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HALOGENATED HYDROCARBONS SOLVENTS
TECHNICAL GRADE



FSC 6810

MIL-STD-610A

DEPARTMENT OF DEFENSE
Washington, D. C. 20301

Halogenated Hydrocarbon Solvents, Technical Grade

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1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.
2. Beneficial comments (recommendations, additions, deletion) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Armament Research and Development Command, Attn: DRDAR-TSC-D, Aberdeen Proving Ground, MD 21010, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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FOREWORD

This book format standard on technical grade halogenated hydrocarbons 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 is not a procurement document.

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1. SCOPE

1.1 Coverage. This standard is a presentation of nomenclature, symbols, physical and chemical properties and requirements, military and typical commercial uses, directions for use, packaging data, labeling, general safety precautions, storage information, disposal data, toxicity data, and shelf life of all military standard halogenated hydrocarbon solvents. 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 technical grade industrial halogenated hydrocarbon solvents for application by the Department of Defense. This standard covers the following twenty-one (21) items:

<u>NAME</u>	<u>NO. OF ITEMS</u>
CHLOROBENZENE, TECHNICAL	2
O-DICHLOROBENZENE, TECHNICAL	1
DICHLOROMETHANE, TECHNICAL	3
ETHYLENE CHLORIDE, TECHNICAL	3
SYM-TETRABROMOETHANE, TECHNICAL	1
TETRACHLOROETHYLENE, TECHNICAL	2
1,1,1,-TRICHLOROETHANE, TECHNICAL	4
TRICHLOROETHYLENE, TECHNICAL	5

1.2 Application. Items listed herein accommodate essential requirements of the military and defense agencies, and will effect continued economies in all logistics functions when properly employed in new applications.

2. REFERENCED DOCUMENTS

The issue of the following documents in effect on the date of invitation for bids form a part of this standard to the extent specified herein.

Federal Specification

O-T-236	Tetrachloroethylene (Perchloroethylene); Technical Grade
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 Specifications

MIL-C-12038	Chlorobenzene, Technical
MIL-C-25107	Carbon Removing Compound, Orthodichlorobenzene, for Engine Parts
MIL-D-6998	Dichloromethane, Technical
MIL-E-10662	Ethylene Chloride, Technical
MIL-T-27602	Trichloroethylene, Oxygen Propellant Compatible

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Military Standards

MIL-STD-129

Marking for Shipment and Storage

Rules and Regulations

TB35

Health Hazards from Industrial Solvents

TB223

Respiratory Protection Program

3. GLOSSARY

3.1 Definitions.

Ambient - Surrounding.

Anhydrous - Pertaining to a salt which has no water of hydration present in the crystalline structure.

Aromatic base - Referring to chemical compounds characterized by the presence of one or more benzene rings.

Aromatic odor - A fragrant, spicy, pungent odor.

Boiling point - The temperature at which the vapor pressure of liquid is equal to the external pressure. In this standard, if there is no mention of the external pressure at which the boiling point was determined, it is understood to be approximately one atmosphere (760 mm mercury).

Caustic - This term designates a substance, usually a strong base or a strong acid, which has a corroding action on metal or a disintegrating action on living tissue.

Centipoise - A standard unit of viscosity equal to 0.01 poise.

Corrosive - A caustic material which causes a burning sensation and destruction of living tissue, and which causes a destructive effect on metal.

Cubical coefficient of expansion - The ratio of the change in volume of a substance per degree C to the volume at 0°C. It is approximately three times the linear coefficient of expansion.

Dielectric constant - The ratio of the electrical capacity of a condenser containing the specified material to the capacity of the same condenser with the material replaced by a vacuum. Generally speaking, it is a measure of the ability of a material to maintain a difference in electrical charge over any specified distance.

Distillation range - The inclusive difference between the temperature observed at the start of distillation and that observed at which a specified volume has distilled, or at which the dry point is reached.

Dyne - The unit of force in the centimeter, gram, second (CGS) system equal to a gram centimeter per second squared. It is the force necessary to give an acceleration of one centimeter per second per second to one gram of mass.

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- Electrical conductivity - The property or capacity of a substance to transmit electricity.
- Flash point - The lowest temperature at which a combustible liquid will give off a flammable vapor which will ignite momentarily by a specified flame.
- Formula weight - The sum of the atomic weights of all atoms appearing in a chemical formula. In this standard the formula weight is computed according to international atomic weight values of 1961.
- Freezing point - The temperature at which a liquid and solid exist together and transition from the liquid to the solid occurs.
- Heat of formation - The heat absorbed or evolved in the formation of one mole of a compound in its standard state from its elements in their standard state. The standard state is taken at the most stable condition of the substance at 25°C and 760 mm of pressure.
- Heat of fusion - The total amount of heat required to change a unit weight of a substance from the solid to the liquid state with no temperature change.
- Ignition temperature - The minimum temperature required to initiate or cause self-sustained combustion. This action is independent of the presence of an ignitor such as an electric spark or fire.
- Kauri Butanol Value - Is an indication of the solvent properties of a substance and will normally increase with the general solvent power of the various materials. Kauri butanol value is usually used to determine the solvent power of petroleum thinners used in paints and varnishes. It is added to 20 grams of solution of Kauri gum in butyl alcohol.
- Latent heat of vaporization - The quantity of heat necessary to change one gram of liquid to vapor without a change of temperature, measured in calories per gram.
- Miscible - The property of liquids which enables them to be mixed with one another in all proportions.
- Ohm - The unit of electrical resistance through which a potential difference of one volt will produce a current of one ampere.
- Poise - The unit of viscosity expressed as one dyne per second per square centimeter.
- Refractive index - A constant, characteristic of each substance, which represents the ratio of the velocity of light in a vacuum to that in the substance.
- Soxhlet - Analytical procedure used for chemical extraction.
- Specific gravity - The ratio of the mass of a unit volume of a material at a stated temperature to the mass of an equal volume of gas-free distilled water at 4°C or other specified temperature. In this standard, the first temperature indicates the temperature of the substance, and the second indicates the temperature of water it is referred to. If there is no mention of the temperature, (20/4°C) is understood.

