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MILITARY STANDARD
MISCELLANEOUS ALCOHOLS AND AMINES
TECHNICAL GRADE



FSC 6810

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DEPARTMENT OF DEFENSE
WASHINGTON, D. C. 20301

Miscellaneous Alcohols and Amines, Technical Grade

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1. This Military Standard is mandatory for use by all Departments and Agencies of the Department of Defense, to assure that selection of new items is limited to essential items, for which no comparable standard item exists.
2. Recommended corrections, additions, or deletions should be addressed to Commander, Edgewood Arsenal, Attn: SAREA-DE-ES, Aberdeen Proving Ground, Maryland 21010.

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FOREWORD

This book format standard on technical grade miscellaneous alcohols and amines, is mandatory 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 required to support state-of-the-art changes.

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1. SCOPE

1.1 Coverage. This standard is a presentation of nomenclature, symbols, physical and chemical properties, constants and requirements, military and typical commercial uses, directions for use, packaging data, labeling, general safety precautions, storage information and shelf life of all military standard miscellaneous alcohols and amines. 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 miscellaneous alcohols and amines for application by the Department of Defense. This standard covers fifty-five items.

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 issues 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 Specifications

O-C-940	Cyclohexylamine, Technical
O-D-1271	Diethylenetriamine, Technical
O-E-780	Ethylene Glycol Monomethyl Ether, Technical
O-G-491	Glycerol, Technical (High Gravity)
O-M-232	Methanol (Methyl Alcohol)
O-M-575	Morpholine, Technical
TT-A-516	Amyl Alcohol, Secondary
TT-B-846	Butyl Alcohol, Normal (for use in organic coatings)
TT-B-848	Butyl Alcohol, Secondary (for use in organic coatings)
TT-E-776	Ethylene Glycol Monobutyl Ether (for use in organic coatings)
TT-E-781	Ethylene Glycol Monoethyl Ether, Technical
TT-I-735	Isopropyl Alcohol
TT-P-143	Paint, Varnish, Lacquer, And Related Materials, Packaging, Packing, And Marking Of
PPP-C-300	Chemicals, Liquid; Packaging and Packing of
PPP-C-96	Can, Metal, 28 Gage and Lighter
PPP-C-1337	Container, Metal, With Polyethylene Inserts
PPP-D-729	Drum, Shipping and Storage, Steel, 55 Gallon
PPP-P-704	Pail, Shipping, Steel (1 through 12 Gallon)

Military Specifications

MIL-B-26701	Bottle, Screw Cap And Carboys, Polyethylene Plastic
MIL-D-98	Diphenylamine, Technical

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MIL-E-199	Ether Diethyl, Technical
MIL-H-502	Hexamethylenetetramine, Technical
MIL-E-9500	Ethylene Glycol, Technical, Uninhibited
MIL-A-10450	Aniline, Technical
MIL-T-12014	Tributylamine, Normal
MIL-D-20305	Dimethylaniline
MIL-D-23296	Diethylene Glycol, Technical
MIL-M-23573	Monoethanolamine, Chelating Agent Solution
MIL-E-50011	Ethanolamines (Monoethanolamine, Diethanolamine, and Triethanolamine), Technical
MIL-G-81239	Glycerol Monooleate

Rules and Regulations

DoT Shipping Regulations Title 49 - Chapter I of the Code of Federal Regulations

3. GLOSSARY

3.1 Definitions

Autoignition temperature - The temperature at which the combustion of substance will occur spontaneously. This action is independent of the presence of an igniter which has an electrical spark or flame.

Boiling point - The temperature at which the vapor pressure of a 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).

Centipoise - One one-hundredth (1/100) of a poise. A poise is the unit of viscosity expressed as one dyne second per square centimeter.

Centistoke - One one-hundredth (1/100) of a stoke. Stoke, the kinematic unit of viscosity, is equal to the viscosity in poises divided by the density of the liquid in grams per cubic centimeter, both measured at the same temperature.

Dielectric constant - The ratio of the electrical capacity of a condenser, containing the specific material, to the capacity of the same condenser with the materials 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.

Flammable - A liquid with a flash point of 80°F (26.5°C) or less.

Flash point - The lowest temperature at which a combustible liquid will give off a flammable vapor which will burn momentarily.

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Freezing point - The temperature at which a liquid and solid exist together in equilibrium and the transition from liquid to solid occurs. For pure substances, the freezing point and melting point are the same temperature.

Grignard Reagent - A very important class of reagents of synthetic organic chemistry, made by the union of metallic magnesium with an organic chloride, bromide, or iodide usually in the presence of an ether, and in the complete absence of water.

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

Heat of fusion - The heat evolved when one mole of a substance is transformed from a liquid to a solid at its freezing point.

Hydride - A compound of hydrogen with some element or radical. This term is usually reserved for compounds in which hydrogen shows a negative oxidation state.

Melting point - The temperature at which a liquid and solid exist together in equilibrium and the transition from the solid to the liquid occurs. For pure substances, the melting point and freezing point are the same temperature.

Milliequivalent - A thousandth (1/1000) of an equivalent weight. An equivalent weight of a substance is its atomic weight divided by its valence.

Miscible - The property of liquids which enables them to be mixed with one another in all proportions without separation, or to exhibit mutual solubility in all proportions.

Mole - The weight of a substance equal numerically to its formula weight.

Molecular weight - The sum of the atomic weights of all the atoms in a molecule.

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.

Specific gravity - The ratio of the mass of a unit volume of a material at a stated temperature to the mass of the same volume of gas-free distilled water at a stated temperature. In this standard, the first temperature indicates the temperature of the material, and the second indicates the temperature of water to which it is referred. If there is no mention of temperature, 20/4°C is to be assumed.

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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 mole degree temperature change in a weight of material.

Technical Grade - Denotes a quality of chemicals which are generally used for industrial, solvent, and manufacturing applications. Generally, specific processes are not employed by the manufacturer to limit all the impurities, aside from the normal precautions which are taken in the manufacturing process. A technical 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.

Viscosity - The internal resistance offered by a fluid (liquid or gas) to flow. Viscosity is a characteristic property and is measured as the ratio of applied tangential shear stress to shear rate under laminar flow conditions.

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

API - American Petroleum Institute

btu - British thermal unit

cal - calorie

C - Celsius (Centigrade)

COC - Cleveland Open Cup

deg - degree

DOT - Department of Transportation

F - Fahrenheit

gal - gallon

g - gram

Hg - Mercury

IUPAC - International Union of Pure and Applied Chemistry

Kcal - Kilocalorie

lb - pound

max - maximum

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mg - milligram

min - minimum

mm - millimeter

mw - molecular weight

No. - number

SOCMA - Synthetic Organic Chemical Manufacturers Association

wt - weight

4. GENERAL REQUIREMENTS

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

4.2 Miscibility. Where alcohol and/or ether is mentioned in Section 5, it is meant that material is miscible with ethyl alcohol or/and diethyl ether.

4.3 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 basic names are in capital letters. To form the Defense item name use the basic name followed by the modifier TECHNICAL (e.g. ANILINE, TECHNICAL). Other names that are sometimes used commercially are in small letters immediately beneath. The technically correct name as defined by the International Union of Pure and Applied Chemistry is followed by the designation (IUPAC). The name standardized by the Synthetic Organic Chemical Manufacturers Association is followed by the designation (SOCMA).

4.4 Packaging data and labeling. All liquid chemicals included in this standard shall be packaged in accordance with Federal Specification PPP-C-300 and all applicable documents mentioned in this standard. Labeling in Section 5 of this standard shall be as outlined in the applicable specification. In case of conflict of labeling requirements between standard and referenced specification for an item the labeling outlined in Section 5 shall be used as the criteria.

4.5 Safety. All hazardous chemicals in this standard are indicated as such immediately beneath each item name. General safety and hygienic measures should be exercised in the handling and use of all chemicals. For more specific information on hazardous chemicals the appropriate safety and medical authorities must be consulted in order to determine personal protective measures and environmental controls.

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4.6 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 this material will no longer be suitable for its intended use is also presented. The term "cool" denotes temperatures from above freezing up to 100°F but not consistently over 100°F 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 packages 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. 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.

4.7 Solubility data. Solubility data is given only for the most common solvents.

4.8 Temperature. If the temperature at which a property was determined is not specified, it is understood to be room temperature (20 to 25°C or 68 to 77°F).

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

4.10 Substitutability and interchangeability. None of the alcohols and amines in this standard are completely interchangeable with other chemicals in any given circumstance. One chemical may provide the same end result as another, however, procedures, techniques, and other factors would have to be altered to do so. Time, economy, and the discretion of the user would govern such circumstances.

4.11 Pollution potential. All items described in this military standard should be assumed to have a pollution potential, however, to minimize the potential, use, storage, and disposal instructions must be strictly observed.

4.12 Disposal. To minimize disposal problems, it is recommended that no more than a 1-year supply of each item listed in this military standard be stocked, unless otherwise stated in Section 5. Should excess stocks occur, it is recommended that the stocks be sold to commercial users or processors if possible, before disposing as outlined in Section 5.

4.12.1 Incinerating small quantities. Sand which has been mixed with a chemical and shoveled into a cardboard box and small quantities of materials suitable for incineration may be burned in general refuse incinerators. These quantities should be mixed in with general refuse and should not

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comprise more than 10 percent, by weight, of the total waste mixture. Materials in containers larger than one gallon should not be disposed in this manner.

4.12.2 Incinerating large quantities. Disposal operations involving the atomization of materials into an incinerator should be coordinated with appropriate facilities engineering and safety offices. Care should be taken to eliminate or minimize exposure to toxic materials as well as fire or explosion hazards. Proper atomization equipment and controls should be employed to assure that incinerator design temperatures are not exceeded.

4.12.3 Incinerating empty containers. Emptied containers should be sufficiently opened and/or punctured before incineration to prevent explosions.

4.12.4 Technical assistance. Pollution abatement guidance may be requested from the US Army Environmental Hygiene Agency in those cases where existing facilities are not adequate for the disposal of large quantities of materials.

5. DETAIL REQUIREMENTS

5.1 Name. sec-AMYL ALCOHOL, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHOHCH}_3$, MW 88.15
1-Methylbutyl Alcohol
Methyl Propyl Carbinol
2-Pentanol (IUPAC), (SOCMA)

5.1.1 Specification. TT-A-516

5.1.2 Technical description. sec-Amyl Alcohol is an isomer of Amyl Alcohol. It is a colorless liquid, slightly soluble in water; miscible with alcohol and ether. It is derived from fractional distillation of mixed alcohols resulting from the chlorination and hydrolysis of pentanes, shall be free from sediment and suspended matter, shall have no residual odor after drying from filter paper for two hours. It shall be miscible without turbidity with 19 volumes of 10° Heptane. sec-Amyl Alcohol shall conform to the following quantitative requirements.

Quantitative Requirements

Characteristic	Requirements	
	min	max
Specific gravity 20°/20°C	0.810	0.820
Nonvolatile matter	---	0.005
Acidity mg g KOH per gram of sample	---	0.06
Distillation:		
Initial boiling point at 760mm pressure	113°C	---
Distillate below 114°C percent by volume	---	5

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Quantitative Requirements (CONT'D)

<u>Characteristic</u>	<u>Requirements</u>	
	<u>min</u>	<u>max</u>
Distillate below 120°C percent by volume	96	---
Dry point at 760 mm pressure °C	---	125°C
Color (Platinum-Cobalt scale)	---	20
Flash point °F	100	110
Flash point °C	37.75	43.30

5.1.3 Use data. Secondary Amyl Alcohol is intended for military use in organic coatings such as lacquers and dopes. Commercial uses are as solvent in lacquers and paints; pharmaceutical intermediate.

5.1.4 Packaging data and labeling. Secondary Amyl Alcohol shall be packaged in one-gallon quantities in cans conforming to specification PPP-C-96, Type V, Class 4. Each container shall be marked with a white label with the following information printed in red letters.

