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UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 2 10 1 O-5422

ABERDEEN PROVING GROUND, MD 2 10 1 O-5422

GUIDELINES FOR CONTROLLING HEALTH HAZARDS IN PAINTING OPERATIONS

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24 AUG 1987

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2. This technical guide provides occupational health, environmental and procedural information and guidance associated with health hazards in painting operations within the Army.

3. Additional copies may be obtained by calling AUTOVON 584-4117/3931 or writing to Commander, U.S. Army Environmental Hygiene Agency, ATTN: HSHB-AI-A, Aberdeen Proving Ground, MD 210105422.

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REPLY TO ATTENTION OF

HSHB-MO-IT

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GUIDELINES FOR CONTROLLING HEALTH HAZARDS IN PAINTING OPERATIONS

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C-31 through C-32. . . . , ... , . . . ,	C-31 through C-32
G-l through G-4. . . . . , ... , . .	G-1 through G-4

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REPLY TO ATTENTION OF

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August 1987

USAEHA TECHNICAL GUIDE NO. 144

GUIDELINES FOR CONTROLLING HEALTH HAZARDS IN PAINTING OPERATIONS

CHAPTER 1
INTRODUCTION

1-1. PURPOSE. This technical guide--

a. Provides occupatlonal health, environmental, and procedural information and guidance associated with controlling health hazards in painting operations within the Army. Special emphasis is provided on the chemical agent resistant coating (CARC).

b. Applies to the palntlng of tactical mllitary materiel and their components. It *doesnot* apply to the painting of facilities or structures.

c. Implements the provisions of AR 40-5 chapter 5 section III Additional information on paint systems and techniques for application and painting equipment is presented In TM 43-0139. Guidance for painting watercraft and aircraft is presented In TB 746-93-4 and TB 746-93-2.

1-2. REFERENCES. Required and related publications are listed in Appendix A.

1-3. EXPLANATION OF ABBREVIATIONS AND TERMS. Abbreviations and special terms used In this technical guide are explained in the glossary.

1-4. BACKGROUND.

a. The primary function of painting is to protect metal and other material against corrosion. Additional functions of painting are identification, camouflage, and enhanced vlsiblllty. Paint is composed of a pigment and a vehicle. The *pigment*, or solid component dispersed in paint, provides the color in the paint and allows a film to form on the surface of a material. The *vehicle* is the liquld portlon of the paint which includes components such as binders, extenders, flow additives and volatile components known as thinners (solvents). The materials used in paint may be potentially hazardous to personnel and the environment. This document consolidates information on the enamel, lacquer, and polyurethane paint (PUP) systems used by the U.S. Army. It also provides guidance on the recognition, evaluation, and control of potentlal health and environmental hazards associated with specific operations.

b. Vehicles and equipment have traditionally been painted with enamel and lacquer paint systems. A new CARC system is now being used that is superior In durability and service life to enamel and lacquer paints. The CARC also provides surfaces with superior resistance to chemical agent penetration and greatly simplifies decontamination. Eventually all tactical equipment is expected to be palnted using the CARC system.

c. Appendlx 8 presents a general description of enamel paints. lacquers, CARC, and metal preparation.

1-5. STANDARDSIn oversea workplaces where the applicable Status of Force Agreements specifically require that U.S. forces standards comply wlth host country law, host country standards take precedence if stricter. If host country law is less strict or nonexistent, Army requirements apply.

CHAPTER 2
RECOGNITION, EVALUATION, AND CONTROL OF POTENTIAL HEALTH AND ENVIRONMENTAL HAZARDS ASSOCIATED WITH SPECIFIC OPERATIONS

2-1. SPRAY PAINTING (recognition).

a. Spray painting saves time over brush painting and Is used when. large volumes of work are performed. It is especially adaptable to maintenance work when blendlng old and new surfaces.

b. Spray painting results In slgnlflcant aerosolitatlon of paints and solvents. In addition, thinners are used extensively to achieve the correct spraying viscosity. As the thlnners evaporate, excessive solvent atmospheric concentrations may occur. Painting materials may also contain lead, zinc chromate, chromium VI and hexamethylene diisocyanate (HDI). Worker exposure to excessive contaminant concentrations may occur in large booths because:

(1) Ventilation rates vary In these booths or are Inadequate.

(2) The potential for reduced air flow in and around equipment to be sprayed exists due to dead air pockets or low air flow.

(3) The worker Is often positioned between the work and the ventilation exhaust.

(4) The worker does not properly use supplementary personal protective equipment (PPE) or the equipment is Inadequate.

(5) Blow back associated wlth compressed air units bounces droplets Into breathing areas.

c. Spray cabinets or conveyor-type booths do not present as great a potential for exposure because the worker is usually not located between the material painted and the source of exhaust ventllatlon.

d. In either operation, statistically valid personal samples must be collected for HDI. chromium VI, lead, and the solvents that are used. The sampling results determine the required types and leve1 of respiratory protection and engineering controls.

e. When spray painting is conducted outdoors, the level and type of respiratory protection depends on whether the spraying is conducted in a confined space or not.

2-2. SPRAY BOOTHS OR SPRAY ROOMS (evaluation and control).

a. Each activity responsible for evaluating spray operations should have a copy of the following references:

(1) 29 CFR 1910.94

(2)29 CFR 1910.107

(3) 29 CFR 1910.134

(4) 29 CFR 1910.1000

(5) National Fire Protection Association (NFPA) Standard No. 33

(6) American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation Manual.

(7) Threshold Limit Values (TLVs)® for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices with Intended Changes for the Current Year, ACGIH, Cincinnati, Ohio.

(8) American National Standards Institute (ANSI) Standard 29.3.

b. The acceptability of a paint booth or room is based on observing the operation, obtaining representative atmospheric sampling, and determining the physical parameters.

(1) The evaluation begins by observing the operation. Information on the material being used and the equipment being painted must be gathered. Use the Information in Appendix C and the material safety data sheet (MSDS) to identify the contaminants being released during the operation.

(2) Sampling methods to collect these contaminants should be chosen per Chapter 6.

(3) The required respiratory protection is based on the contaminant levels and the length of time the person must work at the operation.

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(4) The physlcal parameters and evaluation methodology for spray booths or spray rooms are discussed In Appendix D. Based on these physical parameters and sampling results, recommendations concerning the operation of an individual booth can be made.

c. Inadequate ventilation (when compared with the requirements shown in Appendix E) will not require upgrade unless an exposure exceeding the appropriate standard has been documented. Therefore sampling data is critical to documenting the hazard potential of a painting operation.

d. When an upgrade is required or a new booth Is being designed, the physical parameters provided in the references listed in paragraph 2-2a must be incorporated into the design.

e. Solvents encountered may be methyl ethyl ketone (MEK), xylene, toluene, ethyl acetate, and others. The MSDS for all materials used must be consulted-(see para 4-l).

f. Paints and primers which contain less toxic materials may be available. Whenever possible, Type II or III aliphatic PUP should be substituted for MIL-C-46168 Type I since they are lead and chromate free. Non-lead-containing primers should be used when available (see App C, para C-15).

2-3. BRUSH OR ROLLER PAINTING *(recognition)*.Brush or roller painting does not cause significant aerosolization of paint or primer constituents, and exposure to HDI or pigment contents should not occur. However, solvent concentrations are present in the air from vaporization. Solvent emissions from brush or roller painting will be less than spray painting since the materials are applied without additional thinning and usually less paint/solvent is used. Solvent exposures would be expected only in very confined spaces.

2-4. INDOOR OR OUTDOOR BRUSH AND ROLLER PAINTING *(evaluation and control)*. PPE and respiratory protection requirements are determined by the quantity of material being used and the location of the operation. For example, in confined spaces a supplied air respirator is required. In large open bays and outdoors the potential for overexposure is extremely remote and a lesser requirement for a respirator may exist.

2-5. DRYING *(recognition)*. Solvents are released during the drying or curing process. The vapor concentrations measured at many paint operations indicate that levels are usually well below current health standards. However, the solvent vapors are typically irritating to the eyes and have low odor thresholds. Drying painted items in an occupied, unventilated space may cause solvent overexposure. After drying, there is no hazard from the solvents.

2-6. DRYING *(evaluation and control).*

a. Since ventilation in drying areas is usually very poor, sampling must be performed to determine the air concentiatlons of the solvents when personnel are working in these areas.

b. HDI in the PUP does not present a health hazard after the paint has cured, unless exposed to heat sufficient for thermal decomposition of the coating.

2-7. GRINDING AND SANDING *(recognition).*

a. Grinding or sanding painted surfaces can expose personnel to--

(1) hazardous concentrations of lead, zinc, copper, tin, or chromium VI dusts from primers or paints, and

(2) noise and eye hazards associated with grinding.

b. There is no expected exposure from solvents or HDI.

2-8. GRINDING AND SANDING *(evaluation and control).*

a. Atmospheric sampling of particulates should be conducted to determine exposure levels. High efficiency air purifying respirators should be used when grinding or sanding on painted equipment.

b. Noise readings should be taken during the operations to determine exposure levels. Hearlng protection should be worn. and the area posted as noise hazardous if noise levels exceed 85 dBA.

c. The potential for eye injuries exists during these operations and protective eyewear should be worn. The area should be posted as an eye hazardous area.

2-9. WELDING AND CUTTING *(recognition).* Toxic gases, vapors, and metal fumes are released when welding or cutting is performed on painted metal. Depending on the types of coatings, these gases may include carbon monoxide, cyanides, aldehydes, and possibly HDI monomer. Welding and cutting on CARC-coated metal is prohibited because significant quantities of isocyanate may be released, unless the coatings have been removed down to bare metal.

2-10. WELDING AND CUTTING *(evaluationand.control).* When welding or cutting painted surfaces, sand or grind down to the bare metal. an area 4 inches on either side of where the heat Is applied. If a painted surface is on the other side of the weld spot, it must also be removed. In some operations, local exhaust ventilation may be used to remove the fumes and gases.

2-11. MIXING *(recognition)*. All material which is sprayed must be thinned to achieve the correct viscosity, and the two component coatings require a waiting period before use. This is usually done in a separate area. In addition, thls area is usually used to store painting materials.