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Specific heat - The ratio of the heat capacity of a substance to the heat capacity of water at 15°C; or the quantity of heat required for a one degree temperature change in a unit weight of the material.

Surface tension - The property of a liquid, due to molecular forces existing in the surface film of all liquids, which tends to contract the volume into a form with the least surface area. The particles in the surface film are inwardly attracted, thus resulting in tension.

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 impurities, aside from the normal precautions which are taken in the manufacturing process. A TECHNICAL 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.

Thermal conductivity - The property or capacity of a substance to transmit heat.

Threshold Limit Value-Time Weighted Average (TLV-TWA) - The time-weighted average air born concentration for a normal eight (8) hour working day or forty (40) hour work week to which nearly all workers may be repeatedly exposed day after day without adverse effect.

Vapor density - The concentration of vapor, measured by weight per unit volume.

Vapor pressure - Vapor pressure is the force exerted when a solid or liquid is in equilibrium with its own vapor. The vapor pressure is a function of the substance and of the temperature.

Viscosity - The internal resistance offered by a fluid (liquid or gas) to flow. The viscosity is a characteristic property and is a measure of the combined effects of adhesion and cohesion.

Volatile - Evaporating rapidly due to high vapor pressure.

3.2 Abbreviations. The same abbreviation is used for all tenses, the possessive case, and the singular and plural forms of a given word.

atm - atmosphere

BP - Boiling Point

btu - British thermal unit

C - Celsius (formerly Centigrade)

cal - calorie

cm - centimeter

F - Fahrenheit

ft - foot

FW - Formula Weight

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g - gram

Hg - mercury

hr - hour

ICC - Interstate Commerce Commission

IUPAC - International Union of Pure and Applied Chemistry

Kg - Kilogram

lb - pound

max - maximum

mg - milligram

mg/m³ - Approximate milligrams of substance per cubic meter of air

MIL-STD - Military Standard

min - minimum or minute

ml - milliliter

mm - millimeter

mol - mole

NIOSH - National Institute for Occupational Health and Safety

NO. - Number

OSHA - Occupational Safety and Health Administration

oz - ounce

ppm - parts per million

sq - square

TLV-TWA - Threshold Limit Values-Time Weighted Average

wt - weight

4. GENERAL REQUIRMENTS

4.1 Chemical and physical requirements. All values given in tables of chemical and physical requirements are in percent by weight unless otherwise indicated.

4.2 Nomenclature. All chemicals in this standard conform to the military definition of technical grade as set forth under section 3.1. The Department of Defense item names, as used throughout this standard, are in capital letters. Other names that are sometimes used commercially are in small letters immediately beneath.

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4.3 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 mentioned in this specification.

4.4 Safety. Personal Protective Measures. a. Respiratory Protection. Respirators approved by NIOSH for vapors of the solvents
mittent exposure or for supplementing other control measures (refer to TBMED223).
b. Skin Protection. Personnel using solvents should be provided with and required to use impervious gloves, sleeves, and aprons when indicated. Face shields must be provided and worn whenever splashing may occur. Protective creams and ointments, commonly known as "barrier creams", may be of value in certain cases. (Refer to TBMED35).

4.5 Shelf life. Factors such as moisture, temperature, type and condition of container, exposure to sunlight and the atmosphere cause variations in shelf life. Ideal storage conditions are outlined for each item. An approximate period of time after which the material will no longer be suitable for its intended use is also presented. The term "cool" denotes temperatures from above freezing up to 110 degrees Fahrenheit when stored out of direct sunlight. The term "dry" is usually used to denote an area where condensation does not come in contact with the packaged or contents (for example, storing on pallets away from walls in an enclosure or building). Periodic examinations of the containers or material should be made more frequently when storage conditions vary from the ideal. For applications where quality may be critical each compound should be analyzed prior to use. All the chemicals covered in this standard are solvents and should therefore be stored away from plastics and rubber. Most of these chemicals are volatile and should be stored under good ventilation and kept tightly sealed. Shelf life is dated from the date of manufacture. All chemicals in this standard shall not be older than one year from the date of manufacture when purchased except where specified otherwise under storage data.

4.6 Temperature. If the temperature at which a property was determined is not specified, it is understood to be room temperature (20 to 30°C or 68 to 80°F).

4.7 Toxicity data. Toxicity data is derived from the Handbook of Toxicity American Conference of Governmental Industrial Hygienists and Material Safety Data Sheets.

4.8 Use data. Typical commercial uses are given without regard to specific grades.

4.9 Pollution potential. All items described in this MIL-STD should be assumed to have a pollution potential, however, to minimize the potential, use, storage and disposal instructions must be strictly observed.

4.10 Disposal. To minimize disposal problems it is recommended that no more than a one year supply of each item listed in this MIL-STD be stocked. Should excess stocks occur, it is recommended that the stocks be reported through supply channels as excess stocks. When stocks have been declared excess to Department of Defense requirements every effort should be made to dispose the stocks through property disposal channel by selling to commercial users or processors if possible. Disposal guidelines in section 5 will be limited to spills and leaks for the units of issue indicated for each chemical. For assistance on large spills that grossly contaminate the environment, call, toll free, The Chemical Transportation Emergency Center (CHEMTREC) at 800-424-9300.

