 at 20°C, a melting point of 16.8°C and a boiling point of 44.8°C. Solid sulfur trioxide exists in three forms depending on the arrangement of the SO_3 units. Liquid sulfur trioxide dissolves in sulfuric acid to form pyrosulfuric acid, $H_2S_2O_7$, also known as fuming sulfuric acid or oleum.

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

5.17.2.1 Requirements. Sulfur trioxide, technical grade, is commercially available with an added stabilizer to prevent polymerization. A typical assay of the product, containing 0.2% stabilizer, is 99.6% SO_3. It is also available as an unstabilized product.

5.17.3 Use. Technical grade sulfur trioxide is intended for military use as a sulfonating agent for the production of sulfonated organic intermediates. Commercial applications include the production and regeneration of chlorosulfonic acid as an intermediate for the production of anhydrous hydrogen chloride, and as a sulfonating agent for the production of synthetic organic detergents.

5.17.4 Safety. Sulfur trioxide produces corrosive, toxic fumes when heated. It reacts with moisture or steam to reduce corrosive, toxic fumes of sulfuric acid. Sulfur trioxide is corrosive and can cause severe irritation and burns of the eyes and skin. Inhalation of fumes can cause severe irritation of the respiratory tract. There is no PEL or TLV referenced for sulfuric trioxide, but the PEL and TLV for sulfuric acid are 1 mg/m^3. In case of contact with the skin, wash affected areas with water. For eyes, irrigate with water for at least 20 minutes, and obtain medical attention. Use with adequate ventilation. For personal protective measures, refer to 4.3.1.

5.17.5 Storage. Sulfur trioxide shall be stored in tightly sealed nonreactive containers in a cool, dry place away from reactive materials. (Refer to 4.3.2.)

5.17.6 Disposal. In case of small spills, control with nonreactive absorbent. In case of large spills, dike to prevent spreading. Spills and washings can be neutralized with soda ash or lime. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.) Sulfur trioxide has an EPA Hazardous Waste Classification - Corrosive, Waste Number D002; Reactive, Waste Number D003.

6. NOTES

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

6.2 Subject term (key word) listing.

Acid anhydrides, inorganic
Acids, inorganic
Arsenic trioxide, technical
Boric acid, technical
Chlorosulfonic acid, technical
Chromium trioxide, technical
Disposal, hazardous chemicals
Exposure limits, hazardous chemicals
Fluoboric acid, technical
Fluosilicic acid, technical
Hydrobromic acid, technical
Hydrochloric acid, technical
Hydrofluoric acid, technical
Hypophosphorous acid, technical
Inorganic acid anhydrides
Inorganic acids
Molybdenum trioxide, technical
Nitric acid, technical
Orthophosphoric acid, technical
Phosphorus pentoxide, technical
Safety, hazardous chemicals
Sulfamic acid, technical
Sulfur trioxide, technical
Sulfuric acid, technical, and electrolyte

6.3 Changes from previous issue. Asterisks or vertical lines are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

CONCLUDING MATERIAL

PROJECT NUMBER: 6810-1320

CUSTODIANS:

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-STD-605B	2. DOCUMENT DATE *(YYMMDD)* 940830

3. DOCUMENT TITLE
INORGANIC ACIDS AND ACID ANHYDRIDES, TECHNICAL GRADE

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

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