2-12. MIXING *(evaluation and control)*.

a. Mixing must be conducted in a well ventilated mixing room or spraying area away from open flames, welding torches, and combustion heaters. Personnel doing the mixlng should wear eye protection (i.e., splash goggles or face shield) and clothes providing full skln coverage, especially appropriate gloves.

b. Accurate mixing of two component coatings, according to instructions provided with each kit, Is crucial since sufficient amounts of material cause chemical polymerization to occur. Graduated containers should be used when mixing small amounts from each component. All mixing containers must be dry and clean. In addition to the operational problems caused by dirty mixing containers or improper mixing proportions, the presence of unreacted Component A or B may present a health hazard to personnel. Unreacted PUP may result in higher than normal isocyanate concentrations, and uncured epoxy resins are known to be strong irritants.

c. Since the materials used to thin most paints are classified as class I fire hazard liquids and they will be dispensed in the mixing room, mechanical ventilation is required. The ventilation system must provide at least 1 cubic foot per minute of exhaust per square foot of floor area, but not less than 150 cubic feet per minute. Refer to NFPA Code 30, sections 4-4 and 4-5. The electrical wiring and equipment located in the room must meet class I, division 2, requirements of NFPA Code 70.

2-13. OTHER CONSIDERATIONS. Removal of paint by burning is prohibited since toxic gases and vapors will be produced. When chemical paint removers are used, a health hazard may exist since many of these chemicals contain volatile solvents or other materials. Methylene chloride is a constituent of many chemical paint removers.

CHAPTER 3
NONSPECIFIC HAZARDS AND CONTROL METHODS

3-1. CONFINED SPACES.

a. A confined space occurs when airflow is restricted inside a spray booth or outside of a building, e.g. painting the inside of a vehicle. See Appendix F for specific guidelines.

b. Spray painting in confined spaces typically results In excessive atmospheric concentrations of HDI, metals, chromates and solvents depending on the materials' composition. Therefore an airline respirator is required.

3-2. PERSONAL PROTECTIVE EQUIPMENT.

a. Respiratory protection. Documentation is needed when respiratory protection other than an approved airline respirator is used. When respiratory protection is required, only approved or accepted respirators will be used. The respirator furnished will provide adequate respiratory protection against the particular hazard for which it is designed (see TB MED 502). Appendix G discusses the respiratory protection requirements in all painting operations and the need to document exposure when respiratory protection other than an approved airllne respirator is used. Documentation should be developed using a sampling strategy that accounts for all possible spray painting activities within the booths (see chapter 6)

b. PPE (other than respiratory protective equipment).

(1) The PPE used in conjunction with the respiratory protection equipment includes cloth coveralls, eye protection, gloves, and head coverings. Gloves must be chosen for the paint solvents used.

(2) Spot painters applying palnt by brush or roller must wear clothing and gloves affording full skin coverage.

(3) Persons who clean mixing and painting accessories should wear eye protection and chemical resistant gloves to protect the eyes from splash and preclude solvent absorption and defattlng of the skin on the hands caused by the thinner.

(4) Wearing contact lenses during paintlng operations Is prohibited.

c. Barrier creams. Barrier creams may be used; however, the usefulness in preventing the absorption of solvent through the skin is not documented. If a solvent with a skin notation in the exposure standard is being used, then impervious gloves must be used. If a barrier cream is used, it must also be applied to clean skin at the start of the work shift, removed at break and lunch, and reapplied before returning to work. Remove the barrier cream at the end of the shift. Barrier creams are useful in preventing palnt from adhering to the skin and in combating the "dryness" associated with the defatting action of most solvents. Paint solvents should never be used to remove paint/coating from the skin.

3-3. WORK PRACTICES.

a. Work clothing should be provided- when performing spray painting operations. Brush or roller application may be performed In the Army field uniform. After completing spray painting or sanding operations, showers should be taken prior to changing Into street clothing.

b. When the paints being sprayed contain lead or chromates, special laundry procedures for work clothing must be followed when an exposure above the permissible exposure limit (PEL) occurs (29 CFR 1910.1025). .

3-4. LEGAL REQUIREMENTS. Depending on the concentration of solvents and pigments in the workroom air, added measures such as specific PPE or work practices may be required by federal laws.

CHAPTER 4
HAZARD COMMUNICATIONS

4-1. MATERIAL SAFETY DATA SHEETS.

a. The contractual acquisition of a MSDS Is accomplished through the use of Federal Acquisition Regulation clause 52.223-3. This requirement -applies to materials with national stock numbers (NSNs) and locally purchased items. MSDSs for NSN Items can be extracted from the Hazardous Materials Information System (HMIS) (see AR 700-141). As noted in Appendix C, the solvent composition and pigment composition may vary in each product although all conform to the same specification. A MSDS Is appropriate only for a single shipment or batch of material. Because of the variations allowed, the MSDS must be reviewed for each shipment procured on a single purchase order.

b. The MSDS is a requirement of 29 CFR 1910.1200 and is to be filed in a location readily accessible to workers exposed to the hazardous substance. The MSDS may be used as a training aid for discussion during safety meetings and training of new workers which is also required by 29 CFR 1910.1200. It should assist management by directing attention to the need for specific control engineering, work practices. and protective measures to ensure safe handling and use of the material. It will aid the safety and health staff plan a safe and healthful work environment and suggest appropriate emergency procedures and sources of help in the event of harmful exposure of workers. An alternate source of information is AR 700-141.

c. If a MSDS is not available to the user Information regarding MIL-P-52192 ,MIL-P-53022 ,and MIL-P-53030 may be obtained by contacting: Commander, U.S. Army Belvoir Research, Development and Engineering Center, ATTN: STRBE-VO, Fort Belvolr, VA 22060-5606. Information regarding MIL-P-23377 may be obtained from the U.S. Naval Air Development Center, ATTN: Code 60622, Warminister, PA 18974.

4-2. WARNING LABELS. The specifications (refer to Appendix C) require warning labels on products which contain lead or chromium VI.

CHAPTER 5
OCCUPATIONAL AND ENVIRONMENTAL STANDARDS

5-1. ISOCYANATES (*CARC only*).

a. The only lsocyanate monomer found In allphatlc PUP Is HDI and Is the Ingredient which has generated the majority of concern. This Is because lsocyanates, In general, are known to be sensitizers and Irritants. HDI is present In the uncured PUP coating and may be released during thermal decomposition of the cured PUP coating.

b. The Occupational Safety and Health Administration (OSHA) has no established PEL values for HDI. The NIOSH Publication No. 78-215 recommends a celling value of 0.02 ppm (0.14 mg/m^3) for any lo-minute sampling period and a time-weighted average (TWA) concentration of 0.005 ppm (.035 mg/m^3) for any work shift up to 10 hours'. According to AR 40-5, paragraph 5-3, The Surgeon General has adopted these values as exposure limits for Army employees. Note: The ACGIH has published a notice of Intended change In the TLV Booklet to establish a TLV of 0.005 ppm for HDI with no ceiling value.

5-2. SOLVENTS. All paints, primers, and thinners contain organic solvents. In addition, spray operations require thinning with organic solvents to achieve the desired viscosity. Organic solvents are also used to clean up painting equipment and to clean the substrate prior to painting. As Indicated In Appendix C, the solvent composition and percentages for the paints, primers and thinners vary. However, TLVs or PELs have been established for the solvents such as toluene, xylene. and MEK used In these materials. Per AR 40-5, the Army will comply with the more stringent of the TLV or PEL provisions.

5-3. LEAD. Pigments used In the paints and primers may contain lead. A TWA of 0.05 mg/m^3 for any work shift up to 10 hours has been established by OSHA for lead (29 CFR 1910.1025).

5-4. CHROMIUM VI. The paints and primers may contain water insoluble chromium VI compounds. These substances have a TLV of 0.05 mg/m^3, as chromium, and are recognized as having carcinogenic or cocarcinogenlc potential.

5-5. OTHER METALS. Metals present In the pigments must be determined by using the MSDS and/or the analyses. References should be checked to establish appropriate exposure limits.

5-6. ADDITIVE PROPERTIES. When similar chemical compounds are encountered which elicit similar physiological reactions, the additive effects must be considered. Procedures for: establishing standards for these compounds are contained In the ACGIH TLV Booklet and the OSHA Standards (29 CFR 1910.1000).

5-7. STATE AND LOCAL AIR POLLUTION REGULATIONS..

a. Many state and local air pollution control agencies have regulations governing the design and operation of paint spray booths. Many states require permits for the Installation of new spray paint booths and the modification of exlstlnq booths. Implementing CARC palntlng operations In an existing booth may constitute a process modification and thereby require Issuance of a permit or revision to the existing permit. Numerous states are also In the process of developing an air toxics program which may impact on CARC painting operations due to the HDI constituent In the CARC formulations. Also certain types of solvents and heavy metals (i.e., lead and chromium) may also be regulated under specific state air toxlcs regulations). Specific air pollution requirements or permit conditions may be obtained through the Installation environmental coordinator. This Individual Is usually located within the Directorate of Engineerlng and Housing.

b. Spray painting operations are also regulated In many states by local or state air pollution control agencies. In locations designated as nonattainment areas for ozone, restrictions are often Imposed on the amounts of volatile organic compounds (VOCs) that may be exhausted to the atmosphere. This may affect the types and amounts of thinners and solvents used during palntíng operatîons. Any restrictions or limitations for spray painting operations are typically listed In that source's air pollution operating permit. -Coordination should be made with the installation environmental coordinator to verlfy the permit requirements.

CHAPTER 6
SAMPLING

6-1. SAMPLING STRATEGIES. The sampling strategy developed should account for all possible spray painting activities within the booths.

a. The sampling is done during the painting of different vehicles and equipment, when the booths' filters are clean and dirty, when changes or modifications occur In or to the booths, and for each painter.

b. The documentation should be revalldated *biennially* If the Initial sampling results are *below* one-half of the standard and *semiannually* If *greater than* one-half of the standard.

c. Additional monitoring Is required whenever there has been a production, process, control. or personnel change *or* whenever there Is any other reason to suspect a change that may result In new or additional exposures.

6-2. COLLECTING SAMPLES.

a. Methods of collecting samples for potentlally hazardous paint, primer, and solvent components are presented In U.S. Army Environmental Hygiene Agency (USAEHA) Technical Guide (TG) No. 141. Personal sampling is the preferred method for determining exposure limits. Area samples should be used to determine the effectiveness of control measures or locate problem areas.

b. The USAEHA TG No. 141 also--

(1) Contains procedures for submltti ng air samples.

(2) Identifies laboratories perform1 ng the analyses. When more than one analysis on a collected sample Is desired, the laboratory performing the analysis should be contacted to verify the validity of the sampling method.

