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ORGANIC ACIDS, TECHNICAL GRADE



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DEPARTMENT OF DEFENSE
Washington, D.C. 20301

Organic Acids, Technical Grade

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

FOREWORD

This standard is approved for use by all departments and agencies of the Department of Defense in the selection of items for application. It is intended to prevent the entry of unnecessary items (sizes, types, varieties) into the Department of Defense logistics system. This is not a procurement document. 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 and requirements, military and typical commercial uses, directions for use, packaging data, labeling, general safety precautions, storage information, shelf life, and disposal instructions for military standard organic acids. This standard does not necessarily include all classification 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 organic acids for application by the Department of Defense. This standard covers twenty-two 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 where 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-A-76	Acetic Acid, Glacial, Technical
O-P-281	Phenol, Technical
O-G-491	Glycerol Technical (High Gravity)
O-O-690	Oxalic Acid, Dihydrated, Technical
PPP-B-621	Box, Wood, Nailed and Lock Corner
PPP-D-723	Drum, Fiber
PPP-P-704	Pail, Metal (Shipping, Steel, 1 through 12 Gallon)
PPP-B-1806	Barrels and Kegs, Wood Slack
PPP-C-2020	Chemicals, Liquid, Dry and Paste, Packaging of

Military Specifications

JAN-A-187	Acid, Picric (Trinitrophenol)
MIL-S-271	Stearic Acid, Technical
MIL-M-10452	Monochloroacetic Acid, Technical
MIL-C-11029	Citric Acid, Monohydrate, Technical
MIL-C-13246	Cresylic Acid, Technical
MIL-E-50008	2-Ethylhexoic Acid, Technical

Military Standards

MIL-STD-129	Marking for Shipment and Storage
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Rules and Regulations

DOT Shipping Regulations, Title 49-Chapter I of the Code of Federal Regulations

3. GLOSSARY

3.1 Definitions.

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).

Colloid - A solid, liquid or gaseous substance made up of very small, insoluble, non-diffusible particles that remain in suspension in a surrounding solid, liquid or gaseous medium of different matter.

Density - The concentration of matter measured by the mass per unit volume.

Densensitizer - To take away the sensitivity of; make less sensitive as in the manufacture of ammunition.

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

Freezing point - The temperature at which a liquid and a solid exist in equilibrium and transition from liquid to solid occurs.

Incendiary - Chemicals such as white phosphorous which burst into flame or ignite at a given point or upon detonation of shells, bombs, and missiles.

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

Miscible - The property of liquids and gases which enables them to be mutually soluble in all proportions.

Peptizing - Bringing into colloidal solution.

Quebracho - A tropical tree whose wood yields an extract used in tanning.

Phenolic - A synthetic resin, usually one made by the reaction of phenol with an aldehyde.

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. In this standard, the refractive index of each substance is reported for the D line of the spectrum of sodium (n_D).

Specific gravity - The ratio of the mass of a body to the mass of an equal volume of water at 4°C or other specified temperature. In this standard, the first temperature indicates the temperature of the substance and the second indicates the temperature of the water it is referred to. If there is no mention of the temperatures, (20/4°C) is understood.

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.

Threshold limit values - Refers to air-borne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, exposure at or even below the threshold limit for a substance may not prevent, discomfort, aggravation of a pre-existing condition or occupational illness. Threshold limits should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations.

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

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

BP - Boiling point

C - Celsius (Centigrade)

DOT - Department of Transportation

F - Fahrenheit

FP - Freezing point

g - gram

IUPAC - International Union of Pure and Applied Chemistry

lb - pound

max - maximum

MIL-STD - Military Standard

min - minimum

mm - millimeter

MP - Melting point

MW - Molecular weight

SOCMA - Synthetic Organic Chemical Manufacturers Association

SP GR - Specific gravity

TLV - Threshold limit values

USS - United States Standard

4. GENERAL REQUIREMENTS

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

4.2 Nomenclature. All chemicals in this standard conform to the military definition of technical grade as set forth under section 3.1. The Department of Defense basic names are in capital letters. To form the Defense item name use the basic name followed by the modifier TECHNICAL (e.g. STEARIC ACID, 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).

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4.3 Packaging data and labeling. All liquid chemicals, included in this standard, shall be packaged in accordance with Federal Specification PPP-C-2020 and all applicable documents mentioned in this specification. All dry and paste chemicals, included in this standard, shall be packaged in accordance with Federal Specification PPP-C-2020 and all applicable documents mentioned in this specification. This Military Standard takes precedence, where applicable, over the documents referenced in Section 2, relative to labeling or other instructions except DOT Shipping Regulations Title 49, Chapter I, CFR. In case of conflict between the labeling or other instructions set forth in this publication and those required by the individual Federal or Military specification for each item (when existant) the instructions provided herein shall apply.

4.4 Safety. All hazardous chemicals in this standard are indicated as such immediately beneath each item name. General safety and hygenic measures should be exercised in the handling and the use of all chemicals. Contaminated containers must be handled with caution. Damaged containers must be emptied before disposal. For more specific information on hazardous chemicals the appropriate safety and medical authorities must be consulted in order to determine personal protective measures and enviromental controls.

4.5 Shelf life. Factors such as moisture, temperature, type and condition of container, exposure to sunlight and the atmosphere cause variations in shelf life. Ideal storage conditions are outlined for each item. An approximate period after which the material will no longer be suitable for its intended use is also presented. The term "cool" denotes temperatures from above freezing up to 70° F (21°C), but not consistantly over 80° (27°C) 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 contents 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 be the latest date of manufacture when purchased.

