METRIC

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# MILITARY STANDARD

## HALOGENATED HYDROCARBON COMPOUNDS AND SOLVENTS, TECHNICAL GRADE (METRIC)


AMSC N/A

FSC 6810

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FOREWORD

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.

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

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

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TABLES

# 1. SCOPE

1.1 Scope. This standard is a presentation of nomenclature, formulas, physical and chemical properties, specification requirements, military and typical commercial uses, safety information, storage information and disposal information for halogenated hydrocarbons and solvents, technical grade. This standard does not include all of the items represented by the title or all those items which are commercially available. It does contain items preferred for use in the selection of halogenated hydrocarbons and solvents, technical grade for application by the Department of Defense.

1.2 Application. Halogenated hydrocarbons and solvents, technical grade, have military use in the manufacture of smoke mixtures, explosives and pyrotechnics; as chemical intermediates and processing solvents; as solvents for resins, pesticides, and dyes; as vapor-degreasing and cleaning solvents; in removal of carbon deposits and paint; in clothing impregnation and flame retardation; and in fire extinguishing. Commercial applications are the same as above, and also include use in paint and printing ink formulations.

## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS

FEDERAL

| | |
|---|---|
| O-C-291 | - Chloroform, Technical. |
| O-T-236 | - Tetrachloroethylene (Perchloroethylene), Technical. |
| O-T-620 | - 1,1,1-Trichloroethane, Technical, Inhibited (Methyl Chloroform). |
| O-T-634 | - Trichloroethylene, Technical. |
| PPP-C-2020 | - Chemicals, Liquid, Dry and Paste, Packaging of |

MILITARY

| | |
|---|---|
| MIL-H-235 | - Hexachloroethane, Technical. |
| MIL-C-429 | - Chlorinated Paraffin, Technical. |
| MIL-B-4394 | - Bromochloromethane, Technical. |
| MIL-D-6998 | - Dichloromethane, Technical. |
| MIL-D-10662 | - 1,2-Dichloroethane, Technical. |
| MIL-C-12038 | - Chlorobenzene, Technical. |
| MIL-C-25107 | - Carbon Removing Compound, Orthodichlorobenzene for Engine Parts. |
| MIL-T-81533 | - 1,1,1-Trichloroethane (Methyl Chloroform) Inhibited, Vapor Degreasing. |

STANDARDS

FEDERAL

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

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

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

CODE OF FEDERAL REGULATIONS (CFR)

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

DEPARTMENT OF DEFENSE (DOD)

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

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

AMERICAN CONFERENCE OF GOVERNMENT INDUSTRIAL HYGIENISTS (ACGIH)

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

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|---|---|
| ASTM D 2108 | - Standard Test Method for Color of Halogenated Organic Solvents and their Admixtures (Platinum-Cobalt Scale). |
| ASTM D 4079 | - Standard Specification for Vapor Degreasing Grade Methylene Chloride. |

ASTM D 4080 - Standard Specification for Vapor-Degreasing Grade Trichloroethylene.
ASTM D 4081 - Standard Specification for Drycleaning Grade Perchloroethylene.
ASTM D 4126 - Standard Specification for Vapor-Degreasing Grade and General Solvent Grade 1,1,1-Trichloroethane.
ASTM D 4376 - Standard Specification for Vapor-Degreasing Grade Perchloroethylene.

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

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

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

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

National Fire Codes

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

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

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

## 3. DEFINITIONS

3.1 Halogenated hydrocarbon. A hydrocarbon compound in which part or all of the hydrogen atoms have been replaced by halogen atoms.

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

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

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

4.3.1.4 Training. Employers shall provide employees with training and information including MSDS on all chemical items in their work area, in accordance with 29 CFR 1910.1200 (h), to ensure that employees know potential hazards of the chemicals with which they come in contact and the symptoms of exposure as well as how these chemicals affect the body and bodily functions. Employees shall be adequately trained to render first aid.

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

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

4.3.2.1 Flammable, combustible, pyrophoric and ignitable materials. A flammable material is generally any solid, liquid, vapor or gas that ignites easily and burns rapidly. Combustible materials are generally those that are difficult to ignite and burn slowly. The DOT, in Part 173, Subpart D, Section 173.115 of 49 CFR, defines a flammable liquid as one having a closed cup flash point below 100°F (37.8°C). A combustible liquid is defined, by DOT in the above reference, as one having a closed cup flash point at or above 100°F and below 200°F (93.3°C). A pyrophoric liquid is defined, by DOT in the above reference, as one that ignites spontaneously in dry or moist air at or below 130°F (54.5°C). Materials with flash points of 200°F or higher are to be considered as burnable. The Environmental Protection Agency (EPA), in Part 261, Subpart C, Section 261.21 of 40 CFR*, designates the criteria for flammable and combustible materials and oxidizers that exhibit the characteristic of ignitability (I). Liquids with closed cup flash points of less than 140°F (60°C) are defined by EPA as ignitable. The autoignition point (temperature) of a substance is generally defined as the minimum temperature required to initiate or cause self-sustained combustion in the absence of a spark or flame. Materials that ignite easily under normal industrial conditions are considered to be dangerous fire hazards. Such materials shall be stored in a manner to prevent ignition and combustion. Easily ignitable substances, such as reducing agents, shall be kept away from strong oxidizing agents. All containers shall be tightly sealed. It is important to provide adequate ventilation in storage areas, and to locate the storage areas of these items away from fire hazards. Ample fire-control equipment shall be easily accessible. Storage buildings, rooms and cabinets shall comply with provisions of the National Fire Codes. The building shall be electrically grounded and signs posted to prevent the lighting of matches or smoking in the area. Flammable storage areas shall be equipped with smoke or fire detection equipment.

4.3.2.2 Water-sensitive fire and explosive hazardous materials. These are materials that react on contact with water or steam to ignite or evolve heat or explosive gases. Such materials exhibit the characteristic of reactivity (R) as designated by the EPA in Section 261.23 of the above reference.* These materials shall be stored in well-ventilated, cool, dry areas. All containers shall be tightly sealed. These materials are a fire hazard in contact with water or moisture; therefore, it is essential that no sprinkler be used.

*Refers only to materials that have become waste materials.