CHAPTER 7
MEDICAL SURVEILLANCE

7-1. GENERAL. Retrospective epldemlologlc studies of painters have demonstrated an Increased Incidence of neurobehavloral symptoms. However, there Is poor evidence of objective neurophyslologlc deterioration as measured by behavioral testing. nerve conduction testing, and physical examination findings. Other case-control studies have suggested an Increased risk of lung, laryngeal, and esophageal cancers In painters. Painters are exposed to a wide variety of chemicals which can affect specific organ systems or present generalized toxicity. Additionally. painters perform a wide variety of tasks which may Increase the risk of exposure to these chemical substances.

7-2. HAZARDS.

a. Solvents. A wide variety of solvents (Including ethyl acetate, toluene, xylene, MEK and 2-ethoxyethyl acetate) are encountered In painting operations. They are generally well-absorbed through the skin and respiratory epithellum. The central nervous system and peripheral nervous system are commonly affected by these compounds. The gastrointestinal, respiratory, hepatic, renal, and hematopoietic systems may also be adversely affected by solvents, depending on the specific type of compound. Solvents act as defatting agents which may lead to fissuring and reddening of the skin. Misuse of solvents to clean the skin Is often Implicated in causing dermatitis In palnters. Solvent vapors may produce eye Irritation. Inhalation of solvent vapors may produce acute effects such as dizziness, nausea, headache, narcosis, or unconsciousness. Solvents are thought to be the agents responsible for the production of neurobehavloral symptomatology (such as numbness or tingling In the hands, Irritability, depression, or an Inability to concentrate) seen In chronically exposed painters. Cellosolve acetate (2-ethoxyethyl acetate), which may be a constituent In CARC. will also produce mucous membrane and skin Irritation.

b. Isocyanate. HDI Is a constituent In CARC and has been associated with the respiratory effects seen during and after the application of this material. HDI is highly irritating to the skin and mucous membranes--producing itching and reddening of the skin, a burning sensation of the throat and nose, and watering of the eyes. In sufficient concentrations, HDI may cause acute pulmonary symptoms to include cough, shortness of breath, pain on respiration, Increased sputum production, and chest tightness. In a small percentage of the workforce, it may produce asthmatic symptoms through an allergic, Immunoglobulin E-medicated mechanism. These allergic symptoms may be present: coughing, wheezing, tightness in the chest, or shortness of breath. This al lergic reaction may occur a few days or months after initial exposure to HDI and can occur at atmospherlc concentrations lower than

those which produce HDI's irritant effects. Sensitive individuals may exhibit a decrease in forced expiratory volume in 1 second (FEV_1) on pulmonary function testing after being exposed during the work shift, as compared to preshlft values. A longitudinal study of workers exposed to an analogous compound, toluene diisocyanate, suggests that low level, chronic exposures may result in an increased decrement in pulmonary function, compared to the general population. HDI may be generated and released during thermal decomposition of CARC.

c. Heavy metals.

(1) Lead exposure usually occurs as a result of aerosolization of lead-based paint, grinding or sanding of painted areas, or welding of unprepared surfaces resulting in the production of lead fumes. Lead has been associated with interference of the heme synthesls pathway, resulting in anemia. Additionally, lead exposure may be associated with abdominal cramping (colic), kidney disease, peripheral nervous system disease, and neuropsychiatric disturbances. Lead can cause adverse reproductive effects in men and women. Short-term, high exposures to lead can result in acute encephalopathy progressing to seizures, coma, and death.

(2) Chromium VI, a component in some paint pigments, is similar to lead in that processes such as aerosolitation, grinding, or burning of chromium VI-based paint can increase the risk for exposure. Chromium VI has been associated with penetrating lesions of the skin and nasal septum, dermatitis, and inflammation of the larynx and liver. Chromium VI, as chromate, is a carcinogen producing primarily bronchiogenic carcinomas in exposed workers.

d. Trauma. Airless spray paint guns have produced injection injuries of the hand. Paint injected into the hand may initially appear innocuous, but may progress to ischemia or chemical or thermal burns. Solvents may be injected in sufficient quantities to cause systemic symptoms. All personnel with injection injuries will be referred for surgical consultation to minimize the possibility of infection, gangrene, and disability.

7-3. MEDICAL SURVEILLANCE.

a. Medical surveillance to detect adverse health effects should be determined by the installation medical authority (IMA) based on the specific hazards to which personnel are exposed. The Health Hazard Information Module of the Occupational Health Management Information System (OHMIS) and MSDSs should be used to determine these hazards. See AR 40-5, TB MED 503 and TB MED 505.

b. Medical surveillance guidelines for individual--chemical hazards may be obtained through the Medical Information Module of the OHMIS, in NIOSH Publication No. 81-123 or DOD 6055.5-M. Also see USAEHA TG No. 154 to develop the physical assessment protocol.

c. Medical surveillance for the HDI present in CARC follows:

(1) Preplacement or baseline.

(a) Medical and occupational history with attention to previous exposure to HDI, allergies, respiratory disease, and smoking.

(b) A physical exam with attention to the respiratory system.

(c) Clinical laboratory tests. Specifically--

- Chest x-ray, 14 x 17 inches, posterior-anterior

- Pulmonary function tests to include FEV_1, forced vital capacity (FVC), and FEV_1/FVC ratio (see TB MED 509).

(2) Periodic.

(a) Annually.

(b) Same as preplacement except no chest x-ray.

d. Those workers required to wear respirators will be medically evaluated to determlne if they are physically able to perform their work while wearing this equipment. (See TB MED 502 and TB MED 509.)

CHAPTER 8
WASTE MANAGEMENT

8-1. BACKGROUND. On 21 October 1976, the President signed into law the Resource Conservation and Recovery Act (RCRA) which directed the U.S. Environmental Protection Agency (EPA) to develop and implement regulations for the "cradle-to-grave" management of hazardous waste (HW). Since the RCRA's enactment in 1976 and subsequent reauthorization in 1984, the EPA has promulgated an enormous volume of regulations which govern all aspects of HW management including generation, transportation, treatment, storage, recycling, and ultimate disposal. Also, many state environmental regulatory agencies have promulgated HW regulations which are more stringent than the Federal regulations.

8-2. WASTE STREAMS. .

a. Painting operations, regardless of the types of paints used, typically generate one or more waste streams which are subject to regulation as HW under the RCRA. These waste streams include, but are not limited to the following:

(1) Excess or unserviceable paints, paint components, and paint thinners.

(2) Spent paint thinners and paint stripping solvents.

(3) Paint-contaminated blasting media.

(4) Paint-impregnated paper filter elements from paint booth air filtration systems.

(5) Paint-contaminated water and sludge from paint booth waterfall air filtration systems.

(6) Paint-contaminated strippable coatings from interior paint booth surfaces.

(7) Empty paint, paint component, and solvent containers.

b. Whether any of these waste streams would be defined as HW and thus subject to regulation under the RCRA is dependent on the following two factors:

(1) The waste may be among those specifically listed as an HW by the EPA. For example, unserviceable 1,1,1-trichloroethane (one of the thinners used in the application of CARC) is a listed HW (EPA HW number U226); or

(2) The waste may exhibit one or more of the four characteristics of HW as defined in the RCRA regulations (i.e., ignitability, corrosivity, reactivity, and Extraction Procedure (EP) toxicity (heavy metals)). For example, paint-impregnated paper filter elements may exhibit the characteristic of EP toxicity (lead and/or chromium) if the paints they are impregnated with contained lead and/or chromium in their pigment formulations. Knowledge of the paint formulation and/or actual analytical testing of filter elements would be required before this type of determination could be made.

There are other factors which must be considered when determining if a particular painting waste stream is subject to regulation as an HW. For instance, many wastes are specifically excluded from regulation under the RCRA. For example, containers which held certain HWs are exempt from regulation if they meet the regulatory definition of "empty." Also, certain HWs are exempt from regulation if they are recycled in a specific manner. For example, off-specification 1,1,1-trichloroethane is not subject to regulation as an HW if it is returned to the manufacturer for regeneration.

8-3. MANAGING THE WASTE. The characterization and management of wastes under the RCRA is a complex issue. On DA installations, the installation environmental coordinator is normally assigned the responsibility for ensuring that RCRA issues are adequately addressed. The environmental coordinator acts on behalf of the installation commander who, under provision of AR 420-47, is ultimately responsible for the management of HW on the installation. Therefore, before taking steps to manage any painting waste stream, the installation environmental coordinator must be notified. The environmental coordinator will be able to evaluate each waste stream to determine if it is an HW and will know which regulations, if any, apply.

8-4. TECHNICAL ASSISTANCE. Additional technical assistance and guidance on the proper management of painting wastes may be obtained from the Commander, U.S. Army Environmental Hygiene Agency, Waste Disposal Engineering Division, Aberdeen Proving Ground, MD 21010-5422, AUTOVON 584-3651.

Appendix A
REFERENCES

Section I
Required Publications

AR 40-5	Preventive Medicine. (Cited in paras 1-1c and 7-3a.)
ACGIH Ventilation Manual	Industrial Ventilation, A Manual of Recormnended Practice. (Cited in para 2-2a(6).) (This publication may be obtained from the American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Bldg D7, Cincinnati, Ohio 45211.)
ANSI Standard 29.3	Safety Code for Design, Construction, and Ventilation of Spray Finishing Operations. (Cited in para 2-2a(8), D-5, and D-6.) (A copy of this publication may be obtained from the American National Standards Institute Incorporated. 1430 Broadway, New York, NY 10018.)
NFPA Code 30	Flammable Liquids. (Cited In para 2-12c.)
NFPA Code 33	Standard for Spray Application Using- Flammable and Combustible Materials. (Cited in para 2-2a(5).)
NFPA Code 70	National Electrical Codes. (Cited in para 2-12c.)
TB MED 502	Respiratory Protection Program. (Cited In para 3-3, 7-3d, and G-3.)
TB MED 503	Army Industrial Hygiene Program. (Cited in para 7-3a.)
TB MED 505	The Army Occupational Health Program (to be published). (Cited in para 7-3.)
TB MED 509	Spirometry in Occupational Health. (Cited in paras 7-3c and 7-3d.)
TLV Booklet	TLVs For Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices with Intended Changes for the Current Year. (Cited in paras 2-2a(7), 5-1b and 5-6.) (To obtain this publication. see the ACGIH entry above:)
29 CFR 1910	Occupational Safety and Health Standards. (Cited in paras 2-2a, 4-1b, 5-3a, app D and app E.) (This publication may be obtained on a subscription basis from the Superintendent of Documents, Government Printing Office, Washington, DC 20401.)

Section II
Related publications

A related publication is merely a source of additional information. The user does not have to read it to understand this technical guide.