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

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

4.8 Toxicity data. Toxicity data is determined from the Handbook of Toxicity, American Conference of Governmental Industrial Hygienists and Material Safety Data Sheets.

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

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

4.11 Disposal. To minimize disposal problems, it is recommended that no more than one year supply of each item listed in this MIL-STD be stocked. Should excess stocks occur, it is recommended that the stocks be reported through supply channels as excess to current requirements and request disposition instructions for the excess stocks. When stocks have been declared excess to

DOD requirements, every effort should be made to dispose the stocks through property disposal channels. Disposal data are intended as guidelines to assist on practical and proper disposal management actions for small spills and leaks of issue described. For assistance on large spills that grossly contaminate the environment, call the Chemical Transportation Emergency Center (CHEMTREC) at 800-424-9300, a toll free number. Before applying the disposal methods for each section, it should be coordinated with the installation's Environmental Coordinator for the applicability to State and local requirements. In all cases where the wastes are to be collected, stored, transported and disposed of at a State permitted disposal facility, every effort should be made to retain the identity of the waste.

4.11.1 Destruction/Ultimate Disposal. Contact the installation's Environmental Coordinator on the appropriate method to use. The options that are available are:

4.11.1.1 Incineration. Disposal operations involving the atomization of materials into an incinerator should be coordinated with appropriate facilities engineering and safety officers, and performed in accordance with the Clean Air Act (PL 91-604 and PL 95-95). Care should be taken to eliminate or minimize exposure to toxic material as well as fire or explosion hazards. Proper atomization equipment and controls should be employed to insure that incinerator design temperature is not exceeded. Incineration requirements should be made on a case-by-case basis to ensure that Federal, State and local standards are met.

4.11.1.2 Land burial. Use a permitted chemical waste landfill designed, constructed and operated in accordance with rules and regulations promulgated under the Authority of Resource Conservation and Recovery Act, (PL 94-580, Subtitle C, Hazardous Waste Management).

4.11.1.3 Neutralization. Neutralize to pH 6-8 using a neutralizing solvent as specified by the Environmental Coordinator. Dilute as appropriate with clean tap water and discharge to the sanitary sewer in accordance with the requirements in section 402 of the Clean Water Act (PL 95-500), titled National Pollution Discharge Elimination System (NPDES).

4.11.2 Cleaning Containers. Empty containers will be rinsed and cleaned with a suitable solvent before disposal. Accumulated rinse solutions will be neutralized to pH 6 to 8 using a neutralizing solvent. (The appropriate solvent, rinsing requirements and specific instructions should be worked out with the installation's Environmental Coordinator). The clean containers should be crushed and buried in a sanitary landfill that is designed, constructed and operated in accordance with Title 40, Code of Federal Regulations (CFR) 1977 ed., Part 241, Guidelines for the Land Disposal of Solid Wastes or incinerated in accordance with 40 CFR, 1977 ed., Part 240, Guidelines for the Thermal Processing for Solid Wastes. Empty containers should be kept open or punctured before incineration to prevent explosion.

4.11.3 Technical Assistance. Pollution abatement guidance can be requested from the installation's Environmental Coordinator, who together with the major command's (MACOM) Environmental Coordinator and other appropriate environmental organizations, can provide assistance when an installation's disposal facilities are inadequate.

4.12DISCLAIMER. RECOMMENDED DISPOSAL INSTRUCTIONS ARE FORMULATED FOR USE BY ELEMENTS OF THE DEPARTMENT OF DEFENSE. THE UNITED STATES OF AMERICA IN NO MANNER WHATSOEVER EITHER EXPRESSLY OR IMPLIEDLY WARRENTS, STATES OR INTENDS SAID INSTRUCTION, TO HAVE ANY APPLICATION, USE, OR VIABILITY BY OR TO ANY PERSON OR PERSONS OUTSIDE THE DEPARTMENT OF DEFENSE OR ANY PERSON OR PERSONS CONTRACTING WITH ANY INSTRUMENTALITY OF THE UNITED STATES OF AMERICA AND DISCLAIMS ALL LIABILITY FOR SUCH USE. ANY PERSON USING THESE INSTRUCTIONS WHO IS NOT A MILITARY OR CIVILIAN EMPLOYEE OF THE UNITED STATES OF AMERICA SHOULD SEEK

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COMPETENT PROFESSIONAL ADVICE TO VERIFY AND ASSUME RESPONSIBILITY FOR THE SUITABILITY OF THESE INSTRUCTIONS TO THEIR PARTICULAR SITUATION REGARDLESS OF SIMILARITY TO A CORRESPONDING DEPARTMENT OF DEFENSE OR OTHER GOVERNMENT SITUATION.

5. DETAIL REQUIREMENTS

5.1 Name, ACETIC ACID, GLACIAL CH_3COOH MW 60.05
 Ethanoic Acid
 Methane Carboxylic Acid
 Vinegar Acid
 (HAZARDOUS)

5.1.1 Specifications. O-A-76, Acetic Acid, Glacial, Technical

5.1.2 Technical description. Glacial acetic acid is a clear, colorless liquid with a pungent odor. It is hazardous and is classified as a corrosive material. The commercially available acid is about 99.5%, the balance being water. The freezing point is 16.7°C and the material contracts slightly on freezing. It is an excellent solvent for many organic compounds, also phosphorus, sulfur, and halogen acids. Miscible with water, alcohol, ether, carbon tetrachloride; insoluble in carbon disulfide.

5.1.3 Use data. Glacial acetic acid is intended for military use as a general neutralizing and acidifying agent and as a solvent for essential oils, resins, etc. Typical commercial applications include use in the manufacture of various acetates, acetyl compounds, plastics and rubber; in tanning; as a laundry sour; printing calico and dyeing silk; preserving foods; solvent for gums, resins, volatile oils and many other substances. Widely used in commercial organic syntheses.