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

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

4.3.3 Chemical hazardous exposure limits. Chemical hazardous exposure limits for airborne concentrations of substances are obtained from the current TLVs® Threshold Limit Values and Biological Exposure Indices, adopted by the American Conference of Government Industrial Hygienists (ACGIH); current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL), 29 CFR, Part 1910, Subpart Z; and NIOSH Recommendation for Environmental Exposure Limits. Such information is also shown in MSDSs and the HMIS referred to in 4.2. The identity of sources establishing if a chemical is a carcinogen or potential carcinogen, for hazard communication purposes, is shown in 29 CFR 1910.1200 (d)(4). The more stringent standard shall apply when there is a conflict between standards.

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

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

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

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

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

4.4 Pollution and disposal.

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

*Refers only to materials that have become waste materials.

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

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

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

hazardous materials. It is imperative that the proper description of waste accompany the packaged item at all times. Final disposal of the waste item shall be accomplished by reutilization, transfer, donation or sales by DRMS in accordance with DOD 4160.21-M or by ultimate disposal as described in 4.4.3.2. Spill residue, including contaminants, to be turned in to the DRMO shall first be properly identified, containerized, and labeled. For large scale spills that grossly contaminate the environment, the Chemical Transportation Emergency Center (CHEMTREC), can be called for assistance. Applicable procedures of the local spill control plan shall be followed. Necessary respiratory, eye, and skin protection measures are to be used while performing cleanup operations.

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

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

## 5. DETAILED REQUIREMENTS

5.1 Name. Bromochloromethane $ClCH_2Br$ FW: 129.39
Chlorobromomethane
Methylene chlorobromide

5.1.1 Technical description. Bromochloromethane (pure) is a colorless liquid with a freezing point of -86.5°C, a boiling point of 68.11°C (760 mm Hg), a specific gravity of 1.9344 (20°/4°C), and a refractive index of 1.4838 (20°C). It is very slightly soluble in water (0.9 g/100 g $H_2O$ at 25°C). It is soluble in most organic solvents including ethyl alcohol, diethyl ether, acetone, and benzene.

5.1.2 Specification. MIL-B-4394, Bromochloromethane, Technical.

5.1.2.1 Requirements. The bromochloromethane shall be a technical (98%) grade to which has been added not more than one percent by weight of a corrosion inhibiting agent. The inhibited bromochloromethane shall conform to the chemical and physical characteristics shown in Table I.

TABLE I. Bromochloromethane, technical - military specification chemical and physical characteristics.

| | |
|---|---|
| Assay, as $ClCH_2Br$, % by wt, min | 98 |
| Acidity of water extract, equivalent to mL of 0.01N-NaOH, max | 1.0 |
| Free halogens by KI-starch test | None |
| Water content, % by wt, max | 0.04 |
| Corrosion inhibitor, by aluminum alloy panel test, gross etching, pitting, discoloration | None |
| Nonvolatile residue, g/100 g sample, max | 0.004 |
| Suspended matter or sediment | None |
| Specific gravity (25°/25°C) | 1.190 to 1.940 |
| Boiling range (760 mm Hg), within 3°C including 67.8°C, % by volume | 5 to 95 |

5.1.3 Use. The inhibited bromochloromethane is intended for use as a fire extinguishing fluid. Commercial applications are the same.

5.1.4 Safety. Bromochloromethane does not have a flash point or explosive limits in air. The vapor is heavier than air and will collect at lower levels in confined spaces. It can emit irritating and toxic fumes if heated to vaporization and decomposition. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.1.5 Storage. Bromochloromethane shall be stored in approved containers in a cool dry place away from heat sources.

5.1.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent and place in containers for disposal. In case of large liquid

spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

Bromochloromethane, as a halomethane, has an EPA Hazardous Waste Classification - Toxic.

5.2 Name. Chlorinated Paraffins, Technical

5.2.1 Technical description. Chlorinated paraffins are available in liquid and resinous forms with chlorine contents ranging from 22 to 70 percent by weight. Liquid chlorinated paraffins are miscible with aliphatic, aromatic, and terpene hydrocarbons; chlorinated aliphatic and aromatic hydrocarbons; hydrogenated naphthas; drying oils; and ketones and esters. They are insoluble in water, glycols, glycerine, and lower alcohols. Resinous chlorinated paraffins are soluble in aliphatic, aromatic, and terpene hydrocarbons; chlorinated aliphatic and aromatic hydrocarbons; drying oils; and ketones and esters. They are insoluble in lower alcohols and glycerine.

5.2.2 Specification. MIL-C-429, Chlorinated Paraffin, Technical.

5.2.2.1 Requirements. Chlorinated paraffin, technical, shall be of two types:

Type I - 40 percent chlorine
Type II - 70 percent chlorine

Chlorinated paraffin, technical, shall conform to the chemical and physical characteristics shown in Table II.

TABLE II. Chlorinated paraffin, technical - chemical and physical characteristics.

| | | |
|---|---|---|
| Color, Gardner scale | No darker than No. 5 | --- |
| Hydrochloric acid, mg/20 mL, max | 1.0 | --- |
| Total chlorine, % by wt | 41.0 to 43.0 | 68.8 to 73.0 |
| Free chlorine by starch - potassium iodide test | Pass test | --- |
| Water content, % by wt, max | 0.1 | 0.5 |
| Iron, % by wt, max | 0.01 | 0.01 |
| Volatile matter, mL/100 g, max | --- | 0.5 |
| Specific gravity (25°/15.6°C), min | --- | 1.60 |
| Acid number, mg KOH/g, max | --- | 0.5 |
| Softening point, °C, min | --- | 85 |
| Passing through a No. 50 (300 μ m) sieve, min | --- | 98 |

Chlorinated paraffin corresponding to type I is available from a chemical manufacturer as a medium viscosity liquid, clear light amber color, with good heat stability, and containing about 43 percent by weight chlorine. It is prestabilized for long storage life. Chlorinated paraffin corresponding to type II is available from a chemical manufacturer as a cream-white powdered resin, with good heat stability, and containing about 70 percent by weight of chlorine.