AR 11-XX	Respiratory Protection Program (in press).
AR 40-5	Preventive Medicine.
AR 420-47	Solid and Hazardous Waste Management.
AR 700-141	Hazardous Materials Information System.
AR 750-58	Painting, Camouflage Painting, and Marking of Army Materiel.
30 CFR 11	Respiratory Protective Devices; Tests for Permissibility; Fees.
DHEW (NIOSH) Publication No. 78-210	Occupational Safety and Health Administration (OSHA) Pocket Guide to Chemical Hazards.
DHEW (NIOSH) Publication No. 78-215	Occupational Exposure to Diisocyanate.
DHEW (NIOSH) Publication No. 81-123	Occupational Health Guidelines for Chemical Hazards.
DHHS (NIOSH Publication)	Certified Equipment List, latest edition. (Copies are provided by the U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH, 4676 Columbia Parkway, Cincinnait, Ohio 45226.)
DOD 6055.5-M'	Occupational Health Surveillance Manual. (Copies are available from the Commander, U.S. Army Environmental Hygiene Agency, ATTN: HSHB-MO/Ed Ofc, Aberdeen Proving Ground, MD 21010-5422.)
DOD-P-15328	Primer (Wash), Pretreatment (Formula No. 117 for Metals) (Metric).
FAR 52.223-3	Federal Acquisition Regulation (Hazardous Material Identification and Material Safety Data).

MIL-C-8514	Coatlng Compound, Metal Pretreatment, Resln-Acid.
MIL-C-22750	Coating, Epoxy-Polyamide.
MIL-C-22751	Coating System, Epoxy-Polyamide, Chemical and Solvent Resistant, Process for Application of
MIL-C-46168	Coating, Aliphatlc Polyurethane, Chemical Agent Resistant.
MIL-C-53039	Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant.
MIL-E-52798	Enamel, Alkyd, Camouflage.
MIL-L-11195	Lacquer, Lustreless, Hot Spray.
MIL-i-14486	Lacquer, Vinyl Resin, Semigloss.
MIL-L-52043	Lacquer, Semigloss, Cellulose Nitrate.
MIL-P-11414	Primer Coating, Lacquer, Rust Inhibiting.
MIL-P-14553	Primer Coating, Dipping, Automotive.
MIL-P-15930	Primer Coating, Shipboard, Vinyl-Zinc Chromate (Formula No. 120)
MIL-P-23377	Primer Coatings: Epoxy-Polyamide, Chemical and Solvent Resistant. (This publication is available from the U.S. Naval Air Development Center, ATTN: Code 60622, Warminister, PA 18974.)
MIL-P-52192	Primer Coating: Epoxy. (This publication is available from Cdr, U.S. Army Belvoir Research and Development Center, ATTN: STRBE-VO, Ft. Belvoir, VA 22060-5000.)
MIL-P-52995	Primer Coating, Synthetic. Corrosion Inhibiting, Lacquer-Resisting, Lead and Chromate Free.
MIL-P-53022	Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free. (This publication is available from Cdr, U.S. Army Belvoir Research and Development Center, ATTN: STRBE-VO, Ft. Belvoir, VA 22060-5000.)

MIL-P-53030	Primer Coating, Epoxy, Water Reducible, Lead and Chromate Free. (This publication is available from Commander, U.S. Army Belvoir Research and Development Center, ATTN: STRBE-VO, Ft. Belvolr, VA 22060-5000.)
HIL-T-6095	Thinner, Cellulose-Nitrate-Dope, Blush-Retarding.
MIL-T-81772	Thinner, Aircraft Coating.
TB 43-0144	Painting of Vessels.
TB 746-93-2	Painting and Marking of Army Aircraft.
TB 746-93-4	Painting of Vessels.
TB 746-95-l	Color, Marking, and Camouflage Pattern for Armament Command Equipment.
TM-43-0139	Painting Instructions for Field Use.
'TT-E-485	Enamel, Semigloss, Rust-Inhibiting.
TT-E-489 .	Enamel, Alkyd, Gloss (For Exterior and Interior Surfaces).
TT-E-529	Enamel, Alkyd, Semigloss.
TT-E-776	Ethylene Glycol Monobutyl Ether (For Use In Organic Coatings).
TT-P-636	Primer Coating, Alkyd, Rood and Ferrous Metal.
TT-P-659	Primer Coating and Surfacer: Synthetic, Tints and White, (For Metal and Wood Surfaces).
TT-P-664	Primer Coating, Synthetic, Rust-Inhibiting, Lacquer-Resisting.
TT-P-1757	Primer Coating, Zinc Chromate. Low-Moisture-Sensitivity.
TT-R-25114	Remover, Paint and Varnish.
TT-T-266	Thinner: Dope and Lacquer (Cellulose-Nitrate).
TT-T-291	Thinner, Paint, Mineral Spirits, Regular and Odorless.

TT-T-548	Toluene, Technical.
TT-X-916	Xylene, Technical.
USAEHA TG No. 141	Industrial Hygiene Sampling Instructions., (This publication is available from the Commander, U.S. Army Environmental Hygiene Agency, ATTN: HSHB-AI-A,' Aberdeen Proving Ground, MD 21010-5422.)
USAEHA TG No. 154	Guide for Developing a Physical Assessment Protocol. (To obtain this publication, see the TG entry above.)

APPENDIX B
GENERAL DESCRIPTION

B-1. ENAMEL PAINTS.

a. General. Prior to the introduction of CARC, the standard surface treatment for equipment and vehicles was synthetic alkyd enamel paint. The NSNs for this material are presented in table B-1.

b. Thinners. The enamel must be thinned for various temperature and humidity conditions.

(1) When the temperature is between 30 °F and 60 °F, xylene (TT-X-916) is used to obtain the correct viscosity. Xylene is available in S-gallon drums (NSN 6810-00-584-4070) and in 55-gallon drums (NSN 6810-00-290-4166).

(2) When the temperature is between 60 °F and 80 °F, mineral spirits (TT-T-291) are used to obtain the correct viscosity. This material Is available in 55-gallon drums (NSN 8010-00-246-6115). Composition of this material is listed in paragraph C-26.

(3) When the temperature is above 80 °F, butyl cellosolve is added to the mineral spirits thinner in varylng proportions depending on the relative humidity. Butyl cellosolve is available in l-gallon cans (NSN 6810-00-281-2001).

c. Primers. All metallic surfaces should be prlmed before painting.

(1) Olive drab ferrous metal surfaces are primed with primer meeting TT-P-664, TT-P-636, or MIL-P-14553 (see paragraphs C-5, C-6, and C-9 for composition). White ferrous metal surfaces are primed with primer meeting TT-P-659 (see paragraph C-7).

(2) Aluminum is primed with primer meeting TT-P-1757, MIL-P-52995, or DOD-P-15328 (see paras C-8, C-12, and C-131, when either olive drab or white enamel is used.

d. Application.

(1) Olive drab ferrous metal surfaces are painted with enamel meeting TT-E-485 or TT-E-529. Ferrous metal which is painted white must use enamel meeting TT-E-489. Composition of these materials appears in paragraphs C-17, C-18, and C-20.

Table B-1
NSNs for enamel, alkyd, camouflage (MIL-E-52798)

Color	National stock number	
	5 Gallons	1 Gallon
Desert sand	8010-00-111-8353	8010-00-111-8004
Sand	8010-00-111-8336	8010-00-111-7988
Earth yellow	8010-00-111-8130	8010-00-111-7968
Earth red	8010-00-111-8345	8010-00-111-8003
Field drab	8010-00-111-8129	8010-00-111-7943
Earth brown	8010-00-111-8338	8010-00-111-7998
Olive drab	8010-00-111-8069	8010-00-111-7940
Light green	8010-00-111-8007	8010-00-111-7930
Dark green	8010-00-111-8042	8010-00-111-7938
Forest green	8010-00-111-8010	8010-00-111-7937
Black	8010-00-111-8356	8010-00-111-8005

(2) The olive drab enamel and white enamel used on aluminum metal must meet the same specifications as the enamels used on ferrous metals.

(3) When fiberglass parts are painted, the same materials used to paint ferrous metals are used.

B-2. LACQUERS.

a. Paints. Lacquers are finish materials that dry by evaporation of the volatile portion only. They deposit a film that is generally thinner than the film provided by other paints.

b. Thinners. Lacquer thinner (MIL-T-6095) is the standard material for reducing the viscosity of the lacquers to spraying consistency. When high humidity conditions exist, use cellulose nitrate dope and lacquer thinners (TT-T-266). This material evaporates slower than cellulose nitrate dope blush retarding thinner (MIL-T-6095) and prevents the condensation of moisture on the surface of the lacquer film. Composition of these materials can be found in paragraphs C-24 and C-25.

c. Primers. When ferrous metal or aluminum is painted with lacquer, use primer, lacquer (MIL-P-11414) prior to application of the topcoat. Magnesium alloy metal requires a primer meeting MIL-P-15930. Composition of these materials are presented in paragraphs C-10 and C-11.

d. Application. Lusterless lacquer (ML-i-111951 and semlgloss, cellulose-nitrate lacquer (MIL-L-52043) may be used as a finish for automotive equipment and general use on ferrous metals and aluminum. Magnesium alloy metals are coated with semigloss vinyl resin lacquer (MIL-L-14486). Composition of these materials is in paragraphs C-21 through C-23. These materials may be applied as issued If hot spray techniques are used. However, if the lacquers are sprayed at room temperature and below, they must be properly thinned. Lusterless lacquer is thinned with one part thinner to two parts by volume of packaged material. Semigloss, cellulose-nitrate lacquer is thinned using a ratio of three parts by volume of thinner to five parts by volume of lacquer.

B-3. CARC

a. Coating. The CARC system consists of three different types of coatings; an epoxy polyamide primer used as an undercoat, an aliphatic PUP which is used on external surfaces, and an epoxy polyamide enamel (EPE) which is used on internal applications. The aliphatic polyurethane topcoat is available as a two component system (MIL-C-46168) and a single component system(MIL-L-53039). The composition of these coatings is presented in paragraphs C-14 and C-15. Al l interlor surfaces are coated with a two component EPE (MIL-C-22750). See paragraph C-16.

b. Thinners.

(1) 1,1,1-trichloroethane is used to thin PUP (MIL-C-46168) Type III, in areas having strlngent VOC air pollution limits.

(2) Thinner (MIL-T-81772), Type I is used to thin polyurethane coatings. See paragraph C-27.

(3) Thinner (MIL-T-81772) Type II is used to thin epoxy polyamide coatings and primers.

c. Primers. Specific primers must be used with both the exterior PUP and interior epoxy topcoats. Informati on regarding these primers is in Appendlx C. paragraphs C-l through C-13.

d. Application.