5.1.4 Packaging data and labeling. For military use glacial acetic acid is packaged in a 5-lb (2.27 kg) unit quantity glass bottle, and a 450-lb (204.3 kg), 55-gallon (206.25 liters) unit quantity drum. Each container bottle or drum is labeled in accordance with the Federal Caustic Poison Act. In addition, each container shall be labeled and marked in accordance with MIL-STD-129, Title 49, CFR Parts 100-199 and each container shall bear the following label:

ACETIC ACID, GLACIAL
 DANGER! CAUSES SEVERE BURNS

Do not get liquid or vapor in eyes, on skin, on clothing.
 In case of contact, immediately flush skin or eyes with
 plenty of water for at least 15 minutes; for eyes
 get medical attention.

Store in area maintained above 62°F (16.7°C)

If frozen thaw by carefully moving container to warm area.

TLV for acetic acid is 10 ppm or 25 mg/m^3

5.1.5 Storage data. Glacial acetic acid should be stored in a warm dry area away from sources of heat or flame. Containers should be kept tightly closed and plainly labeled. When stored under ideal conditions, this material has an indefinite shelf life.

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5.1.6 Disposal data. For appropriate disposal procedures contact the installation's Environmental Coordinator. In all cases every effort should be made to recover usable products from the waste material.

5.2 Name. ADIPIC ACID $C_6H_8O_4$, MW 146.14
Hexanedioic Acid (IUPAC)
1,4-Butanedicarboxylic Acid

5.2.1 Specifications. None.

5.2.2 Technical description. Adipic acid is a white, odorless powder with a melting point of $153^{\circ}C$ and a boiling point of $333^{\circ}C$, where it decomposes. Its density is 1.36 g/cm^3 . It is soluble in water, alcohols, and acetone, and slightly soluble in benzene and petroleum ether, and it is insoluble in ether. Since adipic acid is a dicarboxylic acid, its dissociation constants are $K_1 = 3.7 \times 10^{-5}$; $K_2 = 3.9 \times 10^{-5}$

5.2.3 Use data. Adipic acid has a possible military use as an intermediate in the preparation of a high temperature lubricant for jet engines. Typical commercial uses are manufacturing of artificial resins, plastics (nylon), and urethane foams. It is used in baking powders instead of tartaric acid, cream of tartar, and phosphates because adipic acid is not hygroscopic.

5.2.4 Packaging data and labeling. For military use adipic acid is packaged in multi-walled bags containing 50-lbs (22.7 kg) and pillar-pacs containing 2000-lbs (908 kg). Since adipic acid is non-toxic, it requires only ordinary industrial precautions.

5.2.5 Storage data. Solid adipic acid and its aqueous solutions are corrosive to mild steel at ordinary temperatures. Corrosion is accelerated at elevated temperatures. Molten acid and hot aqueous solutions can be handled satisfactorily in stainless steel. Dry acids can be stored and moved in aluminum equipment. The wet acid can be handled in equipment lined with epoxy and modified polyurethane coatings.

5.2.6 Disposal data. See section 5.1.6.

5.3 Name. BENZOIC ACID, (IUPAC) $C_7H_6O_2$, MW 122.12
Phenyl Formic Acid
Benzene Carboxylic Acid

5.3.1 Specifications. None

5.3.2 Technical description. Benzoic acid is a white or yellowish-pinkish white crystalline flake with a slight odor suggestive of benzaldehyde. Its melting point is $122^{\circ}C$, and its boiling point is $249.2^{\circ}C$. It has a density of 1.08 g/cm^3 and a refractive index of 1.5387. Its solubility in different solvents at $25^{\circ}C$, g/100 ml are as follows:

Water	0.95
Water at $95^{\circ}C$	6.80
Carbon Tetrachloride	4.14
Toluene	10.6
Methanol	71.5
Benzene	12.17
Chloroform	15.02

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Acetone 55,60
Ethyl Ether 40,8
Ethanol
(Absolute) 58,4

Benzoic acid has a flash point of 121.1°C, and a dissociation constant of 6.4×10^{-5} at 25°C.

5.3.3 Use data. Benzoic acid has a possible military use as an effective corrosion inhibitor by reducing the tendency of many metals to corrode in various environments. Typical commercial uses are in the preserving of foods, fats, fruit juices & alkaloidal solutions. In the manufacturing of benzoates and benzoyl compounds, dyes, and as a mordant in calico printing and finally as an additive for curing tobacco.

5.3.4 Packaging data and labeling. For possible military use benzoic acid, technical is supplied as flake in 50-lb (22.7 kg) bags per disposable shrink-wrapped pallet. Since benzoic acid is non-toxic, it requires only ordinary industrial precautions. It could be irritating to the skin in some cases, thus prolonged contact should be avoided, as should ingestion.

5.3.5 Storage data. Benzoic acid should be stored in tightly closed containers.

5.3.6 Disposal data. See section 5.1.6

5.4 Name. CITRIC ACID, MONOHYDRATE (IUPAC), $\text{HOOCCH}_2\text{C}(\text{OH})(\text{COOH})\text{CH}_2\text{COOH} \cdot \text{H}_2\text{O}$
MW 210.14
2-Hydroxy-1,2,3-propanetricarboxylic acid
B-Hydroxytricarballic acid

5.4.1 Specifications. MIL-C-11029, Citric Acid, Monohydrate, Technical

5.4.2 Technical description. Citric acid, monohydrate occurs as colorless translucent crystals, or as a white granular to fine crystalline powder. It is odorless with a strong acid taste and is efflorescent in dry air. The specific gravity is 1.542 g/cm³. It is very soluble in water and alcohol. It is also soluble in ether.