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4.11 **DISCLAIMER.** RECOMMENDED DISPOSAL INSTRUCTIONS IN SECTION 5 ARE FORMULATED FOR USE BY ELEMENTS OF THE DEPARTMENT OF DEFENSE. THE UNITED STATES OF AMERICA IN NO MANNER WHATSOEVER EITHER EXPRESSLY OR IMPLIEDLY WARRANTS, STATES, OR INTENDS SAID INSTRUCTION, TO HAVE ANY APPLICATION, USE OR VIABILITY BY OR TO ANY PERSON OR PERSONS 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. DETAIL REQUIREMENTS

5.1 Name. CHLOROBENZENE, TECHNICAL (IUPAC) C_6H_5Cl FW 112.56
 Chlorobenzol
 Monochlorobenzene
 Phenyl Chloride

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

5.1.2 Technical description. Chlorobenzene is a colorless, mobile, volatile, and flammable liquid with an almond-like odor. It is insoluble in water but soluble in ethyl alcohol, ethyl ether, carbon tetrachloride, and most organic solvents. It will dissolve ethyl cellulose, many natural and synthetic resins, and vinyl resins. As with other halogenated hydrocarbons, the solvent power of Chlorobenzene is increased by the addition of amyl, butyl, ethyl, or methyl alcohol or their acetate esters. Chlorobenzene is a reactive compound and a versatile raw material for many organic syntheses. It can be readily nitrated, sulfonated, hydrolyzed, and reacted with various other compounds to produce many aromatic-base organics.

5.1.3 Use data. Chlorobenzene is intended for military use as a solvent and as a raw material in the manufacture of various chemicals. Typical commercial applications include use as: Additive to lacquers; basic raw material in the manufacture of poison gases, drugs, dyes, insecticides and synthetics; solvent in adhesives, polishes, waxes and paints; solvent in a general solvent. Chlorobenzene is limited in its use since dichloromethane is considered safer and has very similar properties.

5.1.4 Packaging data and labeling. For military use, chlorobenzene is packaged in 8 ounce (227 grams) unit quantity bottles and 5 gallon (19 liter) unit quantity cans. It shall be packaged in accordance with the manufacturer's commercial practice to provide protection against damage during shipment from the supply source to the first receiving activity for immediate use. Chlorobenzene shall be packaged in accordance with DOT Regulations, Title 49 CFR, Parts 100 to 199. In addition to any special marking required by the contract or order, all shipping containers shall be marked as required by MIL-STD-129. Each shipping container shall bear a "FLAMMABLE LIQUID" (Red Label) as required by DOT Regulations, Title 49 CFR, Parts 100 to 199, and the following precautionary label:

CHLOROBENZENE (MONO)
 WARNING! VAPOR HARMFUL

Keep away from heat and open flame
 Use only with adequate ventilation.
 Avoid contact with skin;
 Avoid breathing vapor.

The TLV-TWA for chlorobenzene in air is 75 ppm or 350 mg/m³.

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Table I. - Physical constants of chlorobenzene

Property	Constant Characteristics
Coefficient of cubical expansion at 20°C	0.00098
Corrosive properties (metals)	Noncorrosive
Dielectric constant at 20°C	5.708
Electrical conductivity at 0°C	10 ⁻⁹ reciprocal ohms
Flash point	27.5 - 39°C
Latent heat of vaporization	77.6 cal/g
Pounds per gallon at 20°C	9.2
Refractive index (n _D) at 20°C	1.5248
Solubility in water at 30°C	0.049%
Specific heat (0 - 40°C)	0.30 cal/g/°C
Surface tension at 20°C	33.1 dyne/cm
Vapor pressure at 20°C	8.76 mm
Viscosity at 20°C	0.84 centipoises

5.1.5 Safety precautions. Chlorobenzene is a moderately flammable liquid and should not be exposed to open flame. Personnel must be cautioned against careless handling. To fight fires of this material foam, carbon dioxide, and dry powder extinguishers may be used. Personnel must be provided with NIOSH approved protective respiratory equipment as designated by the appropriate safety or medical authorities since chlorobenzene fumes have a narcotic effect. It is necessary to provide good ventilation where this solvent is used. For additional precautions see section 4.4.

Table II. - Chemical and physical requirements of chlorobenzene

Property	Requirements
Acidity as HCl	0.015%
Color	Water white
Distillation range (131°-132°C) at 760 mm Hg, percent distilled away	98 min.
Specific gravity (20/4°C) (g/cm ³)	1.101 to 1.112
Water	0.1% max.

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5.1.6 Storage data. Chlorobenzene must be stored in a cool, properly ventilated place away from areas of definite fire hazard and open flame. Containers must be clearly labeled and tightly sealed. Most construction metals including iron, steel, copper, brass, and tin can be used in chlorobenzene service. Plastic and rubber should not be used with chlorobenzene because of its high solvent nature. When stored in original containers it will remain stable indefinitely. Containers should be inspected periodically and leaking or damaged packages withdrawn.

5.1.7 Disposal data. To preclude further contamination by the spilled or leaking, liquids, dike around the item with an inert dry absorbent (e.g. clay, sawdust or vermiculite). Segregate salvageable materials away from the spill area and initiate waste cleanup operations immediately. Cover the residue with dry absorbent and let stand until the liquid is completely absorbed and package all contaminated dry absorbent and contaminated containers in such a manner that the waste item can be safely handled and transported to an approved disposal site. Packaging, labeling, transportation and record keeping requirements for this waste material are determined by the State. It is recommended, therefore that all activities involving disposal preparation and transportation be properly coordinated with the appropriate State Office(s) responsible for health and environmental aspects of hazardous materials. NOTE: It is imperative that the description of the waste and the exact chemical identity from the original label accompany, at all times, the packaged waste. Final disposal of the waste item should be accomplished at a facility approved by the appropriate Federal, State and/or Local Regulatory Agency to incinerate, bury, or recycle the specific chemical wastes. Examples of approved regulatory agencies are: Federal: EPA; State: Bureau of Sanitation, AZ; Air Quality and Solid Waste Program, SD; Solid Waste Administration, D.C.; and Solid Waste Management Service, GA.