(1) The aliphatic PUP can be applied over well-cured alkyd enamel. However the alkyd coating must be sound and free of absorbed or deposited oils, greases, waxes, etc. The aliphatic PUP cannot be applied over lacquer or vinyl paints due to incompatibility.

(2) Recoatlng may be performed while the orlginal coat is tacky. If the original coat has cured for 14 days or more, light scuff sanding may be necessary for adherence.

(3) The aliphatic PUP should not be applied to bare substrate. Epoxy primers meeting military specifications MIL-P-52192, MIL-P-23377, MIL-P-53022. or MIL-P-53030 must be used first (see paras C-l through C-4).

(4) One quart of mixed allphatlc PUP-covers approximately 100 square feet when applied by brush or -roller. If sprayed, the material should cover about 94 square feet. If a gallon is used, the coverage should be approximately 400 square feet for brush or roller application and 375 square feet for spray application.

(5) New kits to spray small quantities of allphatlc PUP have been and will continue to be introduced into the supply system. One such kit is the Self-Pressurized Spray Kit (NSN 4940-00-803-6444) used for touch-up painting applications. All health protection requirements for spray painting are applicable when this kit is used.

8-4. METAL PREPARATION.

a. Regardless of the type of paints being used; surface preparation is important. All surfaces must be thoroughly cleaned.

b. All loose paint may be removed by light sandblasting or sanding.

c. Paint and varnish remover (TT-R-25114) may be used for enamel and lacquer paint removal. However, it Is not used on CARC painted surfaces.

d. When surfaces for conventional painting are required to be cleaned with solvent, solvent conforming to MIL-T-81772 or TT-T-291 should be used when CARC Is to be applied. Surfaces already painted with acrylic or acrylic nitrocellulose paint are cleaned with either toluene (TT-T-548) or xylene (TT-X-916) prior to overpainting. Pretreatment of bare metals is required before coating with- CARC. Pretreatment material (000-P-15328) is used as a bonding agent and to provide temporary protection against corrosion. This material Is available in quart containers (NSN 8030-00-850-7076) and gallon containers (NSN 8030-00-281-2726).

APPENDIX C
PRIMERS, COATINGS, TOPCOATINGS, AND THINNERS

Section I
Primers

c-1. MILITARY SPECIFICATION MIL-P-52192. 5 JANUARY 1971, PRIMER COATING, EPOXY.

a. This Is an air-drying or baking epoxy primer with a red or brown oxide pigment coloration. This primer contains both lead and Insoluble chromium VI compounds. Depending on the solvent content, this primer Is classified as Composition G for general use or Composition L where air pollution limitations are imposed. The volatile portion for Composition L Is listed in table C-l.

Table C-l
Volatile composition

Ingredients	Percent by volume Maximum
(a) A combination of hydrocarbons, alcohols, aldehydes. esters, ethers and ketones having an olefinic or cyclooleflnic type of unsaturation.	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene	8
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, or toluene.	20
(d) Total of (a) + (b) + (c)	20

Since the solvent content is listed in generic terms, the MSDS for the used primer should be consulted.

b. This primer is furnished in two components: Part A (epoxy resin) and Part B (catalyst).

(1) Component A consists of a bisphenol type epoxy resin and a pigment combined with the necessary amounts of flow control agents and volatile solvents. Pigment composition of the primer is listed in table C-Z-.

Table C-2
Pigment composition

Ingredients	Percent by weight Minimum	Maximum
(a) Iron oxide	17	--
(b) Basic lead silico chromate	51	--
(c) Siliceous extending pigments, and anti-settling agents	--	32

(2) Component B consists of an aliphatic polyamine-epoxy resin adduct combined with the necessary amount of volatile solvents. Prior to use, four parts by volume of Part A are mixed with one part by volume of Part B.

c. This primer is intended for use as a chemical resistant primer coat for materiel It may be baked at 300 °F for 20 minutes or at a lower temperature for a longer period of time.

d. Part A is packaged in l-gallon containers or S-gallon steel pails. When 5-gallon steel pails are used, they contain only 4 gallons of material. Component B is packaged in either l-quart or l-gallon containers. Individual containers are marked Part A (epoxy resin component) or Part B (catalyst Component) whichever is applicable. Individual containers are also marked with the following information:

CAUTION: Avoid contact with skin and eyes
Keep containers closed
Avoid prolonged or repeated breathing of vapor
Use with adequate ventilation
Wear fresh clothing daily when contacting Part B catalyst component

INSTRUCTIONS FOR USE:
Mix Part A well; then add 1 part by volume of Part B to 4 parts by volume of Part A and mix well. Local exhaust ventilation should be provided where Part A and Part B are mixed. For spray application, this material may be thinned with xylene. For Composition L, thin with a xylene substitute that will meet the requirements of air pollution regulations. In spray applications, avoid inhalation and eye or skin contact. This material shall stand 30 minutes after mixing before using and shall be used within 8 hours after mixing."

e. The NSN for the 1 gallon A/1 quart B container is 8010-00-082-1714.

C-2. MILITARY SPECIFICATION MIL-P-23377, 14 MARCH 1978, PRIMER COATINGS, EPOXY-POLYAMIDE, CHEMICAL AND SOLVENT RESISTANT.

a. This is a primer coating formulated primarily for application by various spray techniques. The color of the primers are deep yellow for Type I and dark green for Type II with both types containing water insoluble hexavalent chromium compounds. Type I is the standard primer and Type II is a low infrared reflective primer. This is a two component primer consisting of Component A (epoxy resin component) and Component B (polyamide resin component). Pigment composition of Component A is listed in table C-3.

Table C-3
Pigment composition

Material	Percent by Weight Type I Min	Type I Max	Type II Min	Type II Max
(a) Strontium chromate[1]	52	--	42	--
(b) Titanium Dioxide	10	--	8	--
(c) Siliceous extenders and anti-settling agents	--	38	--	32
(d) Coloring pigments[2]	--	--	--	18

[1] Some strontium chromate pigments cause blistering in the water resistance test (MIL-P-23377, para 3.8.1). Commercial grade, 95 percent SrCr04 is recommended.
[2] Use pigments conforming to TT-P-343 and TT-P-346 to meet color requirements of MIL-P-23377, paragraph 3.6.1.

b. The volatile portion of this primer makes it suitable for use under air pollution regulations. The volatile portion of the components are limited by that presented in table C-4.

Table C-4
Volatile composition

Ingredients	Percent by Volume Maximum
(a) Solvents having an olefinic or cyclo-olefinic type of unsaturation	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene	8
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures or toluene	20
(d) Total of (a) + (b) + (c)	20

Since the solvent content is listed in generic terms, the MSDS for the primer used should be consulted.

c. Components A and B are mixed in a one-to-one volume ratio. The primer is supplied in a kit consisting of equal volumes of pigmented epoxy resin and a polyamide resin. Individual cans must have a label giving the following information:

Component Identification
Component A - Pigmented epoxy resin component
Component B - Polyamide resin component
Specification MIL-P-23377 Type I or Type II (as applicable)
Name of Manufacturer
Date of Manufacture by Month and Year
Batch Number/Net Contents
Precautions:

1. The surface to be primed must be absolutely clean and free of oil, dust, etc.

2. Equipment must be adequately grounded. Clean: spray equipment immediately after use.

3. Mix only that amount to be used in 8 hours.

4. Epoxy-polyamide primer from one vendor;or component thereof, shall never be mixed with that of another vendor.

5. Apply over pretreated metal. On fiberglass-reinforced plastic surfaces, a prior coat of MIL-C-8514 pretreatment coating will facilitate stripping without damage to the fiberglass.

In addition, unit, intermediate, and shipping containers must be marked:

"WARNING: Contains flammable volatile solvent."

d. The NSNs for available quantities of Type I and Type II primer are given in table C-5.

Table C-S
NSNs for primers covered under MIL-P-23377

Type	NSN	Quantity
I (standard)	8010-00-142-9279	1 pt A/1 pt B
	8010-00-935-7080	1 qt A/1 qt B
	8010-00-082-2450	1 gal A/1 gal B
	8010-00-082-2477	5 gal A/5 gal B
II (low infrared reflective formula)	8010-01-050-4082	1 q-t A/1 qt B
	8010-01-048-6539	1 gal A/1 gal B

C-3. MILITARY SPECIFICATION MIL-P-53022, 26 SEPTEMBER 1983, PRIMER EPOXY COATING, CORROSION INHIBITING, LEAD AND CHROMATE FREE.

a. This is a flash drying, corrosion inhibiting epoxy primer for use on ferrous and nonferrous metals. It is white or light gray in color, is lead and chromate free, and meets the air pollution requirements for solvent emissions. The volatile portion of this primer is limited by that presented in table C-6.

Table C-6
Volatile composition

Ingredients	Percent by Volume Maximum
(a) A combination of hydrocarbons, alcohols, aldehydes, esters, ethers and ketones having an olefinic or cycloolefinic type of unsaturation.	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene	8
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, or toluene	20
(d) Total of (a) + (b) + (c)	20

Since the solvent content is listed in generic terms, the MSDS for the primer used should be consulted.

b. This primer is composed of two components: Component A (epoxy resin) and Component B (catalyst).

(1) Component A (epoxy resin) consists of a bisphenol-type epoxy resin and pigment combined with the necessary amounts of flow control agents and volatile solvents to meet the requirements of the specification. The composition of the pigment consists of that presented in table C-7.

Table C-7
Pigment composition

Ingredients	Precent by weight Minimum	Maximum
(a) Titanium dioxide	50.0	
(b) Zinc phosphate	9.0	11.0
(c) Corrosion inhibiting pigment'	0.9	1.1
(d) Siliceous extenders		40.0
(e) Hexavalent chromium .	negative	

' Sicorin RZ, Basf Wyandotte Corp. or equivalent.