5.2.3 Use. Type I chlorinated paraffin is intended for military use in clothing impregnation applications. Type II chlorinated paraffin is intended for use in flame retardation applications. Commercial applications for liquid chlorinated paraffins include use in paints, adhesives, mastics, caulks, lubricants, rubbers, and in fabric finishing. Applications for resinous chlorinated paraffins include use in paints, printing inks, plastics, rubbers, adhesives, mastics, caulks, waxes, polishes, glazes, and in wood treatment and fabric finishings.

5.2.4 Safety. Liquid chlorinated paraffin does not have a flash point or explosive limits in air. Solid chlorinated paraffin is not burnable. Chlorinated paraffins can emit irritating and toxic fumes if heated to decomposition. They can be irritating to the skin and eyes. In case of contact with the skin, wash affected parts with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.2.5 Storage. Chlorinated paraffins shall be stored in approved containers away from heat sources.

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

Chlorinated paraffins have an EPA Hazardous Waste Classification - Toxic.

5.3 Name. Chlorobenzene, Technical $C_6H_5Cl$ FW: 112.56
Chlorobenzol
Monochlorobenzene
Phenyl chloride

5.3.1 Technical description. Chlorobenzene (pure) is a colorless liquid with a freezing point of -45.6°C, a boiling point of 132°C (760 mm Hg), a specific gravity of 1.1058 (20°/4°C), and a refractive index of 1.5241 (20°C). It is practically insoluble in water (<0.1 g/100 g $H_2O$ at 25°C). It is miscible with acetone, ethyl alcohol, diethyl ether, benzene, and chloroform.

5.3.2 Specification. MIL-C-12038, Chlorobenzene, Technical.

5.3.2.1 Requirements. Chlorobenzene, technical, shall conform to the chemical and physical characteristics shown in Table III.

TABLE III. Chlorobenzene, technical - military specification chemical and physical characteristics.

| | |
|---|---|
| Color | Visually clear and colorless |
| Specific gravity (20°/4°) | 1.101 to 1.112 |
| Distillation (760 mm Hg) | |
| Distilling between 131° and 132°C, % by vol, min | 98 |
| Water, % by vol, max | 0.1 |
| Acidity, as HCl, % by wt, max | 0.015 |

5.3.3 Use. Chlorobenzene is intended for military use as a solvent and as a raw material in the manufacture of various chemicals. Commercial applications include use as a solvent for insecticide, paints and resins. It is also used as a chemical intermediate for the manufacture of various products including insecticides, herbicides, and dyestuffs.

5.3.4 Safety. Chlorobenzene is a flammable liquid with a closed cup flash point of 85°F (29.4°C), and explosive limits in air of 1.3 to 7.1 percent by volume. The vapor is heavier than air and can collect at lower levels in confined spaces. It can emit irritating and toxic fumes if heated to decomposition. The liquid can be irritating to the eyes and skin. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.3.5 Storage. Chlorobenzene shall be stored in approved containers in a cool dry place away from heat sources.

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

Chlorobenzene has an EPA Hazardous Waste Classification - Toxic, Waste Number U037.

5.4 Name. Chloroform, Technical $CHCl_3$ FW: 119.38
Trichloromethane (IUPAC)

5.4.1 Technical description. Chloroform (pure) is a colorless liquid with a freezing point of -63.5°C, a boiling point of 61.7°C (760 mm Hg), a specific gravity of 1.4832 (20°/4°C), and a refractive index of 1.4459 (20°C). It is practically insoluble in water (<0.1 g/100 g $H_2O$ at 25°C). It is miscible with acetone, benzene, ethyl alcohol, and diethyl ether at 20°C.

5.4.2 Specification. O-C-291, Chloroform, Technical.

5.4.2.1 Requirements. Chloroform, technical, shall conform to the chemical and physical characteristics shown in Table IV. A suitable stabilizer shall be added to the chloroform not to exceed one percent by weight.

TABLE IV. Chloroform, technical - federal specification chemical and physical characteristics.

| Characteristic | Requirement |
|---|---|
| Appearance | No evidence of suspended matter or sediment |
| Color (Pt-Co Scale) 1/, No., max | 10 |
| Specific gravity (25°C/25°C) | 1.474 to 1.485 |
| Residue after evaporation and heating at 105° to 110°C, g/100 mL, max | 0.002 |
| Boiling range (760 mm Hg), | |

TABLE IV. Chloroform, technical - federal specification chemical and physical characteristics (Continued).

| | |
|---|---|
| distilling between 60° and 62°C, %, min | 95 |
| Acidity, as HCl, %, max | 0.002 |
| Free chlorine, by starch-potassium iodide test | Pass test |
| Phosgene, by $Ba(OH)_2$ solution test | None |
| Odor: during evaporation | No foreign odor |
| after evaporation | No residual odor |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

5.4.3 Use. Chloroform, technical, is intended for military use in the manufacture of chemicals and for solvent purposes. Commercial applications are the same. A propellant grade is available for use in propellant applications.

5.4.4 Safety. Chloroform does not have a flash point or explosive limits in air. The vapor is heavier than air and will collect at lower levels in confined spaces. It can emit irritating and toxic fumes if heated to vaporization and decomposition. Chloroform is a suspected human carcinogen. The liquid can be irritating to the skin and eyes, and can be absorbed through the skin. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.4.5 Storage. Chloroform shall be stored in approved containers in a cool dry place away from heat sources.

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

Chloroform has an EPA Hazardous Waste Classification - Toxic, Waste Number U044.

5.5 Name. o-Dichlorobenzene $C_6H_4Cl_2$ FW: 147.01
1,2-Dichlorobenzene (IUPAC)
1,2-Dichlorobenzol
o-Dichlorobenzol
Orthodichlorobenzene

5.5.1 Technical description. o-Dichlorobenzene (pure) is a colorless liquid with a freezing point of -17.0°C, a boiling point of 180.5°C (760 mm Hg), a specific gravity of 1.3048 (20°/4°C), and a refractive index of 1.5515 (20°C). It is practically insoluble in water (0.0134 g/100 g $H_2O$ at 20°C). It is miscible with most organic solvents including acetone, benzene, carbon tetrachloride, ethyl alcohol, and diethyl ether.