5.2 Name. O-DICHLOROBENZENE, TECHNICAL $C_6H_4Cl_2$ FW 147.01
 1,2-Dichlorobenzene (IUPAC)
 1,2-Dichlorobenzol
 Orthodichlorobenzene
 o-Dichlorobenzol

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

5.2.2 Technical description. O-Dichlorobenzene is a heavy, colorless, volatile and stable liquid with an aromatic odor. It is generally considered nonflammable, but will burn reluctantly if sufficient heat is applied. This solvent is a mixture composed principally of ortho compounds and containing various amounts of para and meta isomers. An indication of its solvent power is its kauri-butanol number (which generally increases with the solvent power) of 130, as compared with 92 for carbon tetrachloride and 115 for methylene chloride. It is insoluble in water, but soluble in ethyl alcohol, ethyl ether, benzene, and carbon tetrachloride. o-Dichlorobenzene can be made to react with many organic and inorganic compounds.

5.2.3 Use data. o-Dichlorobenzene is intended for military use in softening and removing carbon and fuel gum deposits from engine parts by immersion in the heated solution. Most paint coatings, as well, will be removed by this compound. It is also intended for military use as a general solvent and as a heat transfer fluid. Typical commercial applications include the same uses as well as a degreaser for wool, leather, metal and in paper reclaiming processes. Its solvent nature makes it useful in removing neoprene tank linings and removing sulfur from illuminating gas. o-Dichlorobenzene can be used as a raw material in the

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synthesis of other chlorinated benzenes, chlorinated aromatic ketones, phthalic acid, benzoic acid, aromatic derivatives of benzoic acid, chloro-anthraquinones, aromatic sulfonic acids, and many other compounds. It is important in its use as an inert process solvent in the synthesis of many organics.

Table III. - Properties of o-Dichlorobenzene

Property	Requirements
Distillation range (5 to 95% point)	175° to 184°C
Specific gravity (25°/25°C) (min) (g/cm ³)	1.29
Free acid (HCl) (max)	0.01% by weight
Flash point (closed cup) (min)	68°C

5.2.4 Packaging data and labeling. This solvent shall be packaged for military use in accordance with DOT Regulations, Title 49 CFR, Parts 100 to 199. In addition to any special marking required by the contract or order and the marking requirements of MIL-STD-129, each container shall bear the following precautionary label:

DICHLOROBENZENE (ORTHO)
CAUTION! VAPOR IRRITATING

The ingredient materials used in the manufacture of this compound are toxic and caustic. Proper precautions must be taken to prevent contact with skin and clothing and to avoid inhalation of the vapors. If contact should occur, wash the affected area with plentiful amounts of water and call a physician immediately.

The TLV-TWA for orthodichlorobenzene in air is 50 ppm or 350 mg/m³.

5.2.5 Safety precautions. o-Dichlorobenzene is a moderate fire hazard and will not be used near open flames and areas of fire hazard. To fight fires of this material, foam, soda, or dry powder extinguishers may be used. o-Dichlorobenzene is poisonous to the skin after indirect exposure or direct contact. It is necessary to provide good ventilation where this solvent is used.

For additional precautions see section 4.4

5.2.6 Storage data. o-Dichlorobenzene is non-corrosive to most metals, and can be safely stored and handled in steel drums. The use of plastic or rubber containers should be avoided unless they are specifically recommended for use in o-Dichlorobenzene service. If stored in the original containers in a dry, cool place, this material will remain stable indefinitely.

5.2.7 Disposal data. See Section 5.1.7

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5.3 Name. DICHLOROMETHANE, TECHNICAL (IUPAC) CH_2Cl_2 FW 84.93
 Methylene Bichloride
 Methylene Chloride
 Methylene Dichloride

5.3.1 Specifications. MIL-D-6998 (Dichloromethane, Technical).

5.3.2 Technical description. Dichloromethane is a colorless, heavy, mobile, and low-boiling liquid with a pleasant ethereal odor. This solvent is miscible in all proportions with alcohol, ether, chloroform, and with many lacquer solvents. It is a solvent for cellulose esters and ethers, having increased solvent power (when mixed with alcohol, ether, or esters) for alkaloids, bitumens, rubber oils, resins, waxes, and many other organics. Dichloromethane can be oxidized by atomic oxygen to yield phosgene, chlorine, hydrogen chloride, carbon dioxide, and water. When hydrolyzed it yields hydrochloric acid and formaldehyde. It can be fluorinated, chlorinated, and brominated. Dichloromethane can also be made to react with many metals and inorganic salts to form a wide variety of organic salts and compounds. It will react with certain organic compounds in the presence of catalysts to yield various chlorine derivatives. Dichloromethane shall be in two solutions, one containing 0.0005% maximum acidity and one having a maximum acidity of 0.010%.

5.3.3 Use data. Dichloromethane in the 600 lb (272 kg) drum size is intended for military use as a solvent in chemical manufacturing. The one pint (0.48 liters) and the 5 gallon (19 liter) pail sizes are intended for military use in the preparation of paint removers, safety solvents, and an acrylic resin plastic cement. Typical commercial applications include use as a solvent for rubber, bitumen, pitch, oils, waxes, vinyl acetate, plastics, and other resins. It makes a good cleaning solvent and is regarded as the most effective paint remover available. It also finds application as an extractant in the analysis of propellants for fine chemicals, alkaloids, natural and synthetic resins, fats and oils, and other heat sensitive materials. Other industrial uses include application as an ingredient in fire-extinguishing compounds, in the preparation of hexamethylenetetramine, as a refrigerant in low-pressure ice machines and air-conditioning apparatus.

Table IV. - Chemical and physical requirements of dichloromethane

Property	Requirements
Acidity as HCL 600 lb (272 kg) drum one pint (0.48 liters) and 5 gallon (19 liters) pail	0.0005% max 0.010% max
Color platinum cobalt	20
Distillation range	39.0°C to 41.0°C
Nonvolatile content	0.002% max
Specific gravity at 25/25°C (g/cm^3)	1.317 to 1.322
Water content	0.020% max

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5.3.4 Packaging data and labeling. For military use, dichloromethane is packaged in 1 pint unit quantity cans, 5 gallon unit quantity pails, and 600 pound unit quantity drums. When furnished in one pint quantities, the cans shall have a metal screw-cap closure with a metal inner seal. When furnished in 5 gallon quantities, the pails shall have a metal screw-cap closure with a metal inner seal. The following precautionary label shall appear on all individual containers:

CAUTION

Use with adequate ventilation.
 Avoid breathing of vapor.
 Avoid contact with skin.
 Do not take internally.