WARNING!

Keep away from heat and open flame. Keep container closed. Use with adequate ventilation. Avoid prolonged breathing of vapor. Avoid prolonged or repeated contact with skin.

In addition, each can shall be marked in accordance with MIL-STD-129 and paragraph 3.10.3 of Specification TT-P-143.

5.1.5 Storage data. Store in an area away from heat and open flame and where temperature does not exceed 100°F. Keep container closed. The shelf life is indefinite. In opened containers the maximum shelf life is six months from date of opening.

5.1.6 Disposal data. For small spills or releases, absorb on paper and evaporate under hood. Burn the paper. For damaged containers, atomize the contents into an incinerator. Puncture and crush damaged tin cans and burn in an incinerator and/or deposit in authorized sanitary landfill.

5.2 Name. tert-AMYL ALCOHOL, $\text{CH}_3\text{CH}_2\text{COH}(\text{CH}_3)_2$, MW 88.15
Dimethyl Ethyl Carbinol
2-Butanol-2-methyl (IUPAC)
Amylene hydrate
tert-Pentanol
tert-Pentyl Alcohol (SOCMA)

5.2.1 Specification. None

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5.2.2 Technical description. *tert*-Amyl Alcohol is an isomer of Amyl Alcohol. It is a colorless liquid, with a camphor odor and a burning taste. Slightly soluble in water, miscible with a alcohol and ether. Solutions are neutral to litmus. It is derived from the fractional distillation of mixed alcohols resulting from the chlorination and alkaline hydrolysis of pentanes. *tert*-Amyl Alcohol shall conform to the following quantitative requirements.

Quantitative Requirements

<u>Characteristic</u>	<u>Requirements</u>	
	<u>Min</u>	<u>Max</u>
Specific gravity 20°/20°C	--	0.81
Vapor pressure (mm Hg) at 68°F	8	--
Vapor density (air 1.0)	3.0	--
Distillation data:		
Distillate at 100°C percent by volume	--	5
Distillate at 103°C percent by volume	95	--
Flash point (open cup) °C	15.5	--

5.2.3 Use data. *tert*-Amyl Alcohol is intended for use as a solvent for gums and resins in preference to lower boiling aliphatic alcohols. Due to its boiling range it is a suitable substitute for such solvents and couplers as *sec*-Butyl Acetate, Propyl Acetate, *sec*-Butanol, Isobutanol, and Propanol. Its rate of evaporation is less than one-half the slowest of these materials.

5.2.4 Packaging data and labeling. *tert*-Amyl Alcohol shall be packaged in 1-gallon unit quantities in cans conforming to Specification PPP-C-96, Type V, Class 4. Each container shall bear a DOT red label for flammable liquid in addition to a white label with the following information printed in red letters.

WARNING! FLAMMABLE

Avoid vapor and contact with the skin.
In case of overexposure to vapor remove victim and restore breathing. For contact of liquid with skin remove liquid with water. Use an organic canister mask, rubber gloves, and goggles when required.

In addition, each container shall be labeled with name, manufacturer, lot no., and date of manufacture.

5.2.5 Storage data. *tert*-Amyl Alcohol should be stored in a cool ventilated area away from sparks, open flame, and powerful oxidizing agents. In case of fire use carbon dioxide, alcohol foam or dry chemical. Do not use water. The shelf life is estimated to be 1 year.

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5.2.6 Disposal data. For small spills or releases, absorb on paper and evaporate under hood. Burn the paper. For damaged containers, atomize the contents into an incinerator. Puncture and crush damaged tin cans and burn in an incinerator and/or deposit in authorized sanitary landfill.

5.3 Name. ANILINE, (SOCMA), $C_6H_5NH_2$, MW 93.13
Aminobenzene
Aminophen
Aniline Oil
Blueoil
Phenylamine
(HAZARDOUS)

5.3.1 Specification. MIL-A-10450, Aniline, Technical.

5.3.2 Technical description. Aniline is a colorless, oily liquid when it is freshly distilled. When exposed to air, it will rapidly turn to a brown color. It has a characteristic odor and a burning taste. It is soluble in cold water and miscible with hot water, alcohol, ether, and benzene. It reacts with most acids to form salts. When reacted with alkaline-earth metals or alkali, it forms anilides with the evolution of hydrogen. Aniline is one of the most important organic bases and is the parent substance for many dyes and drugs. Aniline shall conform to the following requirements.

Chemical and Physical Requirements
of Aniline, Technical

<u>Property</u>	<u>Requirements</u>
Moisture, max, by volume	0.25%
Nitrobenzene, max	0.2%
Purity, min	99.5%
Specific gravity at 25°/4°C	1.015-1.019

Physical constants of aniline, technical

<u>Property</u>	<u>Constants</u>
Autoignition temperature	617°C
Boiling point	184.2°C
Flash point	
(closed cup)	70°C
(open cup)	75.6°C
Melting point	-6.2°C
Refractive index	1.5863
WT/gal (20°C)	8.52

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5.3.3 Use data. Aniline, technical is intended for military use in rocket fuels and explosives. Typical commercial applications include use in the preparation of dye intermediates and synthetic organic products used in perfumes and drugs. It is also used in photographic chemicals and petroleum refining.

5.3.4 Packaging data and labeling. For military use, aniline, technical is packaged in 55 gallon unit quantity (450 ± 4 lbs), metal drums conforming to DOT specification 17C. It must have a DOT poison label (poisonous liquid or solid Class B). Each container must also bear the following precautionary label.

ANILINE
DANGER! EXTREMELY HAZARDOUS
LIQUID AND VAPOR RAPIDLY ABSORBED THROUGH SKIN

Do not get in eyes, on skin, on clothing.
Avoid breathing vapor.
Use only with adequate ventilation.
In case of contact, immediately remove all contaminated clothing, including shoes, and flush skin or eyes with plenty of water for at least 15 minutes. Get immediate medical attention. Wash clothing before re-use.

POISON

5.3.5 Storage data. Store aniline in tightly closed containers in a cool, dry area away from direct sunlight, fire hazards, open flame and oxidizing materials. If fire occurs in the vicinity of this material, care should be taken to avoid breathing the fumes. Under these storage conditions and in unopened containers, the shelf life of aniline is indefinite. If the container has been opened, aniline has a maximum shelf life of six months from date of opening. Containers should be checked every six months for deterioration.

5.3.6 Disposal data. For small spills or accidental releases, absorb on paper and burn in an incinerator. For large spills cover with sand, mix and shovel into cardboard box, and burn in incinerator equipped with sufficient controls to meet applicable emission standards. Decontaminate the site by covering the area with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spraying with water, and washing into drain with a large excess of water. For large quantities, mix with alcohol and atomize into an incinerator equipped as indicated above. Prior to returning drums, completely drain contents and tighten bungs securely in place with gaskets. If needed, use new gaskets. Wash outside stains with water before starting return movement in accordance with DOT regulations. Damaged empty containers should be punctured and incinerated prior to sending to the nearest salvage yard to be sold as scrap metal or to be crushed and buried in a sanitary landfill. Personnel involved in these

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operations should wear butyl rubber gloves and aprons, coveralls and approved self-contained breathing apparatuses equipped with full-face pieces.

5.4 Name. N-BUTYL ALCOHOL, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$, MW 74.12
Butanol
n-Butanol
1-Butanol (IUPAC)
Butyric Alcohol
Butyl Alcohol, (SOCMA),
(HAZARDOUS)

5.4.1 Specification. TT-B-846, Butyl Alcohol, Normal (For use in organic coatings).

5.4.2 Technical description. n-Butyl Alcohol, technical is of one grade, 98% ONLY. It is a colorless liquid with a wine-like odor. It is moderately soluble in water and miscible with alcohol or ether. This alcohol shall be miscible without turbidity with 19 volumes of 60° API gasoline at 20°C.

Quantitative requirements of n-butyl alcohol, technical

<u>Property</u>	<u>Requirements</u>
Acidity, mg of KOH/gm, max	0.1%
Distillation:	
Initial boiling point, at 760 mm pressure, min	115°C
Dry point, at 760 mm pressure, max	118.5°C
Nonvolatile matter, gm per 100 ml, max	0.005
Specific gravity at 20°/20°C	0.810-0.815

Physical constants of n-butyl alcohol

<u>Property</u>	<u>Constants</u>
Autoignition temperature	650°F (344°C)
Boiling point	117.7°C
Flash point (Tag open cup)	46.0°C
Heat of vaporization	141.31 cal/g
Melting point	-89.0°C
Refractive index (20°C)	1.3993
Specific heat (25°C)	0.569 cal/g-deg

5.4.3 Use data. n-Butyl alcohol, technical is intended for military use as a lubricant and a solvent, and is used in aircraft and diesel engine fuels. Typical commercial applications include use as a latent solvent in nitrocellulose lacquers, in pharmaceuticals, perfumes, photography, hydraulic fluids, cleaners, coatings, and as a general solvent.

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5.4.4 Packaging data and labeling. For military use, n-butyl alcohol, technical is packaged in 5 gallon drums conforming to type I, class 1, of Federal Specification PPP-D-760 with screw cap closures and in 55 gallon unit quantity drums conforming to type II of Federal Specification PPP-D-729. Each drum shall bear a warning label as follows.

CAUTION!

Keep away from heat and open flame. Avoid prolonged breathing of vapor. Use with adequate ventilation. Avoid prolonged or repeated contact with skin. Keep container closed.

5.4.5 Storage data. n-Butyl Alcohol should be stored in tightly closed containers in a cool, dry area away from definite fire hazards, high temperatures, oxidizing materials, and direct sunlight. Under these storage conditions and in sealed containers, this material has an indefinite shelf life. In opened containers, the maximum shelf life is six months from date of opening. Containers should be checked every six months for deterioration.

5.4.6 Disposal data. For small spills or releases, absorb on paper and burn under a hood or in an incinerator. For large quantities, atomize into an incinerator. Containers should be drained, cleaned free of vapors, and returned to manufacturer for refilling. In case of damaged container, puncture, crush, and deposit in authorized sanitary landfill.

5.5 Name. sec-BUTYL ALCOHOL, (SOCMA), $\text{CH}_3\text{CH}_2\text{CHOHCH}_3$, MW 74.12
SBA
2-Butanol
Methylethylcarbinol
(HAZARDOUS)

5.5.1 Specification. TT-B-848, Butyl Alcohol; Secondary (for use in organic coatings).

5.5.2 Technical description. sec-Butyl alcohol is of the 98% grade only. It is a flammable liquid with a wine-like odor. It is moderately soluble in water and shall be miscible without turbidity with 19 volumes 10° heptane. Secondary butyl alcohol shall meet the requirements specified on page 14.

Physical constants of sec-butyl alcohol, technical

<u>Property</u>	<u>Constants</u>
Flash point (closed cup)	75°F (23.85°C)
Melting point	-114.7°C
Refractive index	1.3949
WT/gal (20°C)	6.74 lb

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Chemical and physical requirements of sec-butyl
alcohol, technical

<u>Property</u>	<u>Requirements</u>
Acidity, mg of KOH per g, max	0.037%
Appearance	Clear and free from sediment and suspended matter
Color (platinum cobalt scale), max	10
Distillation (760 mm pressure):	
Initial boiling point, min	97°C
Dry point, max	102°C
Nonvolatile matter (in 100 ml), max	0.005 g
Specific gravity at 20°/20°C	0.807-0.810

5.5.3 Use data. sec-Butyl alcohol is intended for military use in organic protective coatings. Typical commercial applications include use as a general solvent.

5.5.4 Packaging data and labeling. For military use, secondary butyl alcohol is packaged in 1 gallon unit quantity cans, in 5 and 55 gallon unit quantity drums. All three package sizes shall conform to Federal Specification TT-P-143. Each container shall bear a DOT Shipping Regulations label for flammable liquids as well as the following.