TABLE I
Chemical and Physical Requirements
of Citric Acid, Monohydrate

Property	Requirements
Form	Crystal
Assay	99% by weight
Granulation	
USS Sieve Size 4	5% max retained
USS Sieve Size 50	5% max pass

5.4.3 Use data. Citric acid, monohydrate is intended for military use as a cleaning agent in applications such as distillation equipment sets and may be used to prevent solidification (setting) of bleach slurry. Commercial uses are sequestering agent, including water conditioning and cleaning and polishing agent for stainless steel and other metals, alkyd resins and mordant.

5.4.4 Packaging data and labeling. Citric acid shall be packaged in 50-lb (22.7 kg) net quantities in fiber drums conforming to specification PPP-D-723, or 5 gallon (19 liters) pails conforming to PPP-P-704. Each drum shall be labeled with the name, specification number, disposal (Continued)

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instructions as in paragraph 5.4.6, manufacturer, lot number and date of manufacture.

5.4.5 Storage data. Store in a cool, dry place. The shelf life is considered to be indefinite.

5.4.6 Disposal data. See section 5.1.6.

5.5 Name. CRESYLIC ACID
(HAZARDOUS)

5.5.1 Specifications. MIL-C-13246, Cresylic Acid, Technical

5.5.2 Technical description. Cresylic acid is the trade designation for commercial mixtures of phenol materials boiling above the cresol range. This chemical is a colorless to a yellowish liquid with a specific gravity of 1.0336 to 1.0645 g/cm³. Cresylic acid consists of phenols, cresols, xylenols and higher phenols in various proportions, according to its source and boiling range. Moisture content, maximum percent by weight is 1.0, and oil and naphthalene content, maximum percent by weight is 0.25.

TABLE II
Physical Properties of
Cresylic Acid, Technical

Distillation (percent)	At temperature (°C)	
	(min)	(max)
5.0	180	208
50.0	-	212
95.0	-	225
Dry Point	-	230

5.5.3 Use data. Cresylic acid is intended for military use as a peptizing agent in incendiary oils and flame thrower fuels. Typical commercial applications include use for tricresyl phosphate, disinfectants, metal cleaning compounds, phenolic resins, flotation agents, surfactants, chemical intermediates, oil additives, wire enamel solvent, solvent refining of lubrication oils, scouring compounds, detergents and pesticides.

5.5.4 Packaging data and labeling. Cresylic acid, technical grade is packaged for military use in one-gallon (3.785 liter) unit quantity plastic bottles and 55-gallon (206.25 liters) unit quantity lined, low carbon, steel drums. Each package and shipping container shall bear the following label:

CRESYLIC ACID
WARNING! HARMFUL IF SWALLOWED
CAUSES SKIN IRRITATION

Avoid breathing vapors.
Avoid contact with skin and eyes.
Do not take internally.
Keep away from feed or food products.
In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes, get medical attention.

5.5.5 Storage data. Store material in a cool, ventilated area away from sources of heat or flame. Containers should be kept tightly closed and plainly labeled. When stored under ideal conditions the shelf life should be five years from the date of manufacture.

5.5.6 Disposal data. See section 5.1.6

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5.6 Name. 2-ETHYLHEXOIC ACID, (SOCMA)
2-Ethylhexanoic Acid (IUPAC)
(HAZARDOUS)

5.6.1 Specifications. MIL-E-50008, 2-Ethylhexoic Acid, Technical

5.6.2 Technical description. 2-Ethylhexoic acid is a mild-odored liquid. It is slightly soluble in water with a freezing point of -83°C and weighs 7.6 pounds per gallon (3.45 kg per 3.785 liters) at 20°C .

TABLE III
Chemical and Physical Requirements
of 2-Ethylhexoic Acid

Property	Requirements	
	Minimum	Maximum
Specific gravity $20^{\circ}\text{C}/20^{\circ}\text{C}$ (g/cm^3)	0.904	0.909
Color (Pt-Co Standard)	No darker than 50	No darker than 50
Distillation, 760 mm		
Initial BP, $^{\circ}\text{C}$	222	---
5 ml $^{\circ}\text{C}$	224	---
95 ml $^{\circ}\text{C}$	---	230
Purity, percent by weight	95	---

5.6.3 Use data. 2-Ethylhexoic acid is intended for military use as a peptizer in the preparation of incendiary oil thickeners. Typical commercial applications of this material include use as herbicides, and pesticides. Its metallic salts, particularly lead, manganese, cobalt, and zinc are used as high quality paint and varnish driers. Ethylhexoates, of light metals such as lithium, magnesium, calcium, and aluminum have the property of jelling agent for liquid hydrocarbons such as gasoline and common petroleum fractions used in coating thinners. High molecular weight esters of this acid are also especially useful as plasticizers.

5.6.4 Packaging data and labeling. 2-Ethylhexoic acid shall be packaged for military use in oblong, interior lined or coated, one-gallon (3.785 liters) unit quantity cans, both ends double seamed with formed-type bridge handles. The screw-cap closure shall be provided with inner seals and self-shrinking plastic overseals, and internal surfaces shall be lined or coated with the same material as used for lining or coating the internal surfaces of the can. Each can shall be labeled as follows:

CAUTION! LIQUID CAUSES EYE AND SKIN IRRITATION
Avoid contact with eyes or skin.
In case of contact with eyes or skin,
immediately flush with plenty of water for
at least 15 minutes; for eyes, get medical
attention.

In addition, each can shall be labeled with the name, specification number, Federal Stock Number, disposal data as outlined in paragraph 5.1.6, manufacturer, lot number, and date of manufacture.