The TLV-TWA for dichloromethane in air is 200 ppm or 720 mg/m³.

5.3.5 Safety precautions. Dichloromethane is poisonous. However, since it is heavier than air, good ventilation must be provided where this material is used. Containers must be kept tightly closed and clearly labeled. Proper precautions must be taken when handling this volatile solvent. Because of its low boiling point and high volatility, methylene chloride containers may generate pressure and should therefore be opened cautiously.

For additional precautions see section 4.4.

5.3.6 Storage data. Most metals, except aluminum, may be used in service with this material. The use of plastic or rubber containers should be avoided unless specifically recommended for use with dichloromethane. Storage vessels should be built to withstand high pressure to insure adequate strength against internal pressure due to vaporization. When containers are stored in a cool place and kept tightly closed, the dichloromethane will remain stable indefinitely. Periodic surveillance should be performed and damaged containers withdrawn.

5.3.7 Disposal data. See section 5.1.7.

5.4 Name. ETHYLENE CHLORIDE, TECHNICAL $\text{CH}_2\text{ClCH}_2\text{Cl}$ FW 98.97
 Dutch Liquid
 Ethylene Dichloride
 1,2-Dichloroethane (IUPAC)
 sym-Dichloroethane
 Glycol Dichloride

5.4.1 Specification. MIL-E-10662, Ethylene Chloride, Technical

5.4.2 Technical description. Ethylene chloride is a colorless, mobile, volatile, and stable liquid resembling chloroform in its odor and toxicity. It is insoluble in water but soluble in ethyl ether and carbon tetrachloride; it is miscible in all proportions with most common solvents. Ethylene chloride is a good solvent for oils, fats, waxes, some alkaloids, unvulcanized rubber, camphor, dammar, mastics, metallic resinates, and gums. It is also a solvent for various resins including coumarone resins, guaiac resin, rosin, sandarac, phenolic, acrylic, and vinyl resins. It will dissolve some cellulose ethers. Its solvent power is greatly improved for a large number of cellulose esters and ethers when mixed with ethyl or methyl alcohol, or ethyl or methyl acetate. Ethylene chloride is resistant to oxidation and it shows satisfactory stability toward hydrolysis under con-

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ditions of usage. It has a low flash point; therefore it represents a dangerous fire risk.

5.4.3 Use data. Ethylene chloride is intended for military use to dilute mustard gas in order to lower its freezing point. Typical commercial applications are varied and include use: in the textile industry for degreasing wool; as a spotting agent for the removal of tar or paint; and in soap scouring compounds. It is used as a lacquer solvent in paint, varnish, and finish removers, in degreasing metals, and chemical synthesis. This readily available solvent is extensively used in the extraction of edible oils from oil-bearing seeds, vitamins from fish-liver oils, and residual oils from oil cakes. It is a component of tetraethyllead anti-knock fluid.

5.4.4 Packaging data and labeling. Ethylene chloride is furnished in 1 gallon (3.8 liter) unit quantity nonactinic glass bottles, 5 gallon (19 liter) unit quantity steel pails, and 55 gallon (208 liter) unit quantity steel drums. The 1 gallon (3.8 liter) bottle shall be nonactinic glass with plastic screw-cap with cork backing and tin liner. The 5 gallon (19 liter) steel pails (single trip) shall be constructed of 19 gage steel body and head sheets. The 55 gallon (208 liter) steel drums (single trip) shall be constructed of 18 gage steel body and head sheets with phosphatized interior. Openings for these containers shall not exceed 2.3 inches (5.8 centimeters) in diameter. When transported by rail or highway, ICC Regulations authorize these containers for carload and truckload shipments only. All individual containers shall be marked with the following precautionary red label:

ETHYLENE CHLORIDE
WARNING! FLAMMABLE
VAPOR HARMFUL

Avoid breathing of vapor.
Avoid contact with skin.
Keep away from heat, sparks and open flame.
Use only with adequate ventilation.

The TLV-TWA for Ethylene Chloride in air is 50 ppm, 200 mg/m³.

WARNING!
POSSIBLE HUMAN CARCINOGEN

Keep all containers of ethylene chloride closed or covered.

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Table V. - Physical constants of ethylene chloride

Property	Constant Characteristics
Boiling point	85°C
Coefficient of cubic expansion average, liquid	0.00116°C
Dielectric constant, liquid at 20°C	10.45
Explosive limits in air	6.2 - 15.9% by volume
Flash point (open cup)	18.3°C
Freezing point	-35.5°C
Heat of formation, liquid	37.6 Kg/cal/mol
Ignition temperature	413°C
Latent heat of vaporization	77.3 cal/g
Refractive index n_D at 20°C	1.4448
Solubility in water at 20°C	0.87
Solubility of water in solvent at 20°C	0.16
Specific gravity 20/4°C (g/cm ³)	1.253
Specific heat, liquid, 20°C	0.308 cal/g/°C
Specific resistivity	9.0 x 10 ⁶ ohms/cm
Surface tension in air at 20°C	32.2 Dynes/cm
Thermal conductivity, liquid, at 20°C	0.0825 btu/hr (sq ft) (°F/ft)
Vapor pressure at, 20°C, 760 mm Hg	62
Viscosity, liquid, at 20°C	0.84 centipoise

5.4.5 Safety precautions. Ethylene chloride is a flammable, volatile liquid which presents both a fire and explosion hazard. It is poisonous by inhalation, by contact with the skin and upon swallowing. Due to its hazardous properties, this chemical must be handled with extreme caution. All metal containers must be grounded to eliminate explosions due to static electricity. Proper ventilation is necessary at all times while the chemical is being used. Ethylene chloride must never be handled near open flames, hot surfaces, or any fire hazards. In case of fire, water (fog or spray), foam, carbon dioxide, or dry chemicals may be used as extinguishers.