5.5.2 Specification. MIL-C-25107, Carbon Removing Compound, Orthodichlorobenzene for Engine Parts.

5.5.2.1 Requirements. Orthodichlorobenzene, as an ingredient for a carbon removing compound mixture, shall have the chemical and physical characteristics shown in Table V.

TABLE V. Orthodichlorobenzene (for carbon removing compound mixture) - military specification chemical and physical characteristics.

| | |
|---|---|
| Distillation range (760 mm Hg), 5% to 95% point, °C | 175 to 184 |
| Specific gravity (25°C/25°C), min | 1.29 |
| Flash point (closed cup) °C (°F), min | 68 (154.4) |
| Free acid, as HCl, % by wt, max | 0.01 |

Orthodichlorobenzene is commercially available in two grades of purity with specification requirements shown in Table VI.

TABLE VI. Orthodichlorobenzene - commercial specification requirements.

| | | |
|---|---|---|
| Orthodichlorobenzene, wt %, min | 98 | 80.0 to 90.0 |
| Distillation range (760 mm Hg), including 180°C, °C, max | 2.5 | 5 |
| Paradichlorobenzene plus metadichlorobenzene total, wt %, max | --- | 20 |
| Water, ppm, typical | 84 | --- |
| Color, Pt-Co Scale 1/, No., max | 30 | --- |
| Acidity and alkalinity, pH | 6.0 to 8.0 | 6.0 to 8.0 |
| Flash point (open cup), °F (°C), min | 154.4 (68) | 154.4 (68) |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

5.5.3 Use. o-Dichlorobenzene is intended for military use as the major ingredient of a carbon removing compound mixture in accordance with MIL-C-25107. The mixture is used to soften and remove carbon and fuel gum deposits from engine parts by immersion in a heated solution. Most paint coatings will also be removed by this compound mixture. Commercial applications are the same as above for the 80 percent grade of orthodichlorobenzene, and also include use in other cleaning, polishing, and degreasing formulations. Commercial applications for the 98 percent grade include use as a processing solvent for isocyanate intermediates in the manufacture of polyurethanes, and as an intermediate in the production of pesticides and dyes.

5.5.4 Safety. o-Dichlorobenzene is a combustible liquid with explosive limits in air between 2 and 9 percent by volume. The vapor is heavier than air and can collect at lower levels in confined spaces. It can emit irritating and toxic fumes if heated to vaporization and decomposition. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.5.5 Storage. o-Dichlorobenzene shall be stored in approved containers in a cool dry place away from heat sources.

5.5.6 Disposal. In case of small liquid spills, absorb with nonreactive absorbent and place in containers for disposal. In case of large liquid

spills, dike to prevent spreading. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices.

o-Dichlorobenzene has an EPA Hazardous Waste Classification - Toxic, Waste Number U070.

5.6 Name. Dichloromethane, Technical (IUPAC) $CH_2Cl_2$ FW: 84.93
Methylene chloride
Methylene dichloride

5.6.1 Technical description. Dichloromethane (pure) is a colorless liquid with a freezing point of -95°C, a boiling point of 40°C (760 mm Hg), a specific gravity of 1.3266 (20°/4°C), and a refractive index of 1.4242 (20°C). It is slightly soluble in water (1.32 g/100 g $H_2O$ at 25°C). It is miscible with acetone, ethyl alcohol, and diethyl ether.

5.6.2 Specifications.

MIL-D-6998, Dichloromethane, Technical.
ASTM D 4079, Standard Specification for Vapor Degreasing Grade Methylene Chloride.

5.6.2.1 Requirements.

a. Military specification requirements. Dichloromethane, technical, shall be of two grades:

Grade A - 0.0005 percent maximum acidity
Grade B - 0.010 percent maximum acidity

Dichloromethane, technical, shall conform to the chemical and physical characteristics shown in Table VII.

TABLE VII. Dichloromethane, technical - military specification chemical and physical characteristics.

| | |
|---|---|
| Color (Pt-Co Scale) 1/, No., max | 20 |
| Specific gravity (25°C/25°C) | 1.317 to 1.322 |
| Distillation range (760 mm Hg) | |
| Initial boiling point, °C, min | 39.0 |
| Dry point, °C, max | 41.0 |
| Nonvolatile matter, % by wt, max | 0.002 |
| Acidity, as HCl, % by wt, max | |
| Grade A | 0.0005 |
| Grade B | 0.010 |
| Water content, % by wt, max | 0.020 |
| Free halogens, by starch-potassium iodide test | Pass test |
| Residual odor | None |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

b. ASTM specification requirements. Vapor-degreasing grade methylene chloride shall conform to the chemical and physical requirements shown in Table VIII.

TABLE VIII. Methylene chloride, vapor-degreasing grade - ASTM specification chemical and physical characteristics.

| | |
|---|---|
| Specific gravity (25°C/25°C) | 1.300 to 1.325 |
| Distillation range (760 mm Hg) | |
| Initial boiling point, °C, min | 39.0 |
| Dry point, °C, max | 45.0 |
| Acidity, as HCl, wt %, max | 0.0010 |
| Water, wt %, max | 0.0100 |
| Appearance | Clear and free from suspended matter |
| Color, Pt-Co Scale 1/, No., max | 20 |
| Acid acceptance, as NaOH, wt %, min | 0.160 |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

5.6.3 Use. Dichloromethane, technical, is intended for military use as follows: Grade A is intended for use as a solvent in the manufacture of other chemicals. Grade B is intended for use in the preparation of acrylic resin plastic cement, as a paint remover, and as a safety solvent.

Commercial applications are the same as above, and also include use in solvent mixtures for cellulose esters and ethers, plastics processing, as a vapor-degreasing solvent, and as a component in solvent blends for the cold cleaning of metals.

5.6.4 Safety. Dichloromethane does not have a flash point or explosive limits in air. The vapor is heavier than air and will collect at lower levels in confined spaces. It can emit irritating and toxic fumes if heated to vaporization and decomposition. Dichloromethane is a suspected human carcinogen. The liquid can be irritating to the skin and eyes, and can be absorbed through the skin. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.6.5 Storage. Dichloromethane shall be stored in approved containers in a cool dry place away from heat sources.

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

Dichloromethane has an EPA Hazardous Waste Classification - Toxic, Waste Number U080.