5.6.5 Storage data. Store in a cool place away from areas of acute fire hazard and powerful oxidizing agents. Heat has no appreciable effect below the boiling point (222°C). The material will freeze at -83°C but it is not degraded by thawing. This material will develop a color if stored in contact with iron, otherwise the shelf life is indefinite.

5.6.6 Disposal data. See section 5.1.6.

5.7 Name. FORMIC ACID, CH_2O_2 , MW 46.03 (IUPAC)

Methanoic Acid
(HAZARDOUS)

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5.7.1 Specifications. None.

5.7.2 Technical description. Formic acid is a colorless liquid with a sharp odor. Its refractive index is 1.3714 and its density is 1.22 g/cm³. It has a melting point of 8.4°C and a boiling point of 100.7°C. It is infinitely soluble in water, ether, and alcohol and its dissociation constant is 1.8×10^{-4} , with a flash point of 160°F (71.1°C) (open cup) and a freezing point of 1.1°C or 34°F. Formic acid is hazardous and is classified as a corrosive material.

5.7.3 Use data. Formic acid has a possible military use for electroplating. Some typical commercial uses are as a reducer in dyeing wool fast colors, in dehairing and plumping hides, tanning, in regenerating old rubber, and finally in chemical analysis.

5.7.4 Packaging data and labeling. For military use formic acid is packaged in a 5-lb (2.27 kg) unit quantity glass bottle, and a 450-lb (204.3 kg), 55-gallon (206.25 liter) unit quantity drum. Each bottle or drum is labeled in accordance with the Federal Caustic Poison Act. In addition, each container shall be labeled and marked in accordance with MIL-STD-129, Title 49, CFR Parts 100-199 and each container shall bear the following label:

FORMIC ACID

DANGER! CAUSES SEVERE BURNS

Do not get liquid or vapor in eyes, on skin, on clothing. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes get medical attention. Store in area maintained above 62°F (16.7°C). If frozen, thaw by carefully moving container to warm area.

The TLV for formic acid vapor is 5 ppm and for formic acid mist is 9 mg/m³.

5.7.5 Storage data. Formic acid 90% is corrosive to carbon steel, copper alloys and lead compounds. It should be stored in a warm dry area away from sources of heat or flame and well ventilated. When stored under ideal conditions, this material has an indefinite shelf life. It is recommended that formic acid be stored in stainless steel containers.

5.7.6 Disposal data. See section 5.1.6.

5.8 Name. FUMARIC ACID, C₄H₄O₄, MW 116.07
Trans-Butenedioic Acid
1,2-Ethylene Dicarboxylic Acid (IUPAC)

5.8.1 Specifications. None.

5.8.2 Technical description. Fumaric acid is a white odorless crystalline powder. Its solubility in different solvents at 25°C. g/100 ml are as follows:

Acetone	1.7
Benzene	0.003
Carbon Tetrachloride	0.03
Chloroform	0.02
Ethanol	5.5
Ethyl Ether	0.7
Water	0.7
Water at 100°C	9.8
Xylene	0.03

It has a melting point of 286 - 288°C (sealed tube) and a boiling point of 290°C (sealed tube) or a sublimation point of 200°C. The specific gravity at 20°C is 1.635 g/cm³ and its dissociation constants in H₂O at 25°C is $K_1=1 \times 10^{-3}$, $K_2=3 \times 10^{-5}$.

5.8.3 Use data. Fumaric acid has a possible military use as a viscosity index improver, and pour-point depressants for lubricating oils. Typical commercial uses are the production of polyesters, modified alkyds, upgrading drying oils and rosin adducts. Substitute for tartaric acid in beverages and baking powders. As an antioxidant, and as a mordant in dyeing.

5.8.4 Packaging data and labeling. For possible military use fumaric acid, technical is supplied as fine granular powder in 250-lb (113.5kg) drums and 50-lb (22.7 kg) bags. Since fumaric acid is non-toxic it requires only ordinary industrial precautions.

5.8.5 Storage data. Fumaric acid should be stored under cool temperatures. Care should be taken to avoid contact with the eyes or nasal passages. Masks may be necessary in handling. If acid does come in contact with eyes or hands, thorough rinsing is essential.

5.8.6 Disposal data. See section 5.1.6

5.9 Name. GLYCEROL, C₃H₈O₃, MW 92.1
Trihydroxypropane
1,2,3-Propanetriol (IUPAC)

5.9.1 Specifications. O-G-491, Glycerol, Technical (High Gravity)

5.9.2 Technical description. Glycerol is a colorless, odorless liquid with a boiling point of 290°C, where it decomposes, and a melting point of 18.6°C. Its refractive index is 1.4746 and its density is 1.2613 g/cm³. It is infinitely soluble in water and alcohol, and slightly soluble in ether, and it is insoluble in benzene, chloroform, petroleum ether, carbon tetrachloride, and carbon disulfide.

TABLE IV
Chemical and Physical Requirements
of Glycerol

Property	Requirements
Appearance	Clear and free of suspended matter
Odor	Slight, or conforming to sample agreed upon by procuring activity and contractor
Color	Not darker than standard
Specific gravity at 25°C/25°C (g/cm ³)	Not less than 1.2587
Acidity or alkalinity	50 ml shall require not more than 0.30 ml of N HCl or of N NaOH for neutralization
Ash	Not greater than 0.10 percent
Chlorides, calculated as Cl	0.01 percent maximum
Saponification equivalent	Not greater than 0.05 percent
Silver nitrate precipitation	No precipitate formed in 10 minutes

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5.9.3 Use data. Glycerol has a possible military use as a lubricant, and manufacture of explosives. Typical commercial uses are as a solvent, plasticizer, lead oxide cements, keep frost from windshields, anti-freeze in automobiles, gas meters, hydraulic jacks, and in shock absorber fluids.