For additional precautions see section 4.4

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Table VI. - Chemical and physical requirements of ethylene chloride

Property	Requirements
Acidity as HCl	0.005% max
Boiling range (distilling between 82.5° and 84.5°C, at 760 mm)	95% min
Specific gravity (20/20°C) (g/cm ³)	1.253 to 1.257

5.4.6 Storage data. Ethylene chloride should be stored indoors in a cool place away from open flames, hot surfaces, or any fire hazard. This material should not be stored at elevated temperatures. When ethylene chloride comes in contact with metal in the presence of moisture, corrosion takes place. It can be stored indefinitely in glass containers without damage to chemical or container. If stored in a pail (untreated interior) for longer than three months or in a humid atmosphere, rusting of the interior of the container and discoloration of the contents will result. If it is stored in a drum, rusting can occur in spite of the phosphatized interior in as short a time as six months. Solvent stored in these drums should be checked every three months. Ethylene chloride stored in stainless steel drums has an indefinite shelf life.

5.4.7 Disposal data. See section 5.1.7.

5.5 Name. S-TETRABROMOETHANE, TECHNICAL $\text{CHBr}_2\text{CHBr}_2$ FW 345.7
 sym-Tetrabromoethane
 Acetylene Tetrabromide
 Muthmann's Liquid
 1,1,2,2-Tetrabromoethane (IUPAC)

5.5.1 Specification. None

5.5.2 Technical description. sym-Tetrabromoethane is a heavy, mobile, non-flammable, oily liquid, white to yellow in color with an aromatic odor. It is soluble in ethyl alcohol, ethyl ether, chloroform, carbon tetrachloride, and most other solvents, but only slightly so in water.

5.5.3 Use data. sym-Tetrabromoethane is intended for military use as a general solvent and as a fluid in liquid meters. It is used commercially, by reason of its high density, for the separation of mineral mixtures; as a solvent for fats, oils, and waxes; and as a solvent in microscopy.

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Table VII. - Physical constants of sym-Tetrabromoethane

Property	Constant Characteristics
Boiling range	239 - 242°C
Flash point	Nonflammable
Freezing point	-1°C
Refractive index ND at 20°C	1.6380
Solubility in water at 30°C 80°C	0.065 g/100 g solvent 0.28
Specific gravity (25/25°C) (g/cm ³)	2.998 - 3.00
Weight per gallon at 25°C	24.57 lb

5.5.4 Packaging data and labeling. sym-Tetrabromoethane is packaged for military use in $\frac{1}{2}$ pint (0.24 liter) unit quantity bottles. This material shall be packed in accordance with standard commercial practice so as to insure carrier acceptance and safe delivery. This material has hazard classification of ORM-A. The following precautionary label shall be on each container:

WARNING - POISON

Use with adequate ventilation.
Avoid breathing of vapor.
Avoid contact with skin.
Do not take internally.

The TLV-TWA for sym-Tetrabromoethane is 1 ppm 14 mg/m³.

5.5.5 Safety precautions. sym-Tetrabromoethane is extremely poisonous if inhaled or in contact with skin. Conditions of exposure may necessitate the use of appropriate protective equipment. It is necessary to provide ventilation where this solvent is used.

For additional precautions see section 4.4.

5.5.6 Storage data. sym-Tetrabromoethane should be stored in a cool, ventilated place, preferably outside of the general work area to preclude contamination in the event of accidental spillage. Containers should be tightly closed and should be kept away from open flames and moisture. When stored as recommended, in the original glass bottles, this material will have an indefinite shelf life. If exposed to moisture, it will decompose rapidly. Periodic surveillance should be performed and deteriorating material withdrawn.

5.5.7 Disposal data. See section 5.1.7.

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5.6 Name. TETRACHLOROETHYLENE, TECHNICAL CCl_2CCl_2 FW 165.85
 Perchloroethylene
 Ethylene Tetrachloride
 Carbon Dichloride

5.6.1 Specification. O-T-236, Tetrachloroethylene (Perchloroethylene), Technical Grade.

5.6.2 Technical description. Tetrachloroethylene is a heavy, colorless liquid which is stable and nonflammable. It has an ether-like odor, is insoluble in water, and is soluble in ethyl alcohol, ethyl ether, benzene, carbon tetrachloride, and most organic solvents. The miscibility and solvency of tetrachloroethylene are similar to those of trichloroethylene; therefore, it can be a substitute for the latter where a slower rate of evaporation is desired. When this compound is mixed with an active solvent, the mixture will dissolve cellulose esters and ethers. Tetrachloroethylene is not a particularly active compound; however, under certain conditions it will combine because of its double bond. For this reason, tetrachloroethylene finds very little application in chemical reactions re: synthesis.

Table VIII. - Chemical and physical requirements of tetrachloroethylene

Property	Requirements
Acidity as HCl	0.0005% max
Alkalinity as NaOH	0.020% max
Cloud point	0°C max
Color, APHA scale	20 max
Distillation range: initial boiling point	120°C min
end point	122°C max
Nonvolatile residue	0.01% max
Residual odor	none
Specific gravity (20/20°C) (g/cm^3)	1.620 to 1.630
Stability with copper	
Flask loss, $\text{mg}/30 \text{ cm}^2$	10 max
Soxhlet loss, $\text{mg}/30 \text{ cm}^2$	20 max
Condenser loss, $\text{mg}/30 \text{ cm}^2$	20 max
Acidity, ml of 0.01N sodium hydroxide	15 max

5.6.3 Use data. Tetrachloroethylene is intended for military use as a solvent in dry cleaning processes and in vapor degreasing equipment for the removal of oil, grease, and oil-bearing dirt from metallic parts. Typical commercial applications of tetrachloroethylene include use as the primary solvent in dry cleaning; in dissolving cellulose esters and

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waterproofing chemicals; as a carrier for rubber coatings, adhesives, sealants, lubricants, polisher, and silicones. It is also used for extraction of oils in the preparation of pharmaceuticals and foods, as an ingredient in fire extinguishing compounds, as a liquid medium in transformers, and as a general solvent.