(2) Component B is composed of an aliphatic polyamine-epoxy resin adduct combined with volatile solvents. Prior to use, 4 parts by volume of Component A are mixed with 1 part by volume of Component B.

c. This primer is intended for use on ferrous and nonferrous substrates It is lead and chromate free and may be used to replace MIL-P-52192 and MIL-P-23377.

d. Part A is packaged in l-quart or l-gallon containers, or 4-gallon or S-gallon steel pails. When 5 gallon pails are specified they will contain only 4 gallons. Part B is packaged in 1/2-pint, l-quart or l-gallon containers. All primary containers must be labeled "Part A (epoxy resin component>" or "Part B (catalyst component)" as applicable. In addition, containers should be labeled with appropriate information from Section V and VIII of the MSDS. The emergency and first-aid procedures, type of PPE (especially respiratory protection required) and ventilation to be used are to be specified. The following warnings and use instructions are required on the containers:

CAUTION: Avold contact wlth skin and eyes
Keep containers closed
Avoid prolonged or repeated breathing of vapor
Use with adequate ventllatlon
Wear fresh clothing daily when contacting Part B catalyst component

INSTRUCTIONS FOR USE:
Mix Part A well; then add 1 part by volume of Part B to 4 parts by volume of Part A and mix well. Local exhaust ventilation should be provlded where Part A and Part B are mixed. For spray application, this materlal may be thlnned by reducing 4 parts of the mixed primer by volume with one part by volume of dope and lacquer thinner conformlng to TT-T-266. During spray application, avold inhalation and eye or skin contact. .

e. NSNs for ML-P-53022 are listed In table C-8.

Table C-8
NSNs for ML-P-53022

Quart Kit	Gallon Kit	S-Gallon Klt
8010-01-193-0516	8010-01-193-0517	8010-01-187-9820

C-4. MILITARY SPECIFICATION MIL-P-53030, 7 DECEMBER 1983, PRIMER COATING, EPOXY, WATER REDUCIBLE, LEAD AND CHROMATE FREE.

a. This is a VOC compliant primer developed to meet the strict emission requirements of certain states. (This primer contains no more than 340 gm/L of VOC.) It is lead and chromate free, water reducible, air drying, and can be applied to ferrous and nonferrous surfaces. Since this is a water based primer, no solvents are required for thinning. The color of this primer is characteristic of red or brown iron oxide pigments.

b. Component A contains a bisphenol-A type epoxy resin and pigments. The pigment composition of the primer consists of that presented in table C-9.

Table C-9
Piqment composition

Inqredients	Percent by weight Minimum	Maximum
(a) Iron oxide (Fe_2O_3 by analysis)	20.0	45.0
(b) Zinc phosphate	10.0	25.0
(c) Corrosion inhibiting pigment'	0.9	1.1'
(d) Siliceous extenders	--	45.0
(e) Hexavalent chromium	Negative	

[1] Sicorin RZ, Basf Wyandotte Corp. or equivalent.

c. Component B is a clear resin solution.

d . The primer is furnished as a kit with correct proportions of Components A and B. Kit sizes are listed in table C-10.

Table C-10
Primer kits

Kit Size	Primary Container Size	Component	Proportion 3:1 Level Percentage
1-quart	1-quart	A	75
	1/2-pint	B	100
1-gallon	1-gallon	A	75
	1-quart	B	100
4-gallon	S-gallon	A	60
	1-gallon	B	100

Each primary container shall be labeled "Component A (pigmented base component>" or "Component B (curing component)" as applicable, with the manufacturer's mixing and thinninq instructions, the VOC content (in grams per liter) and the following:

CAUTION: Avoid contact with skin and eyes
Keep containers closed
Avoid prolonged or repeated breathing of vapors
Use with adequate ventilation

INSTRUCTIONS FOR USE:

The surface to be primed must be absolutely clean and free of oil, dust, etc.
Apply over pretreated metal
Equipment must be adequately grounded Clean spray equipment immediately after use.
The primer from one vendor, or component thereof, shall never be mixed with that of another vendor. MIX ONLY THAT AMOUNT TO BE USED IN 6 HOURS

e. NSNs for MIL-P-53030 are listed in table C-11.

Table C-11
NSNs for MIL-P-53030

Quart Kit	Gallon Kit	S-Gallon Kit
8010-01-193-0519	8010-01-193-0520	8010-01-193-0521

c-5. FEDERAL SPECIFICATION TT-P-664, 13 JANUARY 1969, PRIMER COATING, SYNTHETIC, RUST-INHIBITING, LACQUER-RESISTING.

a. This primer is intended for use as a base coat on bare or chemically treated metal surfaces. It is suitable for use under either synthetic enamel or lacquer top coats. The color of the primer is characteristic of the red or brown iron oxide pigments. This primer contains insoluble chromium VI compounds. Depending on the solvent content, this primer is classified as Composition G for general use or Composition L where air pollution limitations are imposed. The volatile portion for Composition L is listed in table C-12.

Table C-12
Volatile composition

Ingredients	Percent by volume Maximum
(a) Aromatic compounds with eight or more carbon atoms except ethylbenzene	8
(b) Ethylbentene and toluene	20
(c) Solvents with an olefinic or eycloolefinic type of unsaturation	negative
(d) Ketones	negative
(e) Total of (a) + (b)	20

Composition G volatile portion shall be xylene. Since volatile composition is in generic term, the MSDS for the material being used must be consulted.

b. The following caution label shall appear on each container:

CAUTION: Contains Zinc Chromate
Avoid breathing mist when spraying
Avoid skin contact

c. NSNs are not listed in HMIS cross reference file.

C-6. FEDERAL SPECIFICATION TT-P-636. 25 MARCH 1971, PRIMER COATING, ALKYD, WOOD AND FERROUS METAL.

a. This primer Is intended for priming the clean rust-free, bare or phosphate-treated ferrous metal parts of vehicles, guns, gun mounts, tanks, shipping containers and similar ordnance material. It may also be used as a sealing undercoat on the wooden parts of motor vehicles. It Is not intended for use as a lacquer-resistant primer. The color of the prlmer Is characteristic of the red or brown iron oxide pigments. This primer contains insoluble chromium VI compounds and the pigment composition is llmlted by that presented in table C-13.

Table C-13
Piqment Composition

Ingredlents	Percent by weight Minimum	Maximum
(a) Iron oxide (Fe_2O_3)	50	--
(b) Zinc yellow (CrO_3 x 2.4)	10	--
(c) Zinc oxide	10	15
(d) Siliceous extenders	--	'30
(e) Sum of the percentages of iron oxide (Fe_2O_3), zinc yellow (CrO_3 x 2.41, zinc oxide, and acid insoluble siliceous material	90	--

b. Depending on the solvent content, this primer is classified as Composition G for general use and Composition L where alr pollution limitations are imposed. The volatile portion for Composition L is llsted in table C-14.

Table C-14
Volatile composition

Ingredients	Percent by volume Maximum
(a) Aromatic compounds with eight or more carbon atoms except cthylbentene	8
(b) Ethylbenzene and toluene	20
(c) Solvents with an olefinic or cycloolefinic type of unsaturation	negative
(d) Ketones	negative
(e) Total of (a) + (b)	20

Since the volatile composition is in generic terms, the MSDS for the material being used must be consulted.

c. NSNs are not listed in HMIS cross reference file.

C-7. FEDERAL SPECIFICATION TT-P-659, 24 OCTOBER 1973,' PRIMER COATING AND SURFACER: SYNTHETIC, TINTS AND WHITE (FOR METAL AND WOOD SURFACES).

a. This primer is an air-drying or baking, oil-modified alkyd primer, and sanding surfacer for ferrous metal and wood. This primer is not intended for use on metals where rust-inhibiting characteristics are required. The primer is white or lightly tinted with the hiding pigments being composed of titanium dioxide. This primer is suitable for use in areas covered by air pollution regulations. The solvent composition is limited by that presented in table c-15.

Table C-15
Volatile composition

Ingredients	Percent by volume Maximum
(a) Aromatic compounds with eight or more carbon atoms except ethylbenzene	8
(b) Ethylbenzene and toluene	20
(c) Solvents with an olefinic or cycloolefinic type of unsaturation	negative
(d) Ketones	negative
(e) Total of (a) + (b)	20

Since the volatile composition of the primer is In generic terms, the MSDS for the material being used must be consulted.

b. NSNs are not listed in HMIS cross reference file.

C-8. FEDERAL SPECIFICATION TT-P-1757. 26 SEPTEMBER 1983, PRIMER COATING, ZINC CHROMATE, LOW-MOISTURE-SENSITIVITY.

a. This primer is a low-moisture-sensitivity, corrosion-inhibiting primer, for use primari-ly on aluminum aircraft or airborne equipment. The primer can be used alone or top coated with lacquer or enamel: It is suitable for use over a wide range of temperature and humidity conditions. Two colors of primer are available under this specification, color Y, a yellow primer, and color T, a green color. Type 1 is a bulk container and Type II is in aerosol containers. Both colors contain insoluble chromium VI compounds. Solids limitations and pigment composition are shown in tables C-16 and C-17.'

Table C-16
Solids content

Zinc chromate primer	Minimum Requirements Type I	Type II
(a) Total solids (percent by weight of primer)	46	13
(b) Pigment content (percent by weight of total solids)	53	53

Table C-17.
Pigment composition

Pigment' Ingredient'	Percent by weight Minimum	Maximum
(a) Zinc chromate	85	--
(b) Siliceous extenders	--	15

' Carbon black or lamp black are the prime pigments recommended for tinting. However, if required, small quantities of other pigments may be used.

b. This primer is suitable for use under air pollution regulations and must conform to table C-18.

Table C-18
Volatile composition

Ingredients	Percent by volume Maximum
(a) A combination of hydrocarbons, alcohols, aldehydes, esters, ethers, or ketones having an olefinic or cyclo-olefinic type of unsaturation	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene	8
(c) A combination of ethylbenzene, ketone having branched hydrocarbon structures, trichloroethylene or toluene	20
(d) Total of (a) + (b) + (c)	20

c. Each shipping container will be marked with the following information:

PRIMER COATING, ZINC CHROMATE, LOW MOISTURE-SENSITIVITY
TT-P-1757
Type (I or II)
Color (Y or T)

In addition, the following markings are included on Type 1 containers:

"Use thinner conforming to MIL-T-81772, Type III."
"Application directions: Apply by spray, brush or dip to deposit a hiding coat of primer. A wet coat Is necessary to secure maximum adhesion and corrosion-inhibiting properties."

For color T materlal, the label shall contain the following:

"Pretinted to match Interior Green, Color Number 34151 of Fed.Std No. 595."

Each container must contain the following:

CAUTION: Contains tine chromate
Avoid breathing of vapor
Use with adequate ventilation

d. NSNs are not listed in HMIS cross reference file.