CAUTION!

Keep away from heat and open flame.
Avoid prolonged breathing of vapor.
Use with adequate ventilation.
Avoid prolonged or repeated contact with skin.

5.5.5 Storage data. Same as 5.2.5.

5.5.6 Disposal data. For small spills or releases, absorb on paper and burn under a hood or in an incinerator. For large quantities, atomize into an incinerator. Containers should be drained, cleaned free of vapors, and returned to manufacturer for refilling. In case of damaged container puncture, crush, and deposit in authorized sanitary landfill.

5.6 Name. CYCLOHEXYLAMINE, (SOCMA), $C_6H_{11}NH_2$, MW 99.18
Aminocyclohexane (IUPAC)
Hexahydroaniline
(HAZARDOUS)

5.6.1 Specification. O-C-940, Cyclohexylamine, Technical.

5.6.2 Technical description. Cyclohexylamine is a clear, nearly colorless liquid with a characteristic fishy amine odor. It is completely miscible

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with water and with common organic solvents, including alcohols, ethers, ketones, esters, aliphatic hydrocarbons, aromatic hydrocarbons, and their chlorinated derivatives. On distillation with water, cyclohexylamine forms an azeotropic mixture. It shall not contain free ammonia or other chemical harmful to metal surfaces which are commonly used in steam systems. A 0.01% aqueous solution of cyclohexylamine has a pH of 10.5. Cyclohexylamine shall be in 98% concentrated solution.

Physical requirements of cyclohexylamine, technical

<u>Property</u>	<u>Requirements</u>
Distillation range at 760 mm Hg, 1st drop, min	132.0°C
95% (1-96 ml), max	136.0°C
Dry point, max	137.0 ± 1°C
Flash point (COC)	31.7°C to 32.7°C
Specific gravity (15.5°/15.5°C)	.869-.873

Physical constants of cyclohexylamine, technical

<u>Property</u>	<u>Constants</u>
Autoignition temperature	260°C
Boiling point	134.5°C
Melting point	-17.7°C
Vapor density (air 1.00)	3.42

5.6.3 Use data. Cyclohexylamine, technical is intended for military use in low pressure heating plants where the air has not been removed from the feedwater. This compound, when added to the boiler water, will volatilize with the steam and circulate through the steam lines, returning with the condensate to the boiler. Typical commercial applications include use as a corrosion inhibitor, a petroleum additive, a dye intermediate, sweetening agent, and emulsifying agent. It is also used in pharmaceuticals and insecticides.

5.6.4 Packaging data and labeling. For military use, cyclohexylamine, technical is packaged in 55 gallon unit quantity, eighteen gage drums conforming to Federal Specification PPP-D-729, except that exterior surfaces may have a commercial coating. Each drum shall hold three hundred and ninety pounds and, in addition to the labeling required by the Federal Hazardous Substances Labeling Act promulgated by the Department of Health, Education, and Welfare shall bear the following label.

WARNING!
LIQUID AND VAPOR HARMFUL

Keep away from heat and open flame. Keep container closed. Avoid breathing vapor. Avoid contact with skin and eyes. Use with

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adequate ventilation. In case of accident, remove all contaminated clothing. flush skin with water continually for at least 15 minutes; obtain medical treatment.

5.6.5 Storage data. Store cyclohexylamine in tightly closed containers in a cool, dry area away from definite fire hazards, oxidizing materials, and direct sunlight. Under these storage conditions, the shelf life is indefinite. Containers should be inspected every six months for deterioration.

5.6.6 Disposal data. For small spills or releases, cover with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spray with water, and wash into drain with large excess of water. For large quantities, atomize into an incinerator equipped with sufficient controls to meet applicable emission standards. Drums are to be returned to the suppliers or contractors for refilling. Prior to returning drums, completely drain contents and tighten bungs with gaskets securely in-place. If gaskets are damaged, use new gaskets. Wash outside stains with water before starting return in accordance with DOT regulations. Damaged containers should either be punctured and incinerated or rinsed with a 20 percent sodium bisulfate solution equal to 20 percent of the container volume and allowed to stand for 2 hours before draining to the sanitary sewer with a large excess of water. The container should be rinsed a second time using clear water. The rinsed or incinerated container can be sent to the nearest salvage yard to be sold as scrap metal or be crushed and buried in a sanitary landfill. Personnel involved in incinerating or decontaminating operations should wear butyl rubber gloves and aprons, coveralls and approved self-contained breathing apparatuses equipped with full-face piece.

5.7 Name. DIETHANOLAMINE, $(\text{HOCH}_2\text{CH}_2)_2\text{NH}$, MW 105.14
2,2-Iminodiethanol (IUPAC), (SOCMA)
Diethylolamine
bis (Hydroxyethyl)amine
2,2 -Dihydroxydiethylamine
(HAZARDOUS)

5.7.1 Specification. MIL-E-50011, Ethanolamines (Monoethanolamine, Diethanolamine, and Triethanolamine), Technical.

5.7.2 Technical description. Diethanolamine is colorless and viscous with a characteristic mild odor of ammonia when in the liquid state. At normal temperatures it exists in the solid state at which time it has a white, crystalline appearance. It is a strong, chemically active base, and very soluble in water and alcohol.

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Chemical and physical requirements of diethanolamine, technical

<u>Property</u>	<u>Requirements</u>
Appearance	Substantially free of suspended matter
Iron, max	0.003%
Monoethanolamine content, max	1.0%
Diethanolamine content, min	98%
Triethanolamine content, max	1.5%
Specific gravity 20°/20°C	1.090-1.095
Water content, max	1.0%

Physical constants of diethanolamine, technical

<u>Property</u>	<u>Constants</u>
Autoignition temperature	662.0°C
Flash point (open cup)	137.75°C
Freezing point	28°C
Vapor density (air = 1.00)	3.65

5.7.3 Use data. Diethanolamine, technical is intended for military use in the removal of carbon dioxide from air, other gases, and liquids by absorption and as a wetting agent. Typical commercial applications include use with cracking gases and coal or oil gases which contain carbonyl sulfide that would react with monoethanolamine; as rubber chemical intermediate; in the manufacture of surface active agents used in textile specialties, herbicides, petroleum demulsifiers; as emulsifier and dispersing agents in various agricultural chemicals, cosmetics, and pharmaceuticals; in the production of lubricants for the textile industry; as humectant and softening agent; and in organic synthesis.

5.7.4 Packaging data and labeling. For military use, diethanolamine is packaged in 5 gallon pails conforming to type I, class 3 of Federal Specification PPP-P-704 and in 55 gallon drums conforming to type I or II of Federal Specification PPP-D-729. There are no DOT Shipping Regulations on diethanolamine. Each container shall be marked with the following warning label.

DIETHANOLAMINE
WARNING! CAUSES BURNS

Causes severe eye burns. Do not get into eyes. Keep away from heat and open flame. Avoid breathing vapor. Do not take internally. Wear goggles when handling. In case of accident, flush eyes with plenty of water for at least 15 minutes and obtain medical attention immediately.

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5.7.5 Storage data. Store in tightly closed containers in a cool, dry area away from heat, open flame, definite fire hazards, oxidizing materials and direct sunlight. In unopened containers, diethanolamine has an indefinite shelf life. If the container has been opened, the maximum shelf life is six months from the date of opening. Containers should be inspected every six months for deterioration.

5.7.6 Disposal data. For small spills or releases, absorb on paper and burn in an incinerator. Decontaminate the site by covering the area with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spraying with water and washing into drain with a large excess of water. For large quantities, mix with alcohol and atomize into an incinerator equipped with sufficient controls to meet applicable emission standards. Empty 5 and 55 gallon drums should be returned to the supplier or contractor, for refilling. Prior to returning drums, completely drain contents and tighten bungs with gaskets securely in-place. If gaskets are damaged, use new gaskets. Wash outside stains with water before starting return in accordance with DOT regulations. Damaged containers should either be punctured and incinerated or rinsed with a 20 percent sodium bisulfate solution equal to 20 percent of the container volume and allowed to stand for 2 hours before draining to the sanitary sewer with a large excess of water. The container should be rinsed a second time using clear water. The rinsed or incinerated container can be sent to the nearest salvage yard to be sold as scrap metal or be crushed and buried in a sanitary landfill. Personnel involved in incinerating or decontaminating operations should wear butyl rubber gloves and aprons, coveralls and approved self-contained breathing apparatuses equipped with full-face piece.

5.8 Name. DIETHYLENE GLYCOL, (SOCMA), $\text{HOCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH}$, MW 106.12
2.2' -Dihydroxydiethyl ether
(HAZARDOUS)

5.8.1 Specification. MIL-D-23296, Diethylene Glycol, Technical.

5.8.2 Technical description. Diethylene glycol is a clear, colorless, practically odorless, syrupy liquid which is extremely hygroscopic. It is miscible with water, alcohol, acetone, ethylene glycol, or ether. It is immiscible with benzene, carbon tetrachloride, or toluene.

Chemical and physical requirements
of diethylene glycol, technical

<u>Property</u>	<u>Requirements</u>
Acidity (as acetic acid), max	0.005%
Ash content, max	0.005%
Color (Platinum Cobalt), max	15 units
Distillation range:	
Initial boiling point, min	242°C
Dry point, max	250°C
Moisture, max	0.2%
Specific gravity at 20°/20°C	1.1167 to 1.1200

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Physical constants of diethylene
glycol, technical

<u>Property</u>	<u>Constants</u>
Autoignition temperature	228.85°C
Flash point (closed cup)	123.85°C
(open cup)	143.30°C
Freezing point	-8.0°C
Refractive index (25°C)	1.446

5.8.3 Use data. Diethylene glycol, technical is intended for military use as an antifreeze. Typical commercial applications include use as a solvent for nitrocellulose and gums, as a softening agent for glue, tobacco and parchment paper. It also replaces ethylene glycol in the manufacture of explosives and textiles. Other primary uses are as a textile lubricant, and agent to remove moisture from natural gas, in organic synthesis, in cosmetics, and in herbicides.

5.8.4 Packaging data and labeling. For military use, diethylene glycol, technical is packaged in 1 pint unit quantity screw cap bottles, 1 and 5 gallon unit quantity cans and in 55 gallon unit quantity drums. Packaging shall be in accordance with MIL-STD-290. Each package shall be labeled with the hazardous identification symbol in accordance with MIL-STD-1341.

5.8.5 Storage data. Diethylene glycol is a slight fire hazard when exposed to heat or flame. Store in tightly closed containers in a cool, dry place away from fire hazards, oxidizing materials, and direct sunlight. Under these storage conditions and in unopened containers, the shelf life is indefinite. Containers should be inspected every six months for deterioration.

5.8.6 Disposal data. For small spills or releases, flush with large quantities of water to the sanitary sewer. For large quantities, mix with alcohol and atomize into an incinerator. Dispose empty 5 gallon cans and 55 gallon drums by first steam cleaning and return to the manufacturer or contractor for refilling. Dispose empty 1 gallon cans by puncturing, crushing and burying in an authorized sanitary landfill. In case of damaged 5 or 55 gallon drums, dispose of by sending to nearest salvage yard to be sold as scrap metal.

5.9 Name. DIETHYLENETRIAMINE (SOCMA), $(\text{NH}_2\text{C}_2\text{H}_2)_2\text{NH}$ MW 103.17
Bis[B-aminoethyl] amine
2,2'-Diaminodiethylamine
(HAZARDOUS)

5.9.1 Specification. O-D-1271, Diethylenetriamine, Technical.

5.9.2 Technical description. Diethylenetriamine is a clear, yellow liquid with a mild ammoniacal odor. It is strongly alkaline, hygroscopic, some-

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what viscous liquid. It is soluble in water and hydrocarbons. Diethylenetriamine is corrosive to copper and its alloys.