5.9.4 Packaging data and labeling. For military use glycerol, technical, is supplied in 55-gallon (206.25 liter) drums, 5 gallon (18.925 liter) pails, and 1 gallon (3.785 liter) and 55 gallon (206.25 liter) containers. Since glycerol is non-toxic, it requires only ordinary industrial precautions.

5.9.5 Storage data. Glycerol presents no unusual storage problems other than protection of the containers from becoming contaminated.

5.9.6 Disposal data. See section 5.1.6.

5.10 Name. MONOCHLOROACETIC ACID, $\text{Cl}\cdot\text{CH}_2\text{COOH}$, MW 94.5
Chloroacetic Acid (SOCMA)
Chloroethanoic Acid
(HAZARDOUS)

5.10.1 Specifications. MIL-M-10452, Monochloroacetic Acid, Technical.

5.10.2 Technical description. Monochloroacetic acid is deliquescent solid. The density is 1.58 g/cm^3 at $20/20^\circ\text{C}$. The commercial material melts at 61 to 63°C . The boiling range is 186 to 191°C . It is soluble in water, alcohol, ether, chloroform, and carbon disulfide. Monochloroacetic acid is hazardous and is classified as a corrosive material.

TABLE V
Chemical and Physical Requirements
of Monochloroacetic Acid

Form	Crystalline
Color	Colorless to light brown
Freezing Point	60.0°C
Assay as $\text{Cl}\cdot\text{CH}_2\text{COOH}$	97.0% (min)
Dichloroacetic Acid	1.5% (max)
Acetic Acid	1.5% (max)

5.10.3 Use data. Monchloroacetic acid is intended for military use as a laboratory reagent. Commercial uses are herbicide, intermediate in production of carboxymethylcellulose, ethyl chloroacetate, glycine, synthetic caffeine, sarcosine, thioglycolic acid, EDTA, 2,4,-D, and 2,4,5-T.

5.10.4 Packaging data and labeling. Monchloroacetic acid shall be packaged in 1-kilogram (2.2 lb) unit quantity glass bottles. In addition, each bottle shall be labeled and marked in accordance with MIL-STD-129, Title 49, CFR Parts 100 - 199 and each container shall bear the following label:

CAUTION!

Irritating and corrosive to skin.
Avoid contact with eyes or skin.
Avoid inhalation of the dust and vapors.
In case of contact, immediately flush
with plenty of water for 15 minutes;
for eyes get medical attention.

5.10.5 Storage data. Store in a dry area at room temperature. Keep bottles closed when not in use to prevent formation of crust. Under these conditions the shelf life is indefinite.

5.10.6 Disposal data. See section 5.1.6.

5.11 Name. OXALIC ACID, DIHYDRATE, $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$, MW 126.07
Ethanedioic Acid (IUPAC)
(HAZARDOUS)

5.11.1 Specifications. 0-0-690, Oxalic Acid, Dihydrate, Technical.

5.11.2 Technical description. Oxalic acid, dihydrate, is a transparent, colorless, crystal which will effloresce in dry air. It is the simplest dibasic organic acid and among the strongest organic acids. It is moderately soluble in cold water, extremely soluble in hot water, and very soluble in alcohol and ether. The material has a specific gravity of 1.654 g/cm^3 , sublimes at 157°C , and a melting point of 101.5°C

TABLE VI
Chemical and Physical Requirements
of Oxalic Acid, Dihydrate, Technical

Assay as $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, min % by wt	99.5
Ash, max % by wt	0.20
Particle size (for class 2), % by wt	
Passing a 2000-micron (No. 10) sieve min.	100
Retained on a 500-micron (No. 35) sieve, min.	75

TLV for Oxalic Acid is mg/m^3
5.11.3 Use data. Oxalic acid is intended for military use as a laundry sour and as a floor bleach. Typical commercial applications for this material include use as an automobile radiator cleaner, acid rinse in laundries, leather tanning and processing agent, purifying agent in the manufacture of glycerol, glycolic acid, formic acid and esters, dextrin from starch purification of tartaric acid and cream of tartar, bleaching agent, photography, medicinals, dyes and inks, purifying stearin, component of metal polishes, textile treating baths, ink and rust removers, cleaning agent in breweries, precipitating agent for rare earths, wood cleaning compositions, engraving and lithography, and as a catalyst for some organic reactions.

5.11.4 Packaging data and labeling. For military use, oxalic acid, technical is packaged in one pound (.454 kg) unit quantity bottles and 100-pound (45.4 kg) unit quantity drums. Each package and shipping container shall bear the following label:

OXALIC ACID
WARNING! HARMFUL IF SWALLOWED
CAUSES SKIN IRRITATION
Avoid breathing dust.
Avoid contact with skin and eyes
Keep away from feed and food products.
In case of contact, immediately flush skin or eyes
with plenty of water for at least 15 minutes; for
eyes, get medical attention.
Do not take internally.

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5.11.5 Storage data. Store in a cool dry place away from oxidizing material and acute fire hazards. Keep containers tightly capped and plainly marked. This material is incompatible when stored in contact with iron due to the acidic nature of the product. The shelf life of the material under proper storage conditions is at least 2 years from the date of manufacture. It is recommended that annual checks be made of the material and condition of the containers.