5.7 Name. Ethylene Dichloride, Technical $ClCH_2CH_2Cl$ FW: 98.96
1,2-Dichloroethane (IUPAC)
Ethylene Chloride

5.7.1 Technical description. Ethylene dichloride (pure) is a colorless liquid with a freezing point of -35.36°C, a boiling point of 83.47°C (760 mm Hg), a density of 1.2351 g/cm$^3$ (20°C), and a refractive index of 1.4448 (20°C). It is slightly soluble in water (0.85 g/100 g $H_2O$ at 25°C). It is miscible

with organic solvents such as acetone, alcohols, ethers, and glycols. It is stable and resistant to oxidation at moderate temperatures. It does not corrode metals at ordinary temperatures when moisture-free.

5.7.2 Specification. MIL-D-10662, 1,2-Dichloroethane, Technical.

5.7.2.1 Requirements. 1,2-Dichloroethane, technical, shall conform to the chemical and physical characteristics shown in Table IX.

TABLE IX. 1,2-Dichloroethane, technical - military specification chemical and physical characteristics.

| | |
|---|---|
| Appearance | Visually free from suspended matter or sediment |
| Color | To pass test |
| Boiling range (760 mm Hg) | |
| Distilling between 82.5° and and 84.5°C, % by vol, min | 95 |
| Specific gravity (20°/20°C) | 1.253 to 1.257 |
| Acidity, as HCl, % by wt, max | 0.005 |

5.7.3 Use. Ethylene dichloride is intended for military use as a diluent for "mustard gas" (dichlorodiethyl sulfide) in order to lower the freezing point of the agent. Commercial applications include use as an intermediate for the manufacture of vinyl chloride, 1,1,1-trichloroethane, trichloroethylene, perchloroethylene, ethylene amines, and polysulfide elastomers. It is also used in paint removers, metal degreasing solvents, and cleaning compounds.

5.7.4 Safety. Ethylene dichloride is a flammable liquid with a closed cup flash point of 56°F (13.3°C), an autoignition temperature of 755°F (413°C), and explosive limits in air of 6.2 to 15.6 percent by volume. The vapor is heavier than air and can collect at lower levels in confined spaces. It can emit irritating and toxic fumes if heated to vaporization and decomposition. It is toxic by ingestion, inhalation, or skin absorption. It is a suspected human carcinogen. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.7.5 Storage. Ethylene dichloride shall be stored in approved containers in a cool dry place away from heat sources.

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

Ethylene dichloride has an EPA Hazardous Waste Classification - Ignitable, Waste Number D001; Toxic, Waste Number U077.

5.8 Name. Hexachloroethane, Technical $Cl_3CCCl_3$ FW: 236.74
Perchloroethane

5.8.1 Technical description. Hexachloroethane (pure) is a solid in a rhombic crystalline form when separated from an alcohol-ether solution. It has a melting point of 186.8° to 187.4°C (sealed tube), and a specific gravity of 2.091 (20°/4°C). It is insoluble in water. It is very soluble in ethyl alcohol and diethyl ether, and is soluble in benzene.

5.8.2 Specification. MIL-H-235, Hexachloroethane, Technical.

5.8.2.1 Requirements. The military specification covers a technical grade of hexachloroethane with the chemical and physical characteristics shown in Table X.

TABLE X. Hexachloroethane, technical - military specification chemical and physical characteristics.

| | |
|---|---|
| Melting point, °C | 183.0 to 187.0 |
| Assay, as hexachloroethane, % by wt, min 1/ | 98.00 |
| Acidity, as HCl, % by wt, max | 0.04 |
| Iron, % by wt, max | 0.07 |
| Water content, % by wt, max | 0.05 |
| Ammonium chloride, % by wt, max 2/ | 0.02 |

1/ Calculated from the total chlorine after making a deduction of the chlorine in the hydrochloric acid.

2/ This requirement does not apply when the material is to be used in smoke mixtures containing ammonium chloride as one of the ingredients, or if the process used in the manufacture of hexachloroethane does not involve the use of ammonia.

The hexachloroethane shall conform to the particle size characteristics shown in Table XI.

TABLE XI. Hexachloroethane, technical - military specification particle size characteristics.

| Standard sieves (micrometers) | Percent by weight passing | |
|---|---|---|
| | Minimum | Maximum |
| 850 | 95 | --- |
| 300 | 50 | --- |
| 150 | --- | 30 |
| 75 | --- | 10 |

5.8.3 Use. Hexachloroethane, technical, is intended for military use in white smoke mixtures. It is also used in the manufacture of explosives and pyrotechnics. Commercial applications include use as a camphor substitute in nitrocellulose, and as a rubber accelerator.

5.8.4 Safety. Hexachloroethane does not have a flash point or explosive limits in air. It can emit irritating and toxic fumes if heated to decomposition. It is irritating to the skin and eyes. In case of contact with the skin, wash affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.8.5 Storage. Hexachloroethane shall be stored in approved containers in a cool dry place away from heat sources.

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

Hexachloroethane has an EPA Hazardous Waste Classification - Toxic, Waste Number U131.

5.9 Name. Tetrachloroethylene, Technical $Cl_2C=CCl_2$ FW: 165.83
Perchloroethylene
Tetrachloroethene (IUPAC)

5.9.1 Technical description. Tetrachloroethylene (pure) is a colorless liquid with a freezing point of -22°C, a boiling point of 121°C (760 mm Hg), a specific gravity of 1.6227 (20°/4°C), and a refractive index of 1.5053 (20°C). It is practically insoluble in water (0.015 g/100 g $H_2O$ at 25°C). It is miscible with most organic liquids, including ethyl alcohol, diethyl ether, and benzene.

5.9.2 Specifications.

O-T-236, Tetrachloroethylene (Perchloroethylene), Technical.
ASTM D 4081, Standard Specification for Drycleaning Grade Perchloroethylene.
ASTM D 4376, Standard Specification for Vapor-Degreasing Grade Perchloroethylene.

5.9.2.1 Requirements.

a. Federal Specification Requirements. Tetrachloroethylene shall be of two grades:

Grade A - Drycleaning grade
Grade B - Vapor degreasing grade

The tetrachloroethylene shall be a liquid that conforms to the chemical and physical characteristics shown in Table XII.