Chemical and physical requirements of
diethylenetriamine, technical

<u>Property</u>	<u>Requirements</u>
Distillation range at 760 mm Hg	
Initial boiling point, min	185.0°C
Dry point, max	215.0°C
Volume of distillate below 210°C, min	93.0%
Purity, min	97.0%
Specific gravity at 20°/20°C	0.950-0.958
Water content, max	0.5%

Physical constants of diethylenetriamine, technical

<u>Property</u>	<u>Constants</u>
Autoignition temperature	398.85°C
Boiling point	207°C
Flash point (open cup)	101.5°C
Melting point	-39°C
Vapor density (air = 1.00)	3.48
Vapor pressure at 20°C	0.22 mm

5.9.3 Use data. Diethylenetriamine is intended for military use in the manufacture of Decontaminating Agent, DS2. Typical commercial applications include use as a solvent for sulfur, acid gases, various resins, and dyes; as saponification agent for acidic materials, and for making derivatives.

5.9.4 Packaging data and labeling. For military use, diethylenetriamine is packaged in 1 pint unit quantity bottles and 55 gallon unit quantity drums in accordance with specifications forming a part of specification PPP-C-300. Each container shall bear the following label.

DANGER! CAUSES SEVERE EYE AND SKIN BURNS

Do not get in eyes, or skin, or on clothing .
Avoid prolonged or repeated breathing of
vapor. In case of contact, immediately flush
eyes or skin with plenty of water for at
least 15 minutes; for eyes, get immediate
medical attention. Remove contaminated
clothing, including shoes. Wash clothing
before reuse; discard contaminated shoes.

5.9.5 Storage data. Diethylenetriamine should be stored in tightly closed containers in a cool, dry area away from heat, flame, definite fire hazards,

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oxidizing materials, and direct sunlight. In unopened containers, this material has an indefinite shelf life.

5.9.6 Disposal data. For small spills or releases, cover with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spray with water, and wash into drain with large excess of water. For large quantities atomize into an incinerator equipped with sufficient controls to meet applicable emission standards. Drums are to be returned to the suppliers or contractors for refilling. Prior to returning drums, completely drain contents and tighten bungs with gaskets securely in-place. If gaskets are damaged, use new gaskets. Wash outside stains with water before starting return in accordance with DOT regulations. Damaged containers should either be punctured and incinerated or rinsed with a 20 percent sodium bisulfate solution equal to 20 percent of the container volume and allowed to stand for 2 hours before draining to the sanitary sewer with a large excess of water. The container should be rinsed a second time using clear water. The rinsed or incinerated container can be sent to the nearest salvage yard to be sold as scrap metal or be crushed and buried in a sanitary landfill. Personnel involved in incinerating or decontaminating operations should wear buty rubber gloves and aprons, coveralls and approved self-contained breathing apparatuses equipped with full-face piece.

5.10 Name. N,N-DIMETHYLANILINE, (SOCMA), $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)_2$, MW 121.18
N,N-Dimethylaminobenzene
N,N-Dimethylphenylamine
Dimethylaniline
(HAZARDOUS)

5.10.1 Specification. MIL-D-20305, Dimethylaniline.

5.10.2 Technical description. N,N-Dimethylaniline is a yellowish to brownish oily liquid. It is soluble in alcohol and ether, slightly soluble in water. It has a specific gravity of 0.96 at 15.5°C, melting point of 2.5°C, boiling point of 192.5 to 193.5°C, flash point of 63°C (C.C.), and autoignition temperature of 371°C. It is combustible. N,N-Dimethylaniline shall conform to the following requirements.

<u>Property</u>	<u>Requirement</u>
Color	Yellow
Freezing point	1.9°C
Residue	0.1% max
Solubility	100%
Alkalinity or acidity, max	0.005%
Aniline	0.1% max

5.10.3 Use data. N,N-Dimethylaniline is intended for use in the manufacture of tetryl for military use. Commercial uses are in dyes, solvent, manufacture of vanillin and stabilizer (acid acceptor).

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5.10.4 Packaging data and labeling. N,N-Dimethylaniline shall be packed in 55 gallon returnable steel drums or tank cars so constructed and protected as to conform with applicable specifications of Department of Transportation. Each container must bear the following precautionary label.

DANGER! HIGHLY TOXIC

Keep away from heat and open flame. Keep container closed. Avoid breathing vapor. Use with adequate ventilation. Avoid contact with skin and eyes.

In addition each container shall be labeled with the name, specification, manufacturer, lot number, and date of manufacture.

5.10.5 Storage data. Store in an area away from open flames, sparks, and heat where the temperature will not get high enough to cause thermal decomposition resulting in possible formation of carbon monoxide, carbon dioxide and/or oxides of nitrogen. The shelf life conditions are the same as for Aniline. See paragraph 5.3.5.

5.10.6 Disposal data. For small spills or accidental releases, absorb on paper and burn in an incinerator. For large spills cover with sand, mix and shovel into cardboard box, and burn in incinerator equipped with sufficient controls to meet applicable emissions standards. Decontaminate the site by covering the area with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spraying with water and washing into drain with a large excess of water. For large quantities, mix with alcohol and atomize into an incinerator equipped as indicated above. Drums are to be returned to suppliers. Prior to returning drums, completely drain contents and tighten bungs securely in place with gaskets. If needed, use new gaskets. Wash outside stains with water before starting return movement in accordance with DOT regulations. Damaged empty containers should be punctured and incinerated prior to sending to the nearest salvage yard to be sold as scrap metal or to be crushed and buried in a sanitary landfill. Personnel involved in these operations should wear butyl rubber gloves and aprons, coveralls, and approved self-contained breathing apparatuses equipped with full-face pieces.

5.11 Name. DIPHENYLAMINE, (SOCMA), $\text{C}_{12}\text{H}_{11}\text{N}$, MW 169.22
Anilinobenzene
N-Phenylaniline

5.11.1 Specification. MIL-D-98, Diphenylamine, Technical.

5.11.2 Technical description. Diphenylamine described herein is in flake form. It is very pale tan, which may darken on storage to no darker than a light brown color. It is soluble in carbon disulfide, benzene, alcohol,

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and ether. It is insoluble in water. Diphenylamine shall meet the following requirements.

<u>Property</u>	<u>Requirements</u>
Setting point	51.7 - 53.0°C
Insoluble material (Residue), max	0.02%
Moisture, max	0.2%
Acidity (as hydrochloric acid), max	0.005%
Alkalinity (as sodium hydroxide), max	0.005%
Oxidizable material (as aniline), max	0.1%

In addition, the diphenylamine shall be free of extraneous material, such as iron rust, wood particles, dirt, colored salts, and other visible impurities.

5.11.3 Use data. Diphenylamine is intended for use as a stabilizer in production of smokeless powder. Commercial uses are in rubber anti-oxidants and accelerators, stabilizers for plastics, solid rocket propellents, pesticides, explosives, dyes, and pharmaceuticals.

5.11.4 Packaging data and labeling. Diphenylamine shall be packaged in 50 lb unit quantities in fiber drums conforming with specification PPP-D-723, Type III, Grade A or in polyethylene lined 4 ply paper bags. Each drum or bag must have a DOT poisons label. Each container must also bear the following precautionary label.

DIPHENYLAMINE
DANGER! HAZARDOUS VAPORS HARMFUL
RAPIDLY ABSORBED THROUGH SKIN

Keep away from heat and open flame. Do not get in eyes, on skin, or on clothing. Avoid breathing dust. Use only with adequate ventilation. In case of excessive dustiness, wear a respirator approved by the US Bureau of Mines for nuisance dusts. Wear safety goggles for eye protection. In case of accident, get first-aid and call physician immediately.

In addition, each container shall be labeled with specification number, manufacturer, lot no., and date of manufacture.

5.11.5 Storage data. Store in a cool dry area away from heat and oxidizing materials. Heat could cause thermal decomposition which may produce carbon monoxide and/or carbon dioxide. Under these storage conditions and in unopened containers the shelf life is indefinite. If the container has been opened, diphenylamine has a maximum shelf life of 6 months from date of opening. Containers should be checked every 6 months for deterioration.

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5.11.6 Disposal data. For small spills or releases, sweep up and burn in an incinerator equipped with sufficient controls to meet applicable emission standards. For large quantities, dissolve in alcohol and atomize into an incinerator equipped as above. Dispose container in an incinerator. Personnel involved in these operations should wear butyl rubber gloves and aprons, coveralls, and approved self-contained breathing apparatuses equipped with full-face piece. CAUTION: This item is highly toxic by ingestion and inhalation.

5.12 Name. ETHYLENE GLYCOL, (SOCMA), $\text{HOCH}_2\text{CH}_2\text{OH}$, MW 62.07
1,2-Ethanediol (IUPAC)
Ethylene Alcohol
Glycol
Glycol Alcohol
(HAZARDOUS)

5.12.1 Specification. MIL-E-9500, Ethylene Glycol, Technical, Uninhibited.

5.12.2 Technical description. Ethylene glycol is the simplest polyhydric alcohol. It is a clear, colorless, syrupy, sweet-tasting, extremely hygroscopic liquid. It is soluble in water, alcohol, or ether, and lowers the freezing point of water.

Chemical and physical requirements of ethylene glycol, technical

<u>Property</u>	<u>Requirements</u>
Acidity (as acetic acid), max	0.01%
Ash content, per 100 ml, max	0.005 g
Boiling range at 760 mm Hg	
Initial boiling point, min	192°C
95% distilled, max	200°C
Dry point, max	208°C
Flash point (open cup), min	240°F (115.5°C)
Specific gravity 20°/20°C	1.1151 to 1.1156
Total glycols, min	99.5%
Water, max	0.5%

Physical constants of ethylene glycol, technical

<u>Property</u>	<u>Constants</u>
Autoignition temperature	413.75°C
Freezing point	-13.5°C
Refractive index (25°C)	1.430
Specific heat (25°C)	0.58 btu/lb/°F
Viscosity (25°C)	14.8 centistokes

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5.12.3 Use data. Ethylene glycol, technical is intended for military use as a coolant in aircraft engines, as an antifreeze in automobile engines, and as a de-icer in de-icing kits. Typical commercial applications include use in manufacture of explosives and as a solvent in waxes, printing inks, wood stains, glue mixtures, and brake fluid.

5.12.4 Packaging data and labeling. For military use, ethylene glycol, technical is packaged in 1 gallon unit quantity bottles conforming to MIL-B-26701 and in 55 gallon drums conforming to PPP-C-1337, Type II, Class 4.

5.12.5 Storage data. Store in tightly closed containers in a cool, dry area away from definite fire hazards, oxidizing materials, and direct sunlight. If stored under these conditions in unopened containers, the shelf life is indefinite.

5.12.6 Disposal data. For small spills or releases, flush with copious quantities of water to the sanitary sewer. For large quantities, mix with alcohol and atomize into an incinerator. Empty 55 gallon drums should be steam cleaned and returned to the supplier or contractor for refilling. Send damaged drums to salvage yard to be sold as scrap metal. Dispose empty 1 gallon cans by puncturing, crushing, and burying in an authorized sanitary landfill.

5.13 Name. ETHYLENE GLYCOL MONOBUTYL ETHER, $C_4H_9OCH_2CH_2OH$, MW 118.18
2-Butoxyethanol (IUPAC) (SOCMA)
(HAZARDOUS)

5.13.1 Specification. TT-E-776, Ethylene Glycol Monobutyl Ether (for use in organic coatings).

5.13.2 Technical description. Ethylene glycol monobutyl ether is a synthetically prepared solvent. It is a colorless liquid with a mild odor and a low rate of evaporation. It shall be clear and free from sediment, suspended matter, hydrogen sulfide and sulfur dioxide. Ethylene glycol monobutyl ether is soluble in mineral oils, most solvents and water. In general, it is an inert solvent.