5.11.6 Disposal data. See section 5.1.6.

5.12 Name. PHENOL, C_6H_6O , MW94.11
Carbolic Acid
Phenic Acid
Hydroxybenzene (IUPAC)
Phenylic Acid

5.12.1 Specifications. O-P-281. Phenol Technical

5.12.2 Technical description. Phenol is a colorless to light pink solid with a characteristic odor. It is classified as a poison. It has a melting point of $43^{\circ}C$ and a boiling point of $182^{\circ}C$. Its refractive index is 1.5509, and its density is 1.0722 g/cm^3 . It is soluble in water, alcohol, chloroform and carbon disulfide and is very soluble in acetone, and it has a dissociation constant of 1.1×10^{-10} .

5.12.3 Use data. Phenol has a possible military use in many medical and organic compounds. It is used commercially as a disinfectant, either in solution or mixed with slaked lime, in the manufacture of colorless or light colored artificial resins, and as a reagent in chemical analysis.

5.12.4 Packaging data and labeling. For possible military use phenol should be packaged in oblong interior lined or coated, one or 5-gallon (3.75 or 18.75 liters) cans, both ends double seamed with formed-type bridge handles. The screw-cap closure shall be provided with inner seals and self-shrinking plastic overseals, and internal surfaces shall be lined or coated with the same material as used for lining or coating the internal surfaces of the can. Each can shall be labeled with a "POISON" label and shall bear the following caution note:

CAUTION! Can cause irritation when in contact with eyes or skin. Avoid contact with eyes or skin. In case of contact with eyes or skin immediately flush with plenty of water for at least 15 minutes; for eyes, get medical attention!

The TLV for phenol in air is 5 ppm or 19 mg/m^3 .

5.12.5 Storage data. Care should be exercised when transporting material to prevent damage. Protect against physical damage in storage.

5.12.6 Disposal data. See section 5.1.6.

5.13 Name. PICRIC ACID, (IUPAC), (SOCMA), $C_6H_2(NO_2)_3OH$, MW 229.1
 2-Hydroxy-1,3,5-trinitrobenzene
 Phenol trinitrate
 Trinitrophenol
 2,4,6-Trinitrophenol
 Carbazotic acid
 Nitroxanthic acid
 Picronitric acid
 (HAZARDOUS)

5.13.1 Specification. JAN-A-187, Acid, Picric (Trinitrophenol).

5.13.2 Technical description. Picric Acid occurs as yellow crystals or liquid. It is soluble in water, alcohol, chloroform, benzene and ether. It has a very bitter taste. It has a specific gravity of 1.767 g/cm³. It explodes above 300°C. The flash point is 150°C and the autoignition temperature is 300°C. In its dry and crystal form, Picric Acid is classified as HIGH EXPLOSIVE and will explode, if subjected to shock. Picric Acid, wet, with not less than 10% water is classified as a flammable solid.

TABLE VII
 Chemical and Physical Requirements
 of Picric Acid

Property	Requirements
Color	White to yellow
Granulation	99.5% min through 1410 micron (No. 14) USS Sieve
Solidification point	1200°C min
Moisture	
Purchase dry	0.20% max by wt
Purchase wet	22.0% max by wt
Ash	0.1% max by wt
Insoluble matter	0.1% max by wt
Acidity	
Total sulfuric acid	0.1% max by wt
Nitric Acid	None
Lead	0.0004% max by wt

TLV for Picric Acid is 0.1 mg/m³

5.13.3 Use data. Picric acid is intended for military use in the manufacture of ammonium picrate and of compositions used in the loading of high explosive shells. Commercial uses include dyes; matches; electric batteries; etching copper; dyeing and printing textile fabrics with compound dyes which contain also such dyes as benzaldehyde green, methyl violet and indigo carmine; and picrates.

5.13.4 Packaging data and labeling. Must be packed in specification containers as follows: Wooden Boxes, DOT 15A with inside tightly closed glass or earthenware containers. The net weight shall not exceed 25 pounds dry weight in an outside container. Each container shall contain a minimum of 10% water to reduce explosive potential. Each container shall have a FLAMMABLE SOLID label affixed as well as markings required by MIL-STD-129 and the following warning:

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DANGER!

Avoid contact with skin or inhalation. Can cause nausea, vomiting, diarrhea, suppressed urine, yellow skin, convulsions.

Rapid first aid care is critical. Remove victim from exposure. Flush exposed skin thoroughly with water. Conscious victims should gargle with water. Give oxygen or artificial respiration as needed. Get prompt medical attention.

In addition, each container shall be marked as outlined in paragraph G2 of specification JAN-A-187, and disposal data as outlined in paragraph 5.1.6.

5.13.5 Storage data. Store in wooden boxes or kegs with a minimum of 10% water. Store away from metals, reducing materials. Avoid exposure to heat and shock. Under these conditions, the shelf life is indefinite.

5.13.6 Disposal data. See section 5.1.6.

5.14 Name. PYROGALLOL, (SOCMA), $C_6H_3(OH)_3$, MW 126.11
 1,2,3-Benzenetriol
 1,2,3-Trihydroxybenzene (IUPAC)
 Pyrogallol Acid
 (HAZARDOUS)

5.14.1 Specification. None.

5.14.2 Technical description. Pyrogallol exists as white lustrous needle or leaf-like crystals which turn gray on exposure to light. This material has a specific gravity of 1.463 g/cm³ (4/4°C), the melting point is 131-133°C, and the boiling point is 309°C. Pyrogallol is soluble in water, alcohol, or ether and is insoluble in benzene.

5.14.3 Use data. Pyrogallol is intended for use by the military as a photographic chemical and as a general reagent in analysis for oxygen and other free gases in the output of shipboard nitrogen plants. Typical commercial applications of pyrogallol include use as a protective colloid in the preparation of metallic colloidal solutions, photography, dyes, synthetic drugs, medicine, process engraving, analysis of free oxygen in air and other gas mixtures, and as an antioxidant in lubricating oils.