TABLE XII. Tetrachloroethylene, technical - federal specification chemical and physical characteristics.

| | Grade A | Grade B |
|---|---|---|
| Odor | Nonresidual | N/A |
| Foreign matter | Visibly free | Visibly free |
| Color, Pt-Co Scale 1/, No., max | 15 | N/A |
| Distillation range (760 mm Hg): | | |
| Initial boiling point, °C, min | 120 | 118 |
| Dry point, °C, max | 122 | 122 |
| pH of water extraction, min | 6.5 | N/A |
| Total acid acceptance, as NaOH, wt %, min | N/A | 0.10 |
| Water, ppm, max | 30 | 60 |
| Nonvolatile matter, wt %, max | 0.0025 | 0.01 |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

b. ASTM specification requirements. Drycleaning-grade perchloroethylene shall conform to the requirements shown in Table XIII.

TABLE XIII. Perchloroethylene, drycleaning grade - ASTM specification requirements.

| | |
|---|---|
| Appearance | Clear and free from suspended matter and undissolved water. |
| Residual odor | No foreign odor |
| Specific gravity (25°/25°) | 1.615 to 1.625 |
| Distillation range (760 mm Hg) | |
| Initial boiling point, °C, min | 120.0 |
| Dry point, °C, max | 122.0 |
| Acid acceptance, as NaOH, wt %, min | 0.03 |
| Water, wt %, max | 0.0050 |
| Copper corrosion, wt loss, mg, max | |
| Flask | 10 |
| Soxhlet | 20 |
| Condenser | 20 |
| Acidity, as HCl, mL 0.01 N NaOH, max | 15 |
| Nonvolatile residue, wt %, max | 0.0050 |

Vapor-degreasing grade perchloroethylene shall conform to the requirements shown in Table XIV.

TABLE XIV. Perchloroethylene, vapor-degreasing grade - ASTM specification requirements.

| | |
|---|---|
| Appearance | Clear and free from suspended matter |
| Color, Pt-Co Scale 1/, No., max | 20 |
| Specific gravity (25°/25°) | 1.615 to 1.625 |
| Distillation range (760 mm Hg) | |
| Initial boiling point, °C, min | 120.0 |
| Dry point, °C, max | 125.0 |
| Acidity, as HCl, wt %, max | 0.0005 |
| Alkalinity, as NaOH, wt %, max | 0.030 |
| Acid acceptance, as NaOH, wt %, min | 0.025 |
| Water, wt %, max | 0.0050 |
| Halide, as $Cl^-$, wt %, max | 0.0005 |
| Copper corrosion, wt loss, mg, max | |
| Flask | 10 |
| Soxhlet | 20 |
| Condenser | 20 |
| Acidity, as HCl, mL 0.01 N NaOH, max | 15 |
| Nonvolatile residue, wt %, max | 0.0050 |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

5.9.3 Use. Grade A tetrachloroethylene is intended for military use as a dry cleaning solvent. Grade B tetrachloroethylene is intended for military use as a vapor degreasing solvent. Commercial applications are the same as above. Tetrachloroethylene is preferred as a vapor degreasing solvent in some applications because of its higher boiling point. It can melt and solubilize many waxes, pitches, and resins. It also condenses more vapor on metals to be cleaned, and is more effective with lightweight and light gage parts. Other

applications include use as a carrier solvent for fabric finishes, rubber, and silicones; and as an extractive solvent. It is also used as a component in paint remover formulations, printing inks, and safety solvent blends.

5.9.4 Safety. Tetrachloroethylene does not have a flash point, autoignition temperature or explosive limits in air. The vapor is heavier than air and will collect at lower levels in confined spaces. It can form corrosive and toxic gases if heated to decomposition. High vapor concentrations are toxic. It has been shown to cause cancer in some animals. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.9.5 Storage. Tetrachloroethylene shall be stored in approved containers in a cool dry place away from heat sources.

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

Tetrachloroethylene has an EPA Hazardous Waste Classification - Toxic, Waste Number U210.

5.10 Name. 1,1,1-Trichloroethane (IUPAC), Technical $CCl_3CH_3$ FW: 129.39
Methyl chloroform

5.10.1 Technical description. 1,1,1-Trichloroethane (pure) is a colorless liquid with a freezing point of -30.41°C, a boiling point of 74.1°C (760 mm Hg), a specific gravity of 1.3390 (20°/4°C), and a refractive index of 1.4379 (20°C). It is practically insoluble in water (0.07 g/100 g $H_2O$ at 25°C). It is miscible with ethyl alcohol, diethyl ether, and chloroform. It is soluble in benzene. It can be decomposed by strong alkalies.

5.10.2 Specifications.

O-T-620, 1,1,1-Trichloroethane, Technical, Inhibited (Methyl Chloroform).
MIL-T-81533, 1,1,1-Trichloroethane (Methyl Chloroform) Inhibited, Vapor Degreasing.
ASTM D 4126, Standard Specification for Vapor-Degreasing Grade and General Solvent Grade 1,1,1-Trichloroethane.

5.10.2.1 Requirements.

a. Federal specification requirements. 1,1,1-Trichloroethane, technical, inhibited, shall be of one grade and three types:

Type I - Regular
Type II - With dauber
Type III - Aerosol

The material shall consist of 1,1,1-trichloroethane, inhibited against the corrosive attack of aluminum alloys, and containing not less than 90.0 percent by volume of 1,1,1-trichloro-

ethane. The inhibitors and impurities shall consist of materials such that the toxicity of the solvent mixture shall not exceed that of the uninhibited 1,1,1-trichloroethane. The material shall be homogeneous. The material shall not contain any individual halogenated constituent, other than 1,1,1-trichloroethane, in excess of 0.5 percent by volume. In addition, the sum total of all halogen constituents, other that 1,1,1-trichloroethane, shall not exceed 2 percent by volume. The propellant content of the type III aerosol mixture shall be excluded from these computations for halogenated constituents. The utility shall not be adversely affected by storage up to 6 months in the original shipping containers under any climatic conditions. 1,1,1-Trichloroethane shall conform to the chemical and physical characteristics shown in Table XV.