5.6.4 Packaging data and labeling. Tetrachloroethylene is packaged for military use in 5 gallon (19 liter) unit quantity pails and 55 gallon (208 liter) unit quantity drums. Each container shall bear the following precautionary marking:

TETRACHLOROETHYLENE
(PERCHLOROETHYLENE)
WARNING! VAPOR HARMFUL

Use only with adequate ventilation.
Avoid breathing of vapor.
Avoid contact with skin.
Do not take internally.

The TLV-TWA for Tetrachloroethylene in air is 100 ppm or 670 mg/m³.

WARNING!
POSSIBLE HUMAN CARCINOGEN

Keep all containers of tetrachloroethylene closed or covered.

5.6.5 Safety precautions. Tetrachloroethylene is nonflammable and not very volatile. Its odor is moderately strong and to some individuals offensive. This material is extremely stable and resists hydrolysis. However, it is volatile enough to warrant storage in a cool, ventilated area. In contact with flame or hot glowing surfaces, perchloroethylene may produce toxic gases. This material should be used with good ventilation, particularly if the ambient temperature is above normal room temperature. Tetrachloroethylene is poisonous if swallowed or inhaled, and when in contact with skin.

For additional safety precautions see section 4.4.

5.6.6 Storage data. Under normal conditions, tetrachloroethylene may be stored satisfactorily in galvanized iron, black iron, or steel. Aluminum is not generally recommended for storage vessels since it may react explosively with tetrachloroethylene under conditions such as high temperatures. Outdoor storage installations require special consideration because this chemical has a freezing point of -8.2°F (-22.3°C). This material will remain stable indefinitely when precautions are taken to exclude moisture. However, periodic surveillance should be performed and leaking or broken containers withdrawn.

5.6.7 Disposal data. See section 5.1.7.

5.7 Name. 1,1,1-TRICHLOROETHANE (IUPAC), TECHNICAL CH_2CCl_3 FW 133.4
Methyl Chloroform

5.7.1 Specification. O-T-620, 1,1,1-Trichloroethane, Technical, Inhibited (Methyl Chloroform).

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5.7.2 Technical description. 1,1,1-Trichloroethane is a colorless, non-flammable mobile liquid with a characteristic mildly sweet odor similar to that of carbon tetrachloride. Unstabilized 1,1,1-Trichloroethane will react with moist air or water to form corrosive hydrochloric acid. However, properly stabilized trichloroethane will not corrode any of the common metals, including aluminum, brass, copper, iron, steel, tin and zinc under normal usage.

Table IX. - Chemical and physical requirements of
1,1,1-Trichloroethane

Property	Requirements
Acidity as HCl	0.001% max
Aluminum alloy corrosion 30 min at 20-25°C	No evidence of etching, pitting or discoloration
Appearance	Clear, free from suspended matter
Color	15 platinum cobalt units, max
Distillation range	
Initial boiling point	70°C min
Dry point	88°C max
Nonvolatile matter at 100°C	0.001% max with no residual odor
Specific gravity at 25/25°C (g/cm ³)	1.288 to 1.321
Water content	100 ppm max

5.7.3 Use data. 1,1,1-Trichloroethane is intended for military use as a solvent for cleaning and degreasing electrical equipment, for removing solvent from type faces of typewriters, and as a spot remover for clothing and fabric or plastic parts of furniture. Typical commercial applications include use as a vapor pressure depressant in the aerosol industry and as a carrier solvent in the manufacture of paints, oils, and silicone moisture-proofing compounds. The rubber industry uses it in the production of a variety of products. Electronic and electrical industries find this compound ideal for cleaning motors, generators, transistors, printed circuits and coils. Tanks, cylinders and miscellaneous equipment in compressed gas service are normally cleaned with this material. It is also used to clean precision machine tools, jewelry and other metal items. 1,1,1-Trichloroethane often replaces carbon tetrachloride in many analytical tests. Residual vitamin oils are removed from the outside of filled capsules by passing them through a bath of this solvent. The relatively fast evaporation rate, low toxicity, and excellent solvency make the use of this product particularly advantageous in many proprietary formulations, shoe polish, printing ink, adhesives, and insecticides. Since the inhibitors present in 1,1,1-Trichloroethane are flammable, the inhibited grade cannot be used in cleaning oxygen equipment.

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5.7.4 Packaging data and labeling. 1,1,1-Trichloroethane is packaged for military use in 1 pint (0.48 liter) and 1 gallon (3.8 liter) unit quantity cans, 5 gallon (19 liter) unit quantity pails, and 55 gallon (208 liter) unit quantity drums. The cans shall have a minimum 0.50 pound (227 grams) electrolytic tin plate coating. The following label shall appear prominently on each can, pail or drum:

CAUTION

Use with adequate ventilation.
 Avoid breathing of vapor.
 Avoid contact with skin.
 Do not take internally.
 Do not use in oxygen systems.

The TLV-TWA for 1,1,1-Trichloroethane in air is 350 ppm or 1900 mg/m³.

5.7.5 Safety precautions. 1,1,1-Trichloroethane is nonflammable; however, it is irritating to the eyes and mucous membranes. Personnel should handle this solvent with caution.

For additional safety precautions see section 4.4.

5.7.6 Storage data. Properly stabilized 1,1,1-Trichloroethane will not corrode any of the common metals under normal usage. As with all chlorinated solvents, this solvent will tend to degrade slowly in contact with water or air, resulting in the formation of hydrochloric acid. Store in a cool, well ventilated place. Under normal conditions this material will remain stable indefinitely; however, periodic surveillance should be performed and leaking or broken containers withdrawn.

5.7.7 Disposal data. See section 5.1.7.

5.8 Name. TRICHLOROETHYLENE (IUPAC), TECHNICAL CHClCCl2 FW 131.4
 Ethylene trichloride
 Ethinyl Trichloride
 1,1,2-Trichloroethylene

5.8.1 Specifications. O-T-634 Trichloroethylene, Technical; MIL-T-27602 for Trichloroethylene, Oxygen Propellant Compatible.