Quantitative requirements of ethylene
glycol monobutyl ether, technical

<u>Property</u>	<u>Requirements</u>
Acidity (mg of KOH/g), max	0.1%
Color - platinum cobalt scale, max	15
Distillation:	
Initial boiling point at 760mm pressure, min	165°C
Distillate below 167°C (percent by volume), max	5
Dry point at 760mm pressure, max	173°C
Nonvolatile matter in 100 ml (gram), max	0.005
Specific gravity at 20°/20°C	0.900-0.905

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Physical constants of ethylene glycol
monobutyl ether, technical

<u>Property</u>	<u>Constants</u>
Autoignition temperature	244.0°C
Flash point (closed cup)	60.5°C
(open cup)	73.85°C
Freezing point	-74.8°C
Refractive index (25°C)	1.4190
Viscosity (20°C)	6.42 centipoise

5.13.3 Use data. Ethylene glycol monobutyl ether, technical is intended for military use as a solvent in organic protective coatings, particularly cellulose lacquers, lacquer thinners, and quick-drying varnishes and enamels. Typical commercial applications include use as a solvent for nitrocellulose resins; spray lacquers; brushing lacquers of the four-hour type; varnish removers; textiles (preventing spotting in printing or dyeing); mutual solvent for "soluble" mineral oils to hold soap in solution and to improve the emulsifying properties.

5.13.4 Packaging data and labeling. For military use, ethylene glycol monobutyl ether, technical is packaged in 1 gallon unit quantity cans, conforming to type V, Class 4, oblong, of Federal Specification PPP-C-96. Individual containers shall bear the following precautionary label.

CAUTION!
VAPOR HARMFUL

Keep away from heat and flame. Use only with
adequate ventilation. Avoid prolonged breathing
of vapor. Avoid prolonged or repeated skin contact.

5.13.5 Storage data. Ethylene glycol monobutyl ether should be stored in tightly closed containers in a cool, dry, well ventilated area away from definite fire hazards, oxidizing materials, and direct sunlight. Under these storage conditions and in unopened containers, the shelf life is indefinite. If containers have been opened, the maximum shelf life is six months for deterioration.

5.13.6 Disposal data. For small releases or spills, absorb on paper and burn in an incinerator. For large quantities, atomize into an incinerator. Empty 1 gallon cans should be punctured and incinerated prior to burying in an approved sanitary landfill.

5.14 Name. ETHYLENE GLYCOL MONOETHYL ETHER, $C_2H_5OCH_2CH_2OH$, MW 90.12
2-Ethoxy Ethanol (IUPAC), (SOCMA)
(HAZARDOUS)

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5.14.1 Specification. TT-E-781, Ethylene Glycol Monoethyl Ether, Technical.

5.14.2 Technical description. Ethylene glycol monoethyl ether, technical is a colorless, practically odorless liquid which is miscible with hydrocarbons and water. It shall be clear, uniform and free from sediment and suspended matter and shall be free of sulfur in any form. It shall meet the following requirements.

Quantitative requirements of
ethylene glycol monoethyl ether

<u>Property</u>	<u>Requirements</u>
Acidity, mg of KOH per g, max	0.28
Color, Platinum Cobalt scale, max	15
Distillation:	
Initial boiling point, 760mm pressure, min	128°C
Distillate below 132°C, percent by volume, max	5
Distillate below 136°C, percent by volume, min	95
Dry point, max	137°C
Evaporation rate (butyl-acetate 100), max	34
Flash point, 100, max	128°F (53.3°C)
Nonvolatile matter g per 100 ml, max	0.005
Specific gravity at 20°/20°C	0.928 to 0.933

Physical constants of
ethylene glycol monoethyl ether

<u>Property</u>	<u>Constants</u>
Autoignition temperature	237.75°C
Refractive index (25°C)	1.4060
Viscosity, centistokes, 25°C	2.00
Viscosity, centistokes, 60°C	1.60
Weight per gallon (20°C)	7.714 to 7.764

5.14.3 Use data. Ethylene glycol monoethyl ether, technical is intended for military use in the manufacture of organic protective coatings. Typical commercial applications include use as a solvent for nitrocellulose, natural and synthetic resins; mutual solvent for the formulation of soluble oils; in lacquers and lacquer thinners, dyeing and printing textiles, varnish removers, cleaning solutions, leather, and as an anti-icing additive for jet fuel.

5.14.4 Packaging data and labeling. For military use, ethylene glycol monoethyl ether is packaged in 1 gallon unit quantity cans, conforming to type V, Class 4, oblong, of Federal Specification PPP-C-96. Each container

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shall bear the following.

CAUTION! VAPOR HARMFUL

Keep away from heat and flame. Use only with adequate ventilation. Avoid prolonged breathing of vapor. Avoid prolonged or repeated skin contact.

5.14.5 Storage data. Ethylene glycol monoethyl ether should be stored in tightly closed containers in a cool, dry area away from definite fire hazards, oxidizing materials and direct sunlight. If stored under these conditions and in unopened containers, this material will have an indefinite shelf life.

5.14.6 Disposal data. For small releases or spills, absorb on paper and burn in an incinerator. For large quantities, atomize into an incinerator. Empty 1 gallon cans should be punctured and incinerated prior to burying in an approved sanitary landfill.

5.15. Name. ETHYLENE GLYCOL MONOMETHYL ETHER, $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OH}$, MW 76.10
2-Methoxyethanol, (IUPAC), (SOCMA)
(HAZARDOUS)

5.15.1 Specification. O-E-780, Ethylene Glycol Monomethyl Ether.

5.15.2 Technical description. Ethylene glycol monomethyl ether is a colorless liquid with a mild, agreeable odor. It is miscible with water, alcohol, hydrocarbons, ketones, and glycols. It shall be clear, uniform, and free of suspended matter.

Chemical and physical requirements of
ethylene glycol monomethyl ether

<u>Property</u>	<u>Requirements</u>
Acidity as acetic acid, max	0.02%
Distillation at 760 mm Hg:	
Initial boiling point, min	123.5°C
Distillate below 127°C (by volume), min	99.0%
Dry point, max	128.5°C
Specific gravity at 20°/20°C	0.964 - 0.967
Viscosity at 25°C	1.50 - 1.66 centipoises
Water content, max	0.2%

5.15.3 Use data. Ethylene glycol monomethyl ether, technical is intended for military use as a general laboratory reagent, a solvent and an ingredient in Decontaminating Agent DS2. Typical commercial applications include use as a solvent for nitrocellulose, cellulose acetate, alcohol-soluble dyes, and natural and synthetic resins; in solvent mixtures; in enamels,

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varnishes, and lacquers; as a perfume fixative; in wood stains; and for sealing moisture-proof cellophane.

Physical constants of ethylene glycol monomethyl ether

<u>Property</u>	<u>Constants</u>
Autoignition temperature	288.3°C
Flash point	46.1°C
Freezing point	-85.1°C
Refractive index (20°/20°C)	1.4024

5.15.4 Packaging data and labeling. For military use, ethylene glycol monomethyl ether, technical is packaged in 1 gallon unit quantity oblong cans conforming to PPP-C-96, Type V, Class 4, and in 1 pound unit quantity bottles conforming to applicable specification forming part of PPP-C-300. Each container shall bear the following warning label.

CAUTION! VAPOR HARMFUL

Keep away from heat and open flame. Use only with adequate ventilation. Avoid prolonged breathing of vapor. Avoid prolonged or repeated contact with skin.

5.15.5 Storage data. See Ethylene Glycol Monobutyl Ether, paragraph 5.13.5.

5.15.6 Disposal data. In case of material release or spilling, absorb on paper and burn in an incinerator. For large quantities, atomize into an incinerator. Personnel involved in these operations should wear butyl rubber gloves, apron, coveralls, and an approved self-contained breathing apparatus. Empty containers should be incinerated prior to burying in an approved sanitary landfill.

5.16. Name. ETHYL ETHER (SOCMA), $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$, MW 74.12
Diethyl Ether
Ethoxyethane (IUPAC)

5.16.1 Specification. MIL-E-199, Ether Diethyl, Technical.

5.16.2 Technical description. Ethyl ether is a colorless, volatile, mobile liquid. It is hygroscopic, has an aromatic odor, a burning and sweet taste. Ethyl ether shall conform to the following chemical and physical requirements.

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<u>Property</u>	<u>Requirements</u>
Specific gravity at 20°/20°C	0.712 to 0.723
Nonvolatile residue, percent by weight, max	0.002
Acidity as acetic acid, percent max	0.006
Acetylene, percent max	0.001
Peroxides	None
Chlorides	None
Aldehydes	None

5.16.3 Use data. Ethyl ether is intended for use in the manufacture of smokeless powder, in the cleaning of optical instruments, and where a high purity ether is required.

5.16.4 Packaging data and labeling. Ethyl ether shall be packaged in 1 pound capacity metal cans or 55 gallon capacity metal drums. Cans shall be round, conical, or dome shaped and shall comply with Type VIII, specification PPP-C-96. The cans shall be provided with inner seals and screw cap closures. Outside of cans shall be coated conforming with finish plan B, specification PPP-C-96. Drums shall conform to Type I or II, specification PPP-D-729. Each container shall bear a DOT red label for flammable liquid in addition to the danger label as follows.

DANGER! EXTREMELY FLAMMABLE
HIGHLY VOLATILE

Tends to form explosive peroxides especially when anhydrous. Keep away from heat, sparks, and open flame. Keep container tightly closed. Do not allow to evaporate to near dryness. Addition of water or appropriate reducing agents will lessen peroxide formation.

In addition, each container shall be labeled with name, specification number, manufacturer, lot number and date of manufacture.

5.16.5 Storage data. Store in an area with adequate ventilation and away from heat or all ignition sources and oxidation materials. Under these conditions, the shelf life is indefinite. Check in storage periodically for peroxide formation. For some applications peroxides must be decomposed before use of the material.

5.16.6 Disposal data. In case material is spilled, absorb on paper and allow to evaporate under a hood. Burn the paper in an incinerator. Disposal of large quantities should be accomplished by qualified personnel in a remote location by detonation. A small explosive charge is used to open and ignite the ether vapors. Explosives Ordnance Disposal (EOD) personnel should determine the amount to be disposed at a given time in accordance

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with existing DOT regulations, as well as state and local regulations. The Technical Escort Center, if requested, is available to assist in the disposal of this material. AR 740-32 outlines the procedure necessary to obtain their services. Liaison may be established with Technical Escort Center by telephone AUTOVON 584-2653, or the Operations Officer, AUTOVON 584-3601.

5.17 Name. GLYCEROL (SOCMA), $\text{HOCH}_2\text{CHOHCH}_2\text{OH}$, MW 92.10
Glycerin
Glycerine
1, 2, 3-Propanetriol (IUPAC)

5.17.1 Specification. O-G-491, Glycerol, Technical (high gravity).

5.17.2 Technical description. Glycerol is a colorless or pale yellow, viscous, odorless liquid with a sweet warm taste. It is miscible in water or alcohol and is very hygroscopic. High gravity glycerol contains 98.7 to 99% glycerol. It shall be clear and free of sediment and suspended material.

Chemical and physical requirements of glycerol

<u>Property</u>	<u>Requirements</u>
Acidity or alkalinity in 50 ml, max of N HCl or of N NaOH for neutralization	0.30 ml
Ash content, max	0.10%
Chlorides (as Cl), max	0.01%
Saponification equivalent, max	0.05%
Specific gravity at 25°/25°C, min	1.2587

Physical constant of glycerol

<u>Property</u>	<u>Constants</u>
Autoignition temperature	392.75°C
Boiling point	290°C, w/decomposition
Flash point (99% glycerol)	177.65°C
Heat of combustion	397 Kcal/mole
Melting point	18.6°C
Refractive index (20°C)	1.47399
Specific heat (26°C)	0.5795 cal/g/°C
Vapor pressure (50°C)	0.0025 mm
Viscosity (20°C)	1449 centipoises

5.17.3 Use data. Glycerol, technical is intended for military use in the manufacture of explosives and in other applications where high gravity glycerol is required. Typical commercial applications include use in ester gums, drugs, cosmetics, food and beverages. It is also used in the manufacture of cellophane, tobacco, and cork.