5.14.4 Packaging data and labeling. For military use pyrogallol is packaged in 5-lb (2.27 kg) unit quantity bottles, and in bulk quantity. Each container shall bear the following label:

PYROGALLOL
 WARNING! HARMFUL IF SWALLOWED
 CAUSES SKIN IRRITATION

Avoid breathing dust.

Avoid contact with skin and eyes.

Do not take internally.

Keep away from feed or food products.

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes, get medical attention.

5.14.5 Storage data. Store in a cool, ventilated area, away from powerful oxidizing agents. Containers should be kept closed and plainly labeled. The material discolors on exposure to air and light. The shelf life is considered to be a minimum of two years from the date of manufacture when stored under proper conditions. This material should be checked annually.

5.14.6 Disposal data. See section 5.1.6.

5.15 Name. STEARIC ACID, (SOCMA), $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, MW 284.49
 Octadecanoic Acid (IUPAC)
 n-Octadecyclic Acid
 Stearophanic Acid

5.15.1 Specification. MIL-S-271, Stearic Acid, Technical.

5.15.2 Technical description. Stearic acid is the most common fatty acid occurring in natural animal and vegetable fats. It is a white to light yellow saturated straight-chain fatty acid. As a glyceride, it occurs with oleic and palmitic acids. Stearic acid is insoluble in water, moderately soluble in alcohol, acetone, benzene, chloroform, and carbon tetrachloride and very soluble in ether. Of the three subgrades, single-pressed contains the most admixed oleic acid, the triple-pressed the least. This is readily illustrated by the iodine value which is 10-14 for the single-pressed, 7-9 for double-pressed, and 2-4 for triple-pressed, as compared with 0 for pure stearic acid. The stearic acid covered by this standard shall be in flake form with a melting range of 54.4 to 55°C, a maximum iodine number of 1. The material has a specific gravity of 0.940 g/cm³, a boiling point of 361°C, and a refractive index of 1.4299 at 80°C.

TABLE VIII
 Physical and Chemical Requirements
 of Stearic Acid

Grit	None
Titer (solidification pt) °C min	66
Acidity, max	0.10
Iodine No., max	1.0
Granulation	
Passing through a No. 50 sieve, percent by wt. min	95
Passing through a No. 100 sieve, percent by wt. min	85

5.15.3 Use data. Stearic acid is intended for use by the military as a desensitizer and as a lubricant in the manufacture of ammunition. Typical commercial applications of stearic acid include use in lubricants, soaps, candles, pharmaceuticals, and cosmetics, rubber compoundry, shoe and metal polish, coatings and food packaging.

5.15.4 Packaging data and labeling. For military use, stearic acid is packaged in 1-gallon (3.785 liter) unit quantity cans and in 5-gallon (18.925 liter) unit quantity pails.

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5.15.5 Storage data. Store in a cool, well ventilated area, away from open flame, acute fire hazards, and powerful oxidizing agents. When stored under these ideal conditions, technical grade stearic acid has a maximum shelf life of one year from the date of manufacture because of unsaturated impurities degeneration. This material shall not be older than one month from the date of manufacture when purchased.

5.15.6 Disposal data. See section 5.1.6.

5.16 Name. TANNIC ACID, $C_{14}H_{10}O_9$, MW 322.23
Gallotannic Acid
Tannin
Digallic Acid

5.16.1 Specification. None.

5.16.2 Technical description. Tannic acid is a naturally-occurring substance widely found in gallnuts and the bark of various trees, such as hemlock, oak, and sumac. There are varied structures and the formula $C_{14}H_{10}O_9$ is only an average value. In the pure form it varies in color from light yellow to brown, and is available in the form of glistening scales, an amorphous powder, or a spongy mass. Its most characteristic property is the ability to form an insoluble compound with collagen, which constitutes the tanning of leather. Tannic acid is a strong astringent. The material is extremely soluble in water and alcohol, and insoluble in benzene, chloroform, ether, and carbon disulfide. It decomposes at $210^{\circ}C$ and the flash point is $390^{\circ}F$ ($198.9^{\circ}C$). The tannic acid covered by this standard is a quebracho extract in powder form with a 65% minimum assay as tannic acid.

5.16.3 Use data. Tannic acid is intended for military use as a deodorizing agent of crude oil. Typical commercial applications for tannic acid include use as a denaturing agent in the tanning of leather; as a mordant in dyeing textiles; as a fermenting agent in the fermenting of wines; in the manufacture of medicines and pharmaceuticals, as a deodorizing agent in crude oil; in the manufacture of rubber substitutes, photographic chemicals, and stove polishing compounds.

5.16.4 Packaging data and labeling. Tannic acid, technical is packaged for military use in 100-lb (45.4 kg) unit quantity bags.

5.16.5 Storage data. Tannic acid should be stored in a cool, well ventilated area away from open flame, acute fire hazards, and powerful oxidizing agents. The shelf life is considered to be five years from date of manufacture.

5.16.6 Disposal data. See section 5.1.6.

MIL-STD-12178

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

ASSIGNEE ACTIVITY: G.S.

PREPARING ACTIVITY: ARMY - EA

REVIEW ACTIVITIES: ARMY - EA
AIR FORCE - 68

USER ACTIVITIES: ARMY - MI, AR
NAVY - AS, MC YD

CUSTODIANS: ARMY-EA
AIR FORCE-68

PROJECT NO. 6810-B103

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

 DIRECT GOVERNMENT CONTRACT SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

YES NO (If "yes", in what way?)

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity - Optional)

DATE

DD FORM 1426
1 JAN 66

REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.