C-9. MILITARY SPECIFICATION MIL-P-14553, 13 NOVEMBER 1972, PRIMER COATING, DIPPING-AUTOMOTIVE.

a. This primer is intended primarily for dip application on automotive components. Although not intended for spray application, it may be used in that manner for spot priming. This primer should not be used under acrylic type lacquers or enamels. There are two classes of this alkyd baking primer; Class 1 - Low bake for temperatures of 300 to 325 °F and Class 2 - High bake for temperatures of 365 to 385 °F. Both classes of primers are divided into Composition G for general use and Composition L which is suitable for use under air pollution regulations. This primer is dark grey or black in color. Pigment for the primer is one of the following materials; carbon black, titanium dioxide, zinc chromate, iron oxide, and extenders. The primer must show a minimum of 5 percent zinc chromate by weight of total pigment which must be at least 30 percent by weight of the primer. Lead is restricted in this primer to less than 0.5 percent.

b. The volatile portion on Composition L primers is limited to that presented in table C-19.

Table C-19
Volatile composition

Ingredients	Percent by volume Maximum
(a) Aromatic compounds with eight or more carbon atoms except ethylbenzene	8
(b) Ethylbenzene, toluene, and branched ketones	20
(c) Solvents with an olefinic or cycloolefinic type of unsaturation	negative
(d) Total of (a) + (b)	20

Since the solvent content is written in generic terms the MSDS for the used primer used must be consulted.

c. This primer is packaged in 1 quart or gallon containers, 5 gallon pails or 55-gallon steel drums. Each container of primer is required to bare the following precautionary markings:

CAUTION: Contains zinc chromate
Take adequate precautions when spraying
Avoid breathing mist or dust
Avoid skin contact .

d. NSNs are not listed in HMIS cross reference file.

C-10. MILITARY SPECIFICATION MIL-P-11414, 10 MAY 1971, PRIMER COATING, LACQUER, RUST-INHIBITING.

a. This primer is a quick drying rust-inhibiting cellulose nitrate primer intended for use on solvent cleaned or phosphated shells, bombs, grenades. tanks, trucks, ammunition, and automotive components. While developed primarily for ferrous metal, it has given excellent performance over vapor-cleaned or chemically-treated aluminum. The color of the primer is characteristic of the iron oxide or chromate pigments used. This primer contains insoluble chromium VI compounds and the pigment composition is limited to that listed in table C-20.

Table C-20
Pigment composition

Ingredients	Percent by weight Minimum	Maximum
(a) Zinc chromate (CrO_3 x 2.4)	10	--
(b) Iron oxide (Fe_2O_3 by analysis)	50	--
(c) Siliceous extenders	--	40
(d) Sum of percentages of iron oxide (Fe_2O_3) and zinc chromate (CrO_3 x 2.4) and acid insoluble siliceous material	90	--

b. Depending on the solvent content, this primer is classified as Composition G for general use or Composition L where air pollution limitations are imposed. Volatile portion of the primer is controlled by that presented in table C-21.

Table C-21
Requirements of volatile portion

Material	Composition G Percent by weight Minimum	Maximum	Composition L Percent by weight Minimum	Maximum
(a) Esters and ketones (other than acetone)	30	--	30	--
(b) Alcohols (other than methanol)	15	22	15	22
(c) Aromatic hydrocarbons	--	50	--	20
(d) Aliphatic hydrocarbons	--	--		30

The volatile content of Composition L also contains the following amount of solvent by volume as presented in table C-22.

Table C-22
Volatile composition

Ingredients	Percent by volume Maximum
(a) Solvents having an olefinic or cycloolefinic type of unsaturation	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene	8
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures or toluene	20
(d) Total of (a) + (b) + (c)	20

Since the solvent composition is in generic terms, the MSDS for the used material used must be consulted.

c. NSNs are not listed in HMIS cross reference file.

c-11. MILITARY SPECIFICATION MIL-P-15930, 14 OCTOBER 1981, PRIMER COATING, SHIPBOARD, VINYL-ZINC CHROMATE (FORMULA NO. 120).

a. This primer is used with conventional or hot spray equipment over pretreated metal surfaces: It is usually top coated with vinyl-alkyd finish or vinyl antifouling paints. Pigment composition of this primer is that presented in table C-23.

Table C-23
Pigment composition

Ingredients	Mass Percent Minimum	Maximum
(a) Zinc chromate, insoluble type'	60.0	----
(b) Magnesium silicate (type A or 8 of MIL-P-151731, Lamp black (TT-P-350), suspension aids, etc.	A---	40.0

' The zinc chromate will be an insoluble type containing 16 to 19 percent CrO_3, 67 to 72 percent ZnO, and not more than 1 percent water soluble salts.

b. Depending on the solvent content, this primer is classified as Composition G for general use or Composition L for use where air pollution limitations are imposed. Volatile portion of the primer is controlled by that presented in table C-24.

Table C-24
Volatile composition

Ingredients	Percent by--volume Composition G Minimum	Composition G Maximum	Composition L Minimum	Composition L Maximum
(a) Methyl isobutyl ketone (TT-M-268)	60.0	----	----	----
(b) Methyl n-butyl ketone[1]	----	----	50	----
(c) Methyl ethyl ketone (TT-M-261)	----	----	10	15
(d) Toluene (TT-T-548)	----	40.0	----	15
(e) Aliphatic naphtha (TT-N-95, type I)[2]	----	----	----	20

[1] The methyl n-butyl ketone will contain no more than 5 percent by volume of branched chain ketones.
[2] The aliphatic naphtha shall contain no more than 11 percent by volume of aromatic hydrocarbons.

The volatile content of Composition L will also conform to the requirements by volume as presented in table C-25.

Table C-25
Volatile composition

Ingredients	Percent by *volume Maximum
(a) A combination of hydrocarbons, alcohols, aldehydes, ethers, esters, or ketones having an olefinic or cyclooelefinic type of unsaturation except perchloroethylene	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene, methyl benzoate, and phenyl acetate	8
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, trichloroethylene, or toluene	20

Since the solvent composition is given in generic terms, the MSDS for the primer used should be consulted.

c. In addition to other information, each container carries the following statement: "Storage at cold temperatures may cause gelling. Fluidity can be restored by heating slowly. Do not exceed 120 °F. If thinning is necessary for Composition G (general use), use a 50/50 mixture of methylethylketone and xylol and for. Composition L (limited use - where air pollution regulations are in effect), use methyl n-butylketone."

d. NSNS are not listed in HMIS cross reference file.

Section II
Allphatlc Polyurethane Coatings

C-12. MILITARY SPECIFICATION MIL-P-52995, 17 SEPTEMBER 1981, PRIMER COATING, SYNTHETIC, CORROSION-INHIBITING, LACQUER-RESISTING, LEAD AND CHROMATE FREE.

a. This is a quick drying, corrosion-Inhibiting, and lacquer-resisting primer for ferrous and nonferrous metals with a red or brown iron oxide pigment coloration. The primer Is lead and chromate free and meets air pollutlon requirements for solvent emissions. The volatile composition is listed in table C-26.

Table C-26
Volatile composition

Inqredient	Percent by weight Maximum
(a) Aromatic compounds with eight or more carbon atoms except ethylbenzene	8
(b) Ethylbenzene and toluene	20
(c) Solvents with olefinic or cyclooefinic type of unsaturation	negative
(d) Ketones	negative
(e) total of (a) + (b)	20

A suggested solvent mixture consisting of:

VMP Naptha (8 percent max, aromatic)	65 percent by weight
n-butyl alcohol	20 percent by weight
Toluene	15 percent by weight

is presented in the specification. However since this is not a requirement the MSDS for this primer should be consulted to obtain the composition of the specific primer used.

b. Total solids for this primer are limited to 60 percent minimum by weight.

c. This primer may be furnished in l-quart or l-gallon multiple friction top containers, in S-gallon lug cover steel pails, or in 55-gallon steel drums.

C-13. MILITARY SPECIFICATION DOD-P-15328, 21 APRIL 1976, PRIMER (WASH). PRETREATMENT (FORMULA NO. 117 FOR METALS) (METRIC).

a. This is a primer pretreatment coatingintended for use on all types of clean metal surfaces as a treatment prior to the application of the coating, system. This primer is considered suitable for use in areas with regulations controlling emission of solvents into the atmosphere.

b. The primer consists of ingredients in the proportions specified in table C-27.

Table C-27
Primer Ingredients

Ingredients	Ingredients per 100 gallons paint Gallons
Ingredients of resin component (80 gallons)	
a. Polyvinyl-butyral resin	6.1
b. Zinc chromate (insoluble type)	1.7
c. Magnesium silicate	0.34
d. Lampblack	0.04
e. Butyl alcohol (normal)	18.48
f. Isopropyl alcohol	53.8
g. Water	1.8
Ingredients of acid component (20 gallons)	
a. Phosphoric acid	2.0
b. Water	3.0
c. Isopropyl alcohol	15.0

c. The solvent portion of this formulation conforms to the requirements in table C-28

Table C-28
Volitile composition

Ingredients	Percent by volume Maximum
a. Aromatic compounds with eight or more carbon atoms to the molecule. except ethylbenzene	1
b. Ethylbenzene content	1
C. Compounds with olefinic or cycloolefinic unsaturation	negative
d. Ketones	1

Since the solvent content may be varied within the limits of the specification, the MSDS for this material must be consulted.

C-14. MILITARY SPECIFICATION MIL-C-53039, 16 APRIL 1984, COATING, ALIPHATIC POLYURETHANE, SINGLE COMPONENT, CHEMICAL AGENT RESISTANT.

a. This coating is a one component aliphatic polyurethane coating used on military combat equipment and will be available in the following colors:

Light Green	Sand	Aircraft Gray
Forest Green	Earth Red	Interior Aircraft Black
Dark Green	Earth Brown	Aircraft Red 31136
Olive Drab	Brown 383	Olive Drab 34087
Green 383	Desert Sand	Aircraft Insignia Blue 35044
Field Drab	Black	Interior Aircraft Gray 36231
Earth Yellow	Aircraft Green	Aircraft Black 37038
		Aircraft White 37875

This coating has a maximum of 420 gm/liter (3.5 lbs/gallon) VOCs as packaged. The only solvent limitation imposed by the specification is 420 gm/liter VOCs. Therefore, the MSDS for the material being used must be consulted. This chromate and lead free coating has not been completely integrated into the supply system but should be by CY87.

b. All containers must be marked with the following information:

CAUTION: The Surgeon General requires airline respirators be used unless air sampling shows exposure to be below standards. Then either chemical cartridge respirators or airline respirators are required. Avoid contact with skin and eyes and use with adequate ventilation. For other safety and disposal recommendations, refer to the Material Safety Data Sheet. Keep container tightly closed. This coating is very water sensitive and caution must be taken to ensure water or high humidity does not come in contact with the coating at "any time during reduction, application or drying. MATERIAL SHOULD BE USED WITHIN 8 HOURS AFTER REDUCTION.