5.17.4 Packaging data and labeling. High gravity glycerol is packaged in

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1 pint unit quantity screw cap bottles of a suitable type covered by specification PPP-C-186 and in 1 gallon unit quantity oblong cans conforming to Type V, Class 4, specification PPP-C-96. Each can shall have a screw cap with inner seal and a formed bridge-type handle. There are no DOT Shipping Regulations for glycerol.

5.17.5 Storage data. Glycerol must be stored in tightly closed containers in a cool, dry area away from definite fire hazards, powerful oxidizers, and direct sunlight. Under these storage conditions, the shelf life is indefinite. If containers have been opened frequently, glycerol should be kept no longer than six months from date of opening. Containers should be inspected every six months for deterioration.

5.17.6 Disposal data. For small quantities, glycerol should be absorbed on paper and burned in an incinerator. For large quantities, mix with alcohol and atomize into an incinerator. Empty containers should be burned in an incinerator prior to burying in an approved sanitary landfill.

5.18 Name. GLYCEROL MONOOLEATE, $C_{21}H_{40}O_4$, MW 356.55
2,3-Dihydroxypropyl Oleate
1-Monoolein

5.18.1 Specification. MIL-G-81239, Glycerol Monooleate

5.18.2 Technical description. Glycerol monooleate is a yellowish oil or soft solid with the melting point depending on purity. It has an iodine value of 65 to 80, is insoluble in water, somewhat soluble in alcohol and most organic solvents. It is combustible, but nontoxic. Glycerol monooleate shall conform to the following requirements.

<u>Property</u>	<u>Requirements</u>
Acid number, max	5.1
Saponification number	165 ± 5
Specific gravity (25°C)	0.950 ± 0.020
Solidification point °C	12 to 17
Color (Gardner scale) max	10

5.18.3 Use data. Glycerol monooleate is intended for use as an ingredient of a wetting agent for rocket motor propellants.

5.18.4 Packaging data and labeling. Glycerol monooleate shall be packaged in 425 lb unit quantity steel drums. The drums shall have a pigmented epoxy phenolic liner of suitable thickness. Each drum shall be labeled in accordance with MIL-STD-129 and requirements of MIL-G-81239.

5.18.5 Storage data. Store in an area away from heat and sunlight at ambient temperature. Keep containers tightly closed to keep from air and oxygen. High temperature in air will cause contents to oxidize. The shelf

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life is considered to be 1 year based on test. Material in storage should be checked every three months. It is recommended that no more than 1 year supply be kept on hand to minimize disposal problems.

5.18.6 Disposal data. Dispose material by mixing with alcohol and atomize into an authorized incinerator. Empty drums should be returned to supplier or contractor for refilling. Damaged drums should be incinerated prior to sending to salvage yard for disposal as scrap metal.

5.19 Name. HEXAMETHYLENETETRAMINE (SOCMA), $C_6H_{12}N_4$, MW 140.19
Aminoform
Ammonoform
Ammonioformaldehyde
Cystamin
Cystogen
Hexamine
Methenamine
(HAZARDOUS)

5.19.1 Specification. MIL-H-502, Hexamethylenetetramine, Technical.

5.19.2 Technical description. Hexamethylenetetramine is a white crystalline powder or colorless lustrous crystals; practically odorless. The specific gravity is 1.27 at 25°C. It is soluble in water, alcohol, and chloroform, but insoluble in ether. It sublimes above 200°C, partly decomposing. Hexamethylenetetramine shall conform to the following chemical characteristics.

<u>Characteristic</u>	<u>Percent by weight</u>
Assay	99.0 min
Formaldehyde	0.0 max
Ammonia	0.02 max
Chloride	0.02 max
Ash	0.1 max
Water content	0.5 max
Insoluble Matter	0.05 max

The solubility in glacial acetic acid shall be complete without turbidity. The material shall meet the following particle size requirements.

<u>Sieve Size</u>	<u>Percent Passing</u>
1190 microns (No. 16)	98 min
250 microns (No. 60)	50 max
149 microns (No. 100)	30 max

5.19.3 Use data. Hexamethylenetetramine is intended for military use in the manufacture of cyclonite and homocyclonite and as a stabilizer. Commer-

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cial uses are catalyst in phenolformaldehyde and resorcinol-formaldehyde resins; ingredient in rubber-to-textile adhesives; protein modifier; organic synthesis and ingredient of high explosive cyclonite.

5.19.4 Packaging data and labeling. Hexamethylenetetramine shall be packaged in 50 lb unit quantities in multiwall Kraft bags lined on the inside with polyethylene film. Each bag shall be labeled in accordance with MIL-STD-129 and as follows.

CAUTION!
MAY CAUSE SKIN IRRITATION

Avoid prolonged or repeated
contact with skin.

5.19.5 Storage data. Store in a cool, dry area away from heat and open flame. Keep bags closed and do not allow material to come in contact with air. Under these conditions the shelf life is indefinite.

5.19.6 Disposal data. For small spills or releases, cover with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spray with water and wash into drain with large excess of water. Large quantities should be dissolved in alcohol and atomized into an incinerator equipped with sufficient controls to meet applicable emission standards. Empty bags should be incinerated.

5.20 Name. METHANOL (IUPAC) (SOCMA), CH_3OH , MW 32.04
Methyl Alcohol
Wood Alcohol
Wood Spirit
(HAZARDOUS)

5.20.1 Specification. O-M-232, Methanol (Methyl Alcohol).

5.20.2 Technical description. Methanol, technical is the simplest of alcohols. It is a clear, volatile, colorless, flammable, mobile liquid which is free of foreign odors. It is miscible with water, alcohol, ether, ketones, and most organic solvents. Methanol has a 99.85% minimum assay as methanol, and covers grade A only. It burns with non-luminous, bluish flame. It is usually a better solvent than ethanol since it dissolves many inorganic salts.

5.20.3 Use data. Methanol, synthetic and technical, is intended for military use as a general solvent and for the generation of hydrogen and carbon dioxide. Typical commercial applications include use in organic synthesis of methylamines, methyl chloride, and methyl methacrylate; in antifreeze; aviation fuel; as a denaturant for ethyl alcohol; and in the manufacture of formaldehyde. Methanol shall conform to the following requirements.

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Chemical and physical requirements of methanol

<u>Property</u>	<u>Requirements</u>
Acetone and aldehydes, max	0.003%
Acidity (as acetic acid), max	0.003%
Alkalinity (as NH_3), max	0.003%
Appearance	Clear and colorless
Distillation range, at 760 mm Hg, max	$64.6^\circ\text{C} \pm 0.010^\circ\text{C}$
Nonvolatile content, max	0.0010%
Water content, max	0.15%
Specific gravity at $20^\circ/20^\circ\text{C}$, max	0.7928

Physical constants of methanol

<u>Property</u>	<u>Constants</u>
Autoignition temperature	470°C
Boiling point	64.5°C
Dielectric constant (20°C)	31.2
Flash point (open cup)	15.5°C
Melting point	-97.8°C
Refractive index (20°C)	1.329
Viscosity (20°C)	0.00593 poise

5.20.4 Packaging data and labeling. Methanol is packaged in 1 quart, 1 gallon, and 5 gallon unit quantity cans and in 55 gallon unit quantity cans in accordance with the applicable requirements, for the packaging of solvents as specified in MIL-STD-290. It must bear the DOT red label for flammable liquid. In addition, each container shall have the following warning label.

DANGER! FLAMMABLE
VAPOR HARMFUL
MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED
CANNOT BE MADE NONPOISONOUS

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

5.20.5 Storage data. Store in a cool, well ventilated area away from definite fire hazards, oxidizing materials, and direct sunlight. Storage tanks should be electrically grounded and drums should be stored with the plugs in an upright position. Under these storage conditions, the shelf life is indefinite. In opened containers methanol has a maximum shelf life of six months from date of opening. The containers should be inspected every six months for deterioration.

5.20.6 Disposal data. For small spills or releases, absorb on paper towel

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and burn in an incinerator. For large quantities atomize into an incinerator. Empty 5 gallon and 55 gallon containers should be returned to the supplier for refilling. Damaged containers should be punctured and completely drained prior to sending to salvage yard for disposal as scrap metal. Containers not salvaged should be punctured, crushed, and buried in a sanitary landfill.

5.21 Name. MONOETHANOLAMINE, $\text{HOCH}_2\text{CH}_2\text{NH}_2$, MW 61.08
 2-Aminoethanol (IUPAC) (SOCMA)
 b-Aminoethanol
 Colamine
 Ethanolamine
 2-Hydroxyethylamine
 MEA
 (HAZARDOUS)

5.21.1 Specification. MIL-E-50011, Ethanolamines (Monoethanolamine, Diethanolamine, and Triethanolamine), Technical

5.21.2 Technical description. Monoethanolamine is a colorless, moderately viscous liquid with a characteristic odor of ammonia. It is a strong, chemically active base, miscible with water; soluble in alcohol, chloroform, and carbon tetrachloride.

5.21.3 Use data. Monoethanolamine, technical is intended for military use in the removal of carbon dioxide from air, other gases, and liquids by absorption; and as a wetting agent, a solution solvent, corrosion inhibitor and a metalworking lubricant. Typical commercial applications include use in shampoos, waxes, detergents, polishes, paints, agricultural sprays, and pharmaceutical softeners.

Chemical and physical requirements of monoethanolamine

<u>Property</u>	<u>Requirements</u>
Appearance	Substantially free of suspended matter
Distillation range, 90% min by volume	165 - 175°C
Iron, max	0.003%
Monoethanolamine content, min	98%
Diethanolamine content, max	1.5%
Triethanolamine content, max	1.0%
Specific gravity 20°/20°C	1.017 - 1.021
Water content, max	1.0%

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Physical constants of monoethanolamine

<u>Property</u>	<u>Constants</u>
Boiling point	170.5°C
Flash point (open cup)	93.3°C
Freezing point	10.5°C
Vapor pressure (20°C)	0.48 mm

5.21.4 Packaging data and labeling. Monoethanolamine is packaged in 1 pint cans conforming to specification PPP-C-96, Type V, Class 4, 1 gallon unit quantity pails conforming to Type I or II, Class 2, specification PPP-P-704, and in 55 gallon drums conforming to Type I or II, specification PPP-D-729. Each container shall have the following warning label.

MONOETHANOLAMINE
WARNING! CAUSES BURNS

Causes severe eye burns. Do not get into eyes. Keep away from heat and open flame. Avoid breathing vapor. Do not take internally. Wear goggles when handling. In case of contact, flush eyes with plenty of water for at least 15 minutes and obtain medical attention immediately.

5.21.5 Storage data. Store in tightly closed containers in a cool, dry area away from heat, open flame, definite fire hazards, oxidizing materials, and direct sunlight. In unopened containers, monoethanolamine has an indefinite shelf life. If the container has been opened, the maximum shelf life is six months from date of opening. Containers should be inspected every six months for deterioration.

5.21.6 Disposal data. For small spills or releases, cover area with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spray with water and wash into drain with large excess of water. For large quantities, mix with alcohol and atomize into an incinerator equipped with sufficient controls to meet applicable emission standards. Drums are to be returned to the supplier or contractors for refilling. Prior to returning drums, completely drain contents and tighten bungs with gaskets securely in-place. If gaskets are damaged, use new gaskets. Wash outside stains with water before starting return movement in accordance with DOT regulations. Damaged containers should either be punctured and incinerated or rinsed with a 20 percent sodium bisulfate solution equal to 20 percent of the container volume and allowed to stand for 2 hours before draining to the sanitary sewer with a large excess of water. The container should be rinsed a second time using clear water. The rinsed or incinerated container can be sent to the nearest salvage yard to be sold as scrap metal or be crushed and buried in a sanitary landfill. Personnel involved in incinerating or decontaminating operations should wear butyl rubber gloves and aprons, coveralls and

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approved self-contained breathing apparatuses equipped with full-face piece.