5.8.2 Technical description. Trichloroethylene is a heavy, low-boiling colorless, mobile liquid with a pleasant, chloroform-like odor. It is quite stable, nonflammable, and nonexplosive. It will not attack the common metals, with the exception of aluminum, even in the presence of moisture. It is insoluble in water but soluble in most organic solvents, some of which are acetones, ethyl ether, benzene, toluene, pyridine, amyl, butyl, ethyl and methyl acetates or alcohols, and mixtures of these solvents. It dissolves cellulose ethers and some types of cellulose acetates. It is a solvent for chewing gum, crude rubber, dyes, bitumens, pitch, sulfur, chlorinated hydrocarbons, stearic acid, oils, fats, waxes, grease, tar, gums, caffeine, and such resins as ester gum, rosin, coumarone, mastic, elemi, and vinyl.

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Table X. - Chemical and physical requirements of trichloroethylene oxygen propellant compatible

Property	Requirements
Acid acceptance	
Amine (as NaOH)	0.01% max
Nonamine (as NaOH)	0.10 to 0.17
Acidity (pH of water extract)	6.5 min
Appearance	Clear and free of suspended matter
Color (Saybolt)	+24 min
Distillation range (760 mm Hg):	
Initial boiling point	86.0°C (186.8°F) min.
Dry point	88.0°C (190.4°F) max
Nonvolatile residue	0.0010% max
Residue soluble in CCl ₄ (as iso-octane)	0.0005% max
Specific gravity (20°/20°C) (g/cm ³)	1.450 to 1.470
Water content (cloud point)	-10°C (14°F) max

5.8.3 Use data. Trichloroethylene is intended for use by the military as a general solvent and in vapor degreasing applications. The oxygen propellant type is for military use in cleaning propellant oxygen handling systems. Trichloroethylene is used as a general industrial solvent. Some of its typical commercial applications include use as a solvent in vapor degreasing, as an activator in the manufacture of adhesive tape, as a solvent medium for rubber cement, as a spotting agent in general cleaning, and as a carrier solvent. Other applications of trichloroethylene include using it as a freezing point depressant for carbon tetrachloride fire extinguishers.

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Table XI. - Chemical and physical requirements of trichloroethylene, technical

Property	Requirements
Acidity (as HCl)	0.01% max
Alkalinity (as NaOH)	0.01% max
Appearance	Clear and free of suspended matter or sediment
Copper corrosion	No discoloration
Free chlorine	10% aqueous potassium iodide solution, max
Specific gravity (20/20°C) (g/cm ³)	1.450 to 1.475
Water content	Clear

5.8.4 Packaging data and labeling. For military use trichloroethylene is packaged in 1 pint (0.48 liters), 1 gallon (3.8 liters) and 5 gallon (19 liters) unit quantity cans; 1 gallon (3.8 liters) unit quantity pails; and 55 gallon (208 liters) unit quantity drums. Packaging sizes shall be standard commercial containers so constructed as to insure acceptance by common or other carrier for safe transportation at the lowest rate to the point of delivery. Containers shall be marked with the name of the material, type, and the number of the contract. The following statement with a caution label shall appear prominently on each container:

TRICHLOROETHYLENE
WARNING! VAPOR HARMFUL

Use only with adequate ventilation.
Avoid breathing of vapor.
Avoid contact with skin.
Do not take internally.

The TLV-TWA for Trichloroethylene in air is 100 ppm or 535 mg/m³.

WARNING!
POSSIBLE HUMAN CARCINOGEN.

Keep all containers of trichloroethylene closed or covered.
5.8.5 Safety precautions. Trichloroethylene is generally considered non-flammable and nonexplosive at room temperature, but at higher temperatures or concentrations, this chemical is flammable and can cause explosion. It is not dangerously reactive except in the presence of strong alkalies, with which it may react to form explosive mixtures (dichloroacetylene). It is poisonous when inhaled, when in prolonged or repeated contact with the skin, and when swallowed. Splashing of the liquid or contact with the vapor can damage the eyes. It is necessary to provide good ventilation where this solvent is used.

For additional safety precautions see section 4.4.

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5.8.6 Storage data. Under normal conditions, free of moisture, trichloroethylene may be stored satisfactorily in galvanized iron, black iron, or steel equipment. Aluminum is unaffected by trichloroethylene but is not generally recommended for storage vessels. When stored in iron containers for long periods of time, ferric chloride can form, coloring the solvent yellow and rusting the container. If trichloroethylene is stored in steel drums, rusting can occur in the relatively short time of approximately three months. If stored in original 55 gallon steel drums, rusting can occur in spite of the phosphatized steel in as short a time as six months. Surveillance inspection of containers and the product should be conducted every two months. Visual check will reveal rusting of containers and discoloration of the trichloroethylene, should they occur. If stored in stainless steel drums, the shelf life is indefinite.

5.8.7 Disposal data. See section 5.1.7.

NOTICE. - Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.

Assignee activity: GS

Preparing activity: Army - EA

Custodians: Army EA
Navy SH
Air Force - 68

Reviewing activities: Army: AV, GL, MD, ME, MI, EA, AR
Navy: AS, OS, SH, YD

User activities: Army: CE, BA, SM
Navy: MC

Project No. 6810-0935

SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 22-R255
<p>INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.</p>		
SPECIFICATION		
ORGANIZATION		
CITY AND STATE		CONTRACT NUMBER
MATERIAL PROCURED UNDER A <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT		
1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? A. GIVE PARAGRAPH NUMBER AND WORDING.		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES		
2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
3. IS THE SPECIFICATION RESTRICTIVE? <input type="checkbox"/> YES <input type="checkbox"/> NO (If "yes", in what way?)		
4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)		
SUBMITTED BY (Printed or typed name and activity - Optional)		DATE

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