TABLE XV. 1,1,1-Trichloroethane, technical, inhibited - federal specification chemical and physical characteristics.

| | |
|---|---|
| Appearance | Clear, free from sediment and suspended matter |
| Odor | Characteristic mild sweet, no residual odor |
| Color, Pt-Co Scale 1/, No., max | 15 |
| Specific gravity (25°/25°C) | 1.284 to 1.324 |
| Distillation range (760 mm Hg) | |
| Initial boiling point, °C, min | 70°C |
| Dry point, °C, max | 88°C |
| Water content, ppm, max | 100 |
| Acidity, as HCl, %, max | 0.001 |
| Nonvolatile matter, at 105 ± 5°C wt %, max | 0.001 |
| Corrosion of aluminum alloy | No evidence of pitting, etching, or discoloration |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

The type III aerosol formulation shall be a mixture of the 1,1,1-trichloroethane, technical, inhibited, and a propellant contained in a pressurized container. The active ingredient shall conform to the requirements of Table XV, and shall be not less than 61 percent by weight of 1,1,1-trichloroethane.

b. Military specification requirements. Inhibited vapor degreasing 1,1,1-trichloroethane shall consist of materials such that the toxicity of the solvent mixture shall not exceed that of the uninhibited 1,1,1-trichloroethane. The material shall be and remain homogeneous, and its utility shall not be adversely affected by storage up to 6 months in the original shipping containers under any climatic conditions. The material shall contain not less than 93.0 percent by weight of 1,1,1-trichloroethane; and shall not contain any individual constituent, other than 1,1,1-trichloroethane, in excess of 0.5 percent by volume. In addition, the sum total of all halogenated constituents, other than 1,1,1-trichloroethane

shall not exceed 1.0 percent by volume. The material shall conform to the chemical and physical characteristics shown in Table XVI.

TABLE XVI. 1,1,1-Trichloroethane - military specification chemical and physical characteristics.

| | |
|---|---|
| Appearance | Free from suspended matter and sediment |
| APHA Color 1/, No., max | 15 |
| Specific gravity (25°/25°C) | 1.300 to 1.327 |
| Distillation range (760 mm Hg): | |
| Initial boiling point, °C, min | 79 |
| Dry point, °C, max | 88 |
| 1,1,1-Trichloroethane, content, % by wt, min | 93.0 |
| Water content, ppm, max | 100 |
| Acidity, as HCl | |
| As received, % by wt, max | 0.001 |
| After 48-hour accelerated oxidation, % by wt, max | 0.020 |
| Free halogen, by potassium iodide-starch test | None |
| Metals corrosion (aluminum alloy, steel, magnesium, and titanium) | No visual corrosion |
| Acid acceptance, as NaOH, % by wt, min | 0.10 |
| Residue soluble in $CCl_4$, as isooctane, % by wt, max | 0.0005 |

1/ Equivalent to Pt-Co Number Scale.

b. ASTM specification requirements. Vapor-degreasing grade and general solvent grade 1,1,1-trichloroethane shall conform to the requirements shown in Table XVII.

TABLE XVII. 1,1,1-Trichloroethane - ASTM specification chemical and physical characteristics.

| | |
|---|---|
| Appearance | Clear and free from suspended matter. |
| Color, Pt-Co Scale 1/, No., max | 20 |
| Specific gravity (25°/25°C) | 1.300 to 1.327 |
| 1,1,1-Trichloroethane content, wt %, min | 90.0 |
| Distillation range (760 mm Hg) | |
| Initial boiling point, °C, min | 70.0 |
| Dry point, °C, max | 88.0 |
| Water, wt %, max | 0.0100 |
| Acidity, as HCl, wt %, max | 0.0010 |
| Alkalinity, as NaOH, wt %, max | 0.020 |
| Acid acceptance, as NaOH, wt %, min | 0.160 |
| Halide, as $Cl^-$, wt %, max | 0.0005 |
| Nonvolatile residue, at 105° ± 5°C, wt %, max | 0.0050 |
| Aluminum scratch | Passes test |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

5.10.3 Use. 1,1,1-Trichloroethane, technical, inhibited, is intended for military use as follows:

Type I material is for use as a solvent for cleaning operations, and for cleaning and degreasing electrical equipment.

Type II material is for removing residue from type faces of typewriters.

Type III material is for the same use as type II material and for cleaning assembled electronic equipment. In addition it can be used as a spot remover.

1,1,1-Trichloroethane, inhibited, is also intended for vapor degreasing where air pollution regulations preclude the use of other materials. Commercial applications are the same as above, and also include use as a versatile all-purpose solvent for cold-cleaning of production parts and assemblies, maintenance cleaning of equipment, as a formulating solvent for printing inks and lubricants, in aerosol propellant systems, in the manufacture of printed circuit boards, by photochemical machining, and in closed textile finishing operations.

5.10.4 Safety. 1,1,1-Trichloroethane does not have a flash point in air, but high vapor concentrations can be ignited by a high-energy source. Its lower and upper explosive limits in air are 8.4 and 16.5 percent by volume. The vapor is heavier than air and will collect at lower levels in confined spaces. It can form corrosive and toxic gases if heated to decomposition. High vapor concentrations are toxic. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.10.5 Storage. 1,1,1-Trichloroethane shall be stored in approved containers in a cool dry place away from heat sources.

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

1,1,1-Trichloroethane has an EPA Hazardous Waste Classification - Toxic, U226.

5.11 Name. Trichloroethylene, Technical $ClCH=CCl_2$ FW: 131.39
Ethylene trichloride
Trichloroethene (IUPAC)
1,1,2-Trichloroethylene

5.11.1 Technical description. Trichloroethylene (pure) is a colorless liquid with a freezing point of -86.4°C, a boiling point of 87°C (760 mm Hg), a specific gravity of 1.4642 (20°/4°C), and a refractive index of 1.4733 (20°C). It is practically insoluble in water (0.11 g/100 g $H_2O$ at 25°C). It is miscible with ethyl alcohol, diethyl ether, and chloroform. It can be decomposed by strong alkalies.

5.11.2 Specifications.

O-T-634, Trichloroethylene, Technical.
ASTM D 4080, Standard Specification for Vapor-Degreasing Grade Trichloroethylene.