5.22 Name. MONOETHANOLAMINE, CHELATING AGENT SOLUTION
(HAZARDOUS)

5.22.1 Specification. MIL-M-23573, Monoethanolamine, Chelating Agent Solution.

5.22.2 Technical description. Chelating monoethanolamine shall be a clear, homogeneous solution of monoethanolamine and chelating agent (monosodium salt of N,N-dihydroxyethyl glycine). The solution shall contain approximately 22 parts by weight of monoethanolamine to one part by weight of chelating agent.

Chemical and physical requirements of
monoethanolamine, chelating agent solution

<u>Property</u>	<u>Requirements</u>
Alkalinity, milliequivalents per gram	14.5 - 15.5
Nitrogen, milliequivalents per gram	14.0 - 15.0
Iron, ppm, max	15
Chelating capacity:	
Against $Pb(NO_3)_2$, millimoles/g	0.16 - 0.19
Against $CaCl_2$, ml, max	0.5

5.22.3 Use data. Chelating monoethanolamine, technical is intended for military use in scrubbing equipment for the removal of carbon dioxide from the air.

5.22.4 Packaging data and labeling. Monoethanolamine chelating agent is packaged in 5 gallon molded polyethylene drums conforming to specification MIL-D-40030, Style B, size 1 and in 55 gallon drums conforming to size 4 respectively. Both sizes shall be overpacked with MIL-D-40030, type 1 steel drums. Each container shall bear the following warning label.

WARNING! MAY CAUSE EYE
INJURY AND SKIN IRRITATION

Avoid getting in eyes, on skin or clothing. In case of accidental contact, immediately flush eyes or skin with plenty of water for 15 minutes. For eyes, get prompt medical attention. Wash contaminated clothing before reuse.

5.22.5 Storage data. Store in tightly closed containers in a cool, dry area away from heat, flame, definite fire hazards, oxidizing materials, and direct sunlight. In unopened containers, the material has an indefinite shelf life. Periodic inspections should be made for deterioration or corrosion of containers.

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5.22.6 Disposal data. For small spills or releases, cover area with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spray with water and wash into drain with large excess of water. For large quantities mix with alcohol and atomize into an incinerator equipped with sufficient controls to meet applicable emission standards. Drums are to be returned to the suppliers or contractors for refilling. Prior to returning drums, completely drain contents and tighten bungs with gaskets securely in-place. If gaskets are damaged, use new gaskets. Wash outside stains with water before starting return movement in accordance with DOT regulations. Damaged containers should either be incinerated or rinsed with a 20 percent sodium bisulfate solution equal to 20 percent of the container volume and allowed to stand for 2 hours before draining to the sanitary sewer with a large excess of water. The container should be rinsed a second time using clear water. The rinsed or incinerated container can be sent to the nearest salvage yard to be sold as scrap metal or be crushed and buried in a sanitary landfill. Personnel involved in incinerating or decontaminating operations should wear butyl rubber gloves and aprons, coveralls and approved self-contained breathing apparatuses equipped with full-face piece.

5.23 Name. MORPHOLINE, (SOCMA), $\text{C}_4\text{H}_9\text{NO}$, MW 87.12
Diethylene imide oxide
Diethylene imidoxide
Diethylene oximide
Tetrahydro-2H-1, 4-oxazine
Tetrahydro-p-oxazine
(HAZARDOUS)

5.23.1 Specification. O-M-575, Morpholine, Technical

5.23.2 Technical description. Morpholine is a colorless, hygroscopic liquid, with an amine-like odor. It is a mild base, soluble in water and organic solvents. The pure compound has a boiling point of 128.9°C , a melting point of -4.9°C , and specific gravity of 1.002 at $20^\circ/20^\circ\text{C}$. Morpholine covered herein shall be Class 3 of O-M-575 conforming to the following requirements.

<u>Property</u>	<u>Requirements</u>
Specific gravity at $20^\circ/20^\circ\text{C}$	1.030 min - 1.034 max
Distillation - 760 mm	
Initial boiling point	100.0°C min
Dry point	130.0°C max
Color - Platinum Cobalt Scale	15 max
Morpholine percent	40.0 ± 1.0

5.23.3 Use data. Morpholine described in this standard is for use in either high pressure or low pressure heating plants where feed water is deaerated. The material when added to the boiler water will volatilize with the steam and circulate through the steam lines, returning with the condensate to the

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boiler. Where boiler feed water has been deaerated, morpholine is preferred to cyclohexylamine since more CO_2 is purged from the feed water and morpholine is less alkaline. Where feed water for low pressure heating plants (under 15 pounds psi) has not been deaerated, cyclohexylamine, specification O-C-940, is preferred.

5.23.4 Packaging data and labeling. Morpholine shall be packaged in 5 gallon unit quantity pails conforming to Type I, Class 3, specification PPP-P-704, except that exterior surfaces may have a commercial coating. Each container shall be labeled as follows.

CAUTION! IRRITATING TO SKIN AND EYES

If spills contact the skin, wash off promptly with soap and water. If clothing becomes saturated, remove at once and wash with soap and water. In case of eye contacts, irrigate with water for at least 15 minutes and get medical attention.

In addition, each container shall be marked in accordance with MIL-STD-129, the Federal Hazardous Substances Labeling Act, and with the name, specification number, Federal Stock Number, manufacturer, lot number, and date of manufacture.

5.23.5 Storage data. Store in a dry area at room temperature. Do not allow temperature in storage area to drop to 23°F to prevent solidifying. The shelf life is considered to be indefinite; however, check containers every six months for rust or corrosion at seams.

5.23.6 Disposal data. For small and large spills cover with sand, mix and shovel into a cardboard box and burn in an incinerator equipped with sufficient controls to meet applicable emission standards. Decontaminate the site by covering the area with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spraying with water and washing into drain with a large excess of water. For large quantities, atomize into an incinerator equipped as indicated above. Drums are to be returned to the suppliers or contractors for refilling. Prior to returning drums, completely drain contents and tighten bungs securely in-place with gaskets. If gaskets are damaged, use new gaskets. Wash outside stains with water before starting return movement in accordance with DOT regulations. Damaged empty containers should be incinerated prior to sending to the nearest salvage yard to be sold as scrap metal or to be crushed and buried in a sanitary landfill. Personnel involved in these operations should wear butyl rubber gloves and aprons, coveralls and approved self-contained breathing apparatuses equipped with full-face pieces.

5.24 Name. OCTADECYLAMINE, (IUPAC), (SOCMA), $\text{CH}_3(\text{CH}_2)_{16}\text{CH}_2\text{NH}_2$, MW 269.50
Stearylamine

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5.24.1 Specification. None.

5.24.2 Technical description. The material covered herein shall be either powder or paste form. The powder form shall meet the following requirements.

<u>Property</u>	<u>Characteristics</u>
Color	Tan to off white
Melting range	47 to 51°C
Solubility	Insoluble in water, soluble in alcohol, ether, acetone, & benzene

The paste form shall meet the following requirements.

<u>Property</u>	<u>Characteristics</u>
Appearance	gray-white emulsified
Flash point (open cup)	200°F (93.30°C)
pH (1% solution)	7.5
Pour point (ASTM)	45°F (7.20°C)
Specific gravity (60°F)(15.5°C)	1.202
Viscosity (75°F)(23.5°C), centistokes	4000 - 6000

5.23.3 Use data. Octadecylamine is intended for use as a filming amine-type corrosion inhibitor used in liquid cooling systems. Commercial uses are the same.

5.23.4 Packaging data and labeling. Octadecylamine in powder form shall be packaged in 30 gallon fiber drums. Paste form shall be packaged in 50 gallon (400 lb) quantities in fiber drums. Both size drums shall have a polyethylene liner of suitable thickness. Each drum shall be labeled as follows.

CAUTION! DO NOT TAKE INTERNALLY

May cause skin irritations on prolonged contact. In case of contact with skin, clean well with soap and water. In case of contact with eyes flush with clear water promptly and thoroughly. In case of injection or contact with eyes, secure immediate medical attention.

Drums containing paste form shall also be labeled.

**KEEP CONTAINER COVERED
PROTECT FROM FREEZING**

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In addition, each drum shall be labeled with name, Federal Stock Number, manufacturer, lot number and date of manufacture.

5.24.5 Storage data. Store in a dry area at room temperature and keep covered when not in use. Under these conditions the shelf life is expected to be 5 years for powder form based on estimate by manufacturer and 1 year or more for paste form based on experience by manufacturer. Chemical gloves and goggles or face mask should be used when handling octadecylamine. Check in storage yearly.

5.24.6 Disposal data. For small spills or releases, sweep up and burn in an incinerator equipped with sufficient controls to meet applicable emission standards. For large quantities, dissolve in alcohol and atomize into an incinerator equipped as above. Dispose of container in an incinerator. Personnel involved in these operations should wear butyl rubber gloves and aprons, coveralls, and approved self-contained breathing apparatuses equipped with full-face piece.

5.25 Name. 2-PROPANOL, (IUPAC), $\text{CH}_3\text{CHOHCH}_3$, MW 60.09
Dimethyl Carbinol
IPA
Isopropanol
Isopropyl Alcohol
2-Propyl Alcohol
sec-Propyl Alcohol
(HAZARDOUS)

5.25.1 Specification. TT-I-735, Isopropyl Alcohol.

5.25.2 Technical description. 2-Propanol is a colorless, flammable liquid miscible with water, alcohol, ether, and chloroform. There are two grades of 2-propanol, the first has a maximum water content of 0.1 percent; the second 0.4 percent.

Chemical and physical requirements of 2-propanol

Property	Requirements	
	Grade A	Grade B
Acidity (as acetic acid), max	0.002%	0.002%
Appearance	Clear & free from sediment & suspended matter	
Distillation range:		
Initial boiling point °C, min	81.3	81.3
Dry point	83.0	83.0
Nonvolatile matter (gram per 100 ml)	0.002	0.002
Specific gravity at 20°/20°C	0.7862-0.7870	0.7862-0.7873
Water content, max	0.10%	0.40%

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Physical constants of 2-propanol

<u>Property</u>	<u>Constants</u>
Autoignition temperature	825°F (440.5°C)
Flash point (Cleveland open cup)	72°F (22.20°C)
Melting point	-88.5 to -89.5°C
Refractive index (20°C)	1.3756
Vapor pressure (20°C)	33 mm
Viscosity (25°C)	2.1 centipoises

5.25.3 Use data. 2-Propanol, technical with a 0.1 percent maximum water content is used as an intermediate for chemical manufacture. With a 0.4 percent water content, it is intended for military use in organic coatings, ordnance material, and anti-icing fluids. Typical commercial applications include use as a substitute for solvent ethyl alcohol and in the manufacture of organic derivatives. It is also used in the manufacture of acetone, perfumes, lacquers, anti-freeze, and rocket fuels.

5.25.4 Packaging data and labeling. For military use, 2-propanol with 0.1 percent maximum water content is packaged in 8 ounce screw cap cans, 1 quart, 1 gallon, and 55 gallon unit quantity containers; with 0.4 percent maximum water content, it is packaged in 5 gallon unit quantity cans and 55 gallon unit quantity drums. The sizes shall be packaged in accordance with specification TT-P-143 as specified for the applicable level except the 8 ounce can. The 8 ounce can shall be 4-3/8 inches long by 2-3/4 inches wide by 1-1/4 inch deep. The DOT red label for flammable liquids is required. Each container must also bear a white label with the following information printed in red letters.