5.11.2.1 Requirements.

a. Federal specification requirements. Trichloroethylene, technical, shall be of two types:

Type I - Regular
Type II - Vapor degreasing

The trichloroethylene shall conform to the chemical and physical characteristics shown in Table XVIII. Type II material shall contain a stabilizer to inhibit acid formation. The added stabilizer, certified by the supplier, shall not reduce the nonflammability or increase the toxicity or noxious characteristics of the trichloroethylene.

TABLE XVIII. Trichloroethylene, technical - federal specification chemical and physical characteristics.

| | Type I | Type II |
|---|---|---|
| Appearance | Clear and free of suspended matter | Clear and free of suspended matter |
| Color, APHA Scale 1/, No., max | 15 | 15 |
| Residual stain | None | --- |
| Specific gravity (25°/25°C) | 1.450 to 1.460 | 1.450 to 1.460 |
| Distillation range (760 mm Hg): | | |
| Initial boiling point, °C, min | 86.0 | 86.0 |
| Minimum 95% distilled, °C, max | 87.5 | 87.5 |
| Dry point, °C, max | 90.0 | 90.0 |
| Acidity, as HCl, wt %, max | 0.01 | 0.01 |
| Alkalinity, as NaOH, wt %, max | 0.015 | 0.015 |
| Acid acceptance, as NaOH, wt %, min | 0.160 | 0.160 |
| Water, ppm, max | 100 | 100 |
| Nonvolatile residue, wt %, max | 0.002 | 0.010 |

1/ Equivalent to Pt-Co Scale

b. ASTM specification requirements. Vapor-degreasing grade trichloroethylene shall conform to the requirements shown in Table XIX.

TABLE XIX. Trichloroethylene, vapor degreasing grade - ASTM specification requirements.

| | |
|---|---|
| Appearance | Clear and free from suspended matter |
| Color, Pt-Co Scale 1/, No., max | 20 |
| Specific gravity (25°/25°C) | 1.450 to 1.460 |
| Distillation range (760 mm Hg): | |
| Initial boiling point, °C, min | 85.0 |
| Dry point, °C, max | 90.0 |

TABLE XIX. Trichloroethylene, vapor degreasing grade - ASTM specification requirements (Continued).

| | |
|---|---|
| Water, wt %, max | 0.010 |
| Acidity, as HCl, wt %, max | 0.0005 |
| Alkalinity, as NaOH, wt %, max | 0.010 |
| Acid acceptance, as NaOH, wt %, min | 0.160 |
| Halide, as $Cl^-$, wt %, max | 0.0005 |
| Nonvolatile residue, wt %, max | 0.0050 |

1/ Color by Pt-Co Scale is in accordance with ASTM D 2108.

5.11.3 Use. Trichloroethylene, type I, is intended for military use in drycleaning and for general solvent purposes. Type II is intended for the vapor degreasing of metals. Commercial applications are the same as above, and also include use as a primary solvent for cleaning aluminum, and as a secondary solvent for cleaning steel prior to galvanizing. It is also used in the production of polyvinyl chloride.

5.11.4 Safety. Trichloroethylene does not have a flash point in air, but high vapor concentrations can be ignited by a high energy source. Its lower and upper explosive limits in air are 8.0 and 10.6 percent by volume. The vapor is heavier than air and will collect at lower levels in confined spaces. It can form corrosive and toxic gases if heated to decomposition. High vapor concentrations are toxic. It has been shown to cause cancer in some animals. The liquid can be irritating to the skin and eyes. In case of contact with the skin, flush affected areas with water. In case of contact with the eyes, flush with water for at least 20 minutes and obtain medical attention.

5.11.5 Storage. Trichloroethylene shall be stored in approved containers in a cool dry place away from heat sources.

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

Trichloroethylene has an EPA Hazardous Waste Classification - Toxic, Waste Number U228.

## 6. NOTES

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

6.1 Intended use. This standard is intended to cite nomenclature, formulas, physical and chemical properties, specification requirements, military and typical commercial uses, safety information, storage information and disposal information for halogenated hydrocarbons and solvents, technical grade, preferred for application by the Department of Defense.

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

6.3 Subject term (key word) listing.

Bromochloromethane
Chlorinated paraffins
Chlorobenzene
Chlorobenzol
Chlorobromomethane
Chloroform
o-Dichlorobenzene
1,2-Dichlorobenzene
o-Dichlorobenzol
1,2-Dichlorobenzol
1,2-Dichloroethane
Dichloromethane
Ethylene Chloride
Ethylene Dichloride
Ethylene trichloride
Exposure limits, hazardous chemicals
Halogenated hydrocarbon
Hazardous waste, disposal and storage of
Hexachloroethane
Information, hazardous chemicals
Methyl chloroform
Methylene chloride
Methylene chlorobromide
Methylene dichloride
Monochlorobenzene
Orthodichlorobenzene
Paraffin, chlorinated
Perchloroethane
Perchloroethylene
Phenyl chloride
Safety, hazardous chemicals
Tetrachloroethane
Tetrachloroethene
Tetrachloroethylene
1,1,1-Trichloroethane
Trichloroethene

Trichloroethylene
1,1,2-Trichloroethylene
Trichloromethane

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

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

Custodians:
Army - EA
Navy - SH
Air Force - 68

Review activities:
Army - AV, GL, MD, MI
Navy - YD
DLA - GS

User activities:
Army - CE
Navy - AS, MC, OS

Preparing activity: Army - EA
(Project Number 6810-1098)

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

*(See Instructions – Reverse Side)*

| 1. DOCUMENT NUMBER | 2. DOCUMENT TITLE |
|---|---|
| MIL-STD-1222A | INORGANIC SALTS & COMPOUNDS, ANALYZED REAGENT & REAGENT GRADE (INCLUDING ACS & USP-NF COMPOUNDS) (ALUMINUM AMMONIUM SULFATE THROUGH ZIRCONYL NITRATE) (METRIC) |

| 3a. NAME OF SUBMITTING ORGANIZATION | 4. TYPE OF ORGANIZATION *(Mark one)* |
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| | ☐ VENDOR<br>☐ USER<br>☐ MANUFACTURER<br>☐ OTHER *(Specify)*: _____ |
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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 | b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional |
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