WARNING!

Flammable. Keep away from heat and open flame. Keep container closed. Avoid prolonged breathing of vapors. Use with adequate ventilation.

5.25.5 Storage data. Store in the same manner as METHANOL, (5.20.5). If the containers have been opened, 2-propanol has a maximum shelf life of six months from date of opening. In unopened containers, the shelf life is indefinite. Periodic inspections for deterioration of containers should be made every six months.

5.25.6 Disposal data. For small spills or releases, absorb on paper towels and burn in an incinerator. Large quantities may be disposed by atomizing into an incinerator. Empty 5 gallon and 55 gallon containers should be returned to the supplier for refilling. Damaged containers should be punctured and completely drained prior to sending to salvage yard for disposal as scrap metal. Containers not salvaged should be punctured, crushed, and buried in a sanitary landfill.

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5.26 Name. TETRAETHYLENE GLYCOL DIMETHYL ETHER, $\text{CH}_3(\text{OCH}_2\text{CH}_2)_4\text{OCH}_3$, MW 222.28
Dimethoxytetraethylene Glycol
Dimethoxytetraglycol
Tetraglyme
2,5,8,11,14-Pentaoxapentadecane (SOCMA)

5.26.1 Specification. None.

5.26.2 Technical description. Tetraethylene glycol dimethyl ether is a water-white liquid with a very mild odor. Generally speaking, it is considered quite inert. However, this compound is affected by certain chemicals because of activation by the ethylene-oxygen linkage. This material is miscible with acetone, benzene, ethanol, ether, octane, or water. The acidity shall be not more than 0.015 percent as acetic acid; the hydrogen content shall be not more than 0.5; and it shall have 0.2 percent maximum water content.

Physical constants of tetraethylene
glycol dimethyl ether

<u>Property</u>	<u>Constants</u>
Autoignition temperature	610°C
Boiling point (760 mm)	275.8°C
Flash point (open cup)	140.5°C
Freezing point	-29.7°C
Refractive index (20°C)	1.4322
Specific gravity (20°/20°C)	1.0132
Vapor pressure (20°C)	0.01 mm
Viscosity (20°C)	0.0405 poise

5.26.3 Use data. Tetraethylene glycol dimethyl ether, technical is intended for military use as a solvent. Typical commercial applications include use as a solvent, in dust control, and to remove carbon dioxide from gas mixtures which are utilized in ammonia synthesis.

5.26.4 Packaging data and labeling. Tetraethylene glycol dimethyl ether is packaged in 1 gallon and 5 gallon cans conforming to specification PPP-C-96, Type V, Class 4 and in 55 gallon drums conforming to Type I or II, specification PPP-D-729. There are no DOT shipping regulations for this material.

5.26.5 Storage data. Store in tightly closed containers in a dark, dry, cool area. This material can be stored indefinitely if not exposed to elevated temperatures. Containers shall be inspected every six months for corrosion or deterioration.

5.26.6 Disposal data. For small spills or releases, absorb on paper and burn in an incinerator. For large quantities, atomize into an incinerator. Quantities which have been used as solvent should be recovered, if possible,

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for reprocessing. If not recoverable, atomize into an incinerator. Empty 5 gallon and 55 gallon containers should be returned to the supplier for reprocessing and refilling. Damaged and nonsalvaged containers should be incinerated prior to sending to the salvage yard for disposal as scrap metal or prior to crushing and burying in an approved sanitary landfill.

5.27 Name. TRIBUTYLAMINE (SOCMA), $C_{12}H_{27}N$, MW 185.35
Tri-n-butylamine
(HAZARDOUS)

5.27.1 Specification. MIL-T-12014, Tributylamine, Normal.

5.27.2 Technical description. Tributylamine is a pale yellow liquid with an amine odor. It has a flash point of 185°F (open cup), is slightly soluble in water, soluble in most organic solvents. It is combustible, but has low toxicity. Tributylamine shall meet the following requirements.

<u>Property</u>	<u>Requirements</u>
Color	To pass test
Total alkalinity (as tributylamine)	97% min
Specific gravity (20°/20°C)	0.77 - 0.80
Boiling range	95 % min distilled between 196 to 216°C
Moisture	0.10 % max

5.27.3 Use data. Tributylamine is intended for military use as a stabilizer. Commercial uses are same, but also as a solvent and an inhibitor in hydraulic fluids.

5.27.4 Packaging data and labeling. Tributylamine is packed in tank cars or in 55 gallon drums in accordance with specifications listed in section 5 of MIL-T-12014. All containers shall be marked in accordance with MIL-STD-129. In addition each container shall be labeled with name, specification number, manufacturer, lot number, and date of manufacture.

5.27.5 Storage data. Store in an area at room temperature away from oxidizing materials. Keep containers closed. Under these conditions the shelf life is six months. Use gloves and goggles when handling. Check in storage every six months.

5.27.6 Disposal data. For small spills or releases, cover with sodium bisulfate ($NaHSO_4$) or sodium dihydrogen phosphate (NaH_2PO_4), spray with water and wash into drain with large excess of water. For large quantities, atomize into an incinerator equipped with sufficient controls to meet applicable emission standards. Empty containers should be returned to supplier for refilling. Damaged and non-salvaged containers should be punctured and incinerated prior to sending to the nearest salvage yard for sale as scrap

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metal or prior to crushing and burying in an approved sanitary landfill.

5.28 Name. TRIETHANOLAMINE, $(\text{HOCH}_2\text{CH}_2)_3\text{N}$, MW 149.19
2,2',2''-Nitrilotriethanol (IUPAC) (SOCMA)
Trihydroxytriethylamine
(HAZARDOUS)

5.28.1 Specification. MIL-E-50011, Ethanolamines (Monoethanolamine, Diethanolamine, Triethanolamine).

5.28.2 Technical description. Triethanolamine, technical is a colorless, very hygroscopic, clear, viscous liquid. It is miscible with water or alcohol, is soluble in chloroform, and is slightly soluble in benzene or ether. It turns brown on exposure to air and light.

Chemical and physical requirements of triethanolamine

<u>Property</u>	<u>Requirements</u>
Appearance	Substantially free of suspended matter
Iron content, max	0.003%
Triethanolamine content	98%
Monoethanolamine content, max	1.0%
Diethanolamine content, max	1.5%
Specific gravity 20°/20°C	1.124 - 1.129
Water content, max	1.0%

Physical constants of Triethanolamine

<u>Property</u>	<u>Constants</u>
Boiling point	360°F (183.0°C)
Flash point (open cup)	375°F (190.5°C)
Melting point (open cup)	20 to 21.2°C
Refractive index (25°C)	1.484
Viscosity (25°C)	600.7 centipoises

5.28.3 Use data. Triethanolamine, technical is intended for military use as an organic base corrosion inhibitor in pipes, radiators, and boilers. Typical commercial applications include use in cosmetics, polishes, waxes, cleaners, solvent, emulsifiers, water repellents, wetting agents, and anti-fume agents.

5.28.4 Packaging data and labeling. Triethanolamine is packaged in 5 gallon unit quantity pails conforming to Type I or II, Class 2, specification PPP-P-704. There are no DOT shipping regulations for this material. Each container shall be plainly marked with the following warning label.

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TRIETHANOLAMINE
WARNING! CAUSES BURNS

Do not get into eyes. Causes severe eye burns. Keep away from heat and open flame. Avoid breathing vapor. Do not take internally. Wear goggles when handling. In case of contact, flush eyes with plenty of water for at least 15 minutes and obtain medical attention immediately.

5.28.5 Storage data. Store in tightly closed containers in a cool, dry area away from definite fire hazards, oxidizing materials, and direct sunlight. Under these conditions, the shelf life is indefinite. Containers should be inspected every six months for deterioration.

5.28.6 Disposal data. For small spills or releases, cover area with sodium bisulfate (NaHSO_4) or sodium dihydrogen phosphate (NaH_2PO_4), spray with water and wash into drain with large excess of water. For large quantities mix with alcohol and atomize into an incinerator equipped with sufficient controls to meet applicable emission standards. Drums are to be returned to the suppliers or contractors for refilling. Prior to returning drums, completely drain contents and tighten bungs with gaskets securely in-place. If gaskets are damaged, use new gaskets. Wash outside stains with water before starting return movement in accordance with DOT regulations. Damaged containers should either be punctured and incinerated or rinsed with a 20 percent sodium bisulfate solution equal to 20 percent of the container volume and allowed to stand for 2 hours before draining to the sanitary sewer with a large excess of water. The container should be rinsed a second time using clear water. The rinsed or incinerated container can be sent to the nearest salvage yard, to be sold as scrap metal or be crushed and buried in a sanitary landfill. Personnel involved in incinerating or decontaminating operations should wear butyl rubber gloves and aprons, coveralls, and approved self-contained breathing apparatuses equipped with full-face piece.

5.29 Name. TRIETHYLAMINE, (SOCMA), $\text{C}_6\text{H}_{15}\text{N}$, MW 101.19
(HAZARDOUS)

5.29.1 Specification. None.

5.29.2 Technical description. Triethylamine is a colorless liquid, with a strong ammoniacal odor. Triethylamine has a flash point of 20°F , hence it is highly flammable and a dangerous fire risk. Triethylamine shall conform to the following requirements.

Property	Requirements
Assay (% min triethylamine)	98.5
Specific gravity ($20^\circ/20^\circ\text{C}$)	0.726 to 0.730
Boiling range $^\circ\text{C}$	88 to 90
Freezing point	-115.30°C
Solubility	Miscible w/water below 18°C Soluble in alcohol

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5.29.3 Use data. Triethylamine is intended for military use as a corrosion inhibitor in water systems and in chlorinated solvents. Commercial uses are catalytic solvent in chemical synthesis; accelerator activators for rubber; wetting, penetrating and water proofing agents of quaternary ammonium types; curing and hardening of polymers and propellant.

5.29.4 Packaging data and labeling. Triethylamine shall be packaged in 5 gallon unit quantities in pails of a suitable type under specification PPP-P-704 or of a type conforming to commercial practice. Each container shall bear a DOT red label for flammable liquid in addition to the danger label as follows.

DANGER! HIGHLY FLAMMABLE
RED LABEL REQUIRED

Keep away from heat and open flame, oxidizing materials, or acid. Highly toxic by ingestion and inhalation, strong irritant to tissue. In case of contact with eyes, wash out with plenty of water. Get medical attention at once. In case of inhalation or ingestion, get medical attention at once.

In addition, each container shall be labeled with the name, Federal Stock Number, manufacturer, lot number, and date of manufacture.

5.29.5 Storage data. Store in a cool area where temperature does not get above 70°F. Keep containers closed and away from heat, open flame, oxidizing materials, and acid. Under these conditions the shelf life is six months or more based on test and experience by manufacturer. Check containers every six months. Use goggles and gloves when handling.

5.29.6 Disposal data. In case material is spilled, absorb on paper and allow to evaporate under a hood. Burn the paper in an incinerator. Disposal of large quantities should be by qualified personnel in a remote location by detonation. A small explosive charge is used to open and ignite the triethylamine vapors. Explosive Ordnance Disposal (EOD) personnel should determine the amount to be disposed at a given time in accordance with their Range Safety and Movement regulations. Movement of triethylamine from a storage location to a range for disposal must be in accordance with existing DOT regulations, as well as state and local regulations. The Technical Escort Center, if requested, is available to assist in the disposal of this material. AR 740-32 outlines the procedures necessary to obtain their services. Liaison may be established with their disposal office by telephone AUTOVON 584-2653, or the Operations Officer on AUTOVON 584-3601.

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

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CUSTODIANS: ARMY - EA
NAVY - YD
AIR FORCE - 68

PREPARING ACTIVITY: ARMY - EA

REVIEW ACTIVITIES: ARMY - MD, ME, MU, WC

USER ACTIVITIES: NAVY - MC, SH

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