NSNs have been assigned for camouflage colors Green 383, Brown 383, Black-and Sand. See table C-29.

Table C-29
NSNs for MIL-C-53039

Color	Color Shade	1-Qt Can 8010-01-	1-Gal Can 8010-01-	S-Gal Can 8010-01-	55-Gal Drum 9010-01-
Green 383	34094	229-7546	229-9561	229-7547	232-8514
Brown 383	30051	229-7543	229-7544	229-754s	233-0060
Black	37030	229-7540	229-7541	229-7542	233-1568
Sand	33303	234-2934	234-2935	234-2936	234-2937

C-15. MILITARY SPECIFICATION MIL-C-46168, 28 MARCH 1984, COATING, ALIPHATIC POLYURETHANE, CHEMICAL AGENT RESISTANT.

a. This is a two- component aliphatic polyurethane coating for use as a finish coat on military combat equipment. Thls coating is available in the following colors:

Light Green	Earth Brown	Aircraft Insignia Blue No. 35044
Forest Green	Desert Sand	Interior Aircraft Gray No. 36231
Dark Green	Black	Aircraft Black No. 37038
Olive Drab	Aircraft Green	Aircraft White No. 37875
Field Drab	Aircraft Gray	Aircraft Black No; 37038
Earth Yellow	Interior Aircraft Black	Aircraft White No. 37875
Sand	Aircraft Red No. 31136	Aircraft Yellow No. 33538
Earth Red	Olive Drab No. 34087	Green 383
		Brown 383

Three types of polyurethane coating are available under the following specifications.

Type I - Standard formulation for all colors
Type II - Lead and chromate free formulation
Type III - Lead and chromate free formulation which uses 1,1,1-trichloroethane to meet volatile organic compound content of 420 gm/liter (3.5 lb/gallon) maximum as applied

b. Al-l three types of coating can be used in areas covered by air pollution regulations. The solvent blend for Types I and II is limited to that presented in table C-30.

Table C-30
Volatile Compositlon

Ingredients	Percent by volume Maximum
(a) Aromatic compounds with eight or more carbon atoms except ethylbenzene	8
(b) Ethylbenzene, toluene, and ketones having branched hydrocarbon structures	20
(c) Solvents with olefinic or cycloolefinic type of unsaturation	negative
(d) Total of (a) + (b)	20

Since the solvent content is limited by generic terms, the MSDS for the paint being used should be consulted.

c. Component A is comprised of orthophthalic-trimethylol propane esters combined with pigments and volatile solvents. Component B consists of a aliphatic polylsocyanate combined with volatile solvents. Prior to use, 4 parts by volume of Component A is mixed with 1 part by volume of Component B. Each primary container Is marked "Component A (polyester)," or "Component B (catalyst)." Proper proportions of polyester and catalyst are packaged together. NSNs for type I and II paints are listed in tables C-31 and C-32.

d. Aliphatic PUP (ML-C-461681 is mixed four parts by volume of Component A with one part by volume of Component B and allowed to stand 15 minutes. Epoxy enamel (ML-C-227501 is mixed 1 part Component A with 1 part Component B and allowed to stand 1 hour. Hhen brush paintlng, the EPE or allphatic PUP admix should be thinned only to a viscosity permitting smooth brush application. If thinning is necessary, it should be thlnned using Aircraft Coating Thinner, ML-T-81772 (see paragraph C-27). DO NOT USE ANY OTHER THINNER.

Table C-31
NSNs for ML-C-46168 Type I formulation

No.	Color	NSN for ea klt 1-Quart Kit 8010-01-	I-Gallon Kit 8010-01-	5-Gallon Kit 8010-01-	55-Gallon Kit 8010-01-
1.	Llght Green	141-2421	128-6957	131-6256	127-8909
2.	Forest Green (Type 1)	141-2411	128-6958	131-6257	127-8910
3.	Forest Green (Type 2)	144-9888	144-9874	144-9881	144-9889
• 4.	Green 383 (Type 2)	160-6741	162-5578	160-6742	160-6743
• 5.	Brown 383 (Type 2)	160-6744	160-6745	160-6746	160-6747
6.	Dark Green	141-2412	130-3343	131-0611	132-2977
7.	Olive Drab	141-2413	130-3344	131-6258	127-8907
8.	Field Drab	141-2414	130-3345	148-3662	127-8911
9.	Earth Yellow	141-2415	130-3346	131-0612	133-l 986
10.	Sand	141-2416	130-3347	131-6259	151-9370
11.	Earth Red	141-2417	130-3348	131-6260	150-0717
12.	Earth Brown	141-2418	134-0383	132-4986	150-0718
13.	Desert Sand	142-0132	131-6253	135-9985	150-0719
• 14.	Black	141-2419	131-6254	131-6261	151-9397
15.	Aircraft Green	141-2420	131-6255	131-6262	
16.	Olive Drab #34087	146-2650	055-2319	144-9875	
17.	Aircraft Gray	144-9882	127-8908	144-9876	
18.	Aircraft White #37875	144-9883	144-9872	144-9877	
19.	Aircraft Red #31136	144-9884	144-9873	144-9878	
20.	Aircraft Black #37038	144-9885	146-2646	144-9879	
21.	Interior Aircraft Black (with Glass Beads)	144-9886	146-2647	146-4376	
22.	Insignia Blue #35044	144-9887	146-2648	144-9880	
23.	Interior Aircraft Gray	170-7583	146-2649	170-0132	

• Color for three color camouflage system

Table C-32
NSNs for ML-C-46168 Type II Formulation

No.	Color	NSN for ea kit 1-Quart Kit 8010-01-	1-Gallon Kit 8010-01-	S-Gallon Kit 8010-01-
1.	Light Green, 34089	141-2421	128-6957	131-6256
2.	Forest Green, 34083	144-9888	144-9874	144-9881
* 3.	Green 383, 34094	160-6741	162-5578	160-6742
* 4.	Brown 383, 30051	160-6744	160-6745	160-6746
5.	Dark Green, 34082	141-2412	130-3343	131-0611
6.	Olive Drab, 33070	141-2413	130-3344	131-6258
7.	Field Drab, 33105	141-2414	130-3345	148-3662
8.	Earth Yellow, 33245	141-2415	130-3346	131-0612
9.	Sand, 33303	141-2416	130-3347	131-6259
10.	Earth Red, 31090	141-2417	130-3348	131-6260
11.	Earth Brown, 30097	141-2418	134-0383	132-4986
12.	Desert Sand, 30315	142-0132	131-6253	135-9985
*13.	Black, 37030	141-2419	131-6254	131-6261
14.	Aircraft Green, 34031	141-2420	131-6255	131-6262
15.	Olive Drab, 34087	146-2650	055-2319	144-9875
16.	Aircraft Gray, 36300	144-9882	127-8908	144-9876
17.	Aircraft White, 37875	144-9883	144-9872	144-9877
18.	Aircraft Red, 31136	144-9884	144-9873	144-9878
19.	Aircraft Black, 37038	144-9885	146-2646	144-9879
20.	Interior Aircraft Black (with Glass Beads), 37031	144-9886	146-2647	146-4376
21.	Insignia Blue, 35044	144-9887	146-2648	144-9880
22.	Interior Aircraft Gray, 36231	170-7583	146-2649	170-0132
23.	Aircraft Yellow, 33538	235-5078	235-8059	235-5079

• Basic three-color CARC camouflage coatings

Each container Is required to carry the following label:

CAUTION: The Surgeon General requires airline respirators be used unless air sampling shows exposure to be below standards, then elther chemical cartridge respirators or airline respirators are required.
Avoid contact with -skin and eyes.
Use with adequate ventilation.
For other safety recommendations refer to the Material Safety Data Sheet.
Keep containers tightly closed.
Component B is very water sensitive and caution must be taken to ensure water or high humidity does not-come in contact with Component B at any time during reduction, application, or drying.

INSTRUCTIONS FOR USE:

Mix Component A well: then add 1 part by volume of Component 8 to 4 parts by volume of Component A and mix well.
Let material stand 1/2 hour after mixing before using.
MATERIAL SHOULD BE USED WITHIN 8 HOURS AFTER MIXING.
WARNING! flammable. Keep away from sparks and open flames.
Use with adequate ventilation.
Avoid prolonged breathing of vapors.

MIL-C-46168 was revised effective 21 May 1'987. The revised document--

a. Deletes lead and/or chromate (hexavalent) formulation (Type I).
b. Adds Type IV high solids formulation.
c. Prohibites the use of ethylene based glycolethers and acetates.

Since this is a new specification, the two component PUP of the old specification will probably continue to be supplied to users. For this reason MIL-C-46168 is retained in this document.

Section III
Topcoatings

C-16. MILITARY SPECIFICATION MIL-C-22750, 2 NOVEMBER 1980. COATING, EPOXY-POLYAMIDE.

a. This epoxy-polyamide, two component coating is suitable for spray of brush application. It is used on areas requiring protection when exposed to chemicals and solvents. It is suitable for interior or exterior use. Component 1 of this coating contains the pigments and Component 2 is clear. This coating Is available in the colors presented in table C-33.

Table C-33
Coating colors

Color No.	Color Name	Color No.	Color Name	Color No.	Color Name
11136	Insignia Red	24087	Olive Drab	13538	Fieldgreen
12197	International Orange	26081	Seaplane Gray	34095	(Type II Coating)
		26307	Gray	35237	
14087	Olive Drab	34087	Olive Drab	36320	
16081	Engine Gray	36440	Light Gull	36375	
16440	Light Gull Gray	37038	Black	36495	
16473	Aircraft Gray				
17038	Black				
17925	Untinted White				
	Clear or Aluminized				

b. This material is available In two types:

Type I - Standard epoxy-polyamide coating

Type II - Low infrared reflective epoxy-polyamide coating

The Type.1 coating is leadfree, but Chromium VI may be present depending on the pigmentation. Both types of materials are suitable for use under air pollution regulations. Solvent composition of the material is limited by that presented in table C-34.

Table C-34
Volatile composition

Iaqredients	Percent by volume Maximum
(a) A combination of hydrocarbons, alcohols, aldehydes, esters, ethers or ketones having an olefinic or cycloolefinic type of unsaturation	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the *molecule* except ethylbenzene	8
(c) A combination of ethylbenzene; ketones having branched'hydrocarbon structures, trichloroethylene or toluene	20
(d) Total of (a) + (b) + (c)	20

Since the solvent content is limited by generic terms, the MSDS for the used material must be consulted. This is also required to determine the presence or absence of chromium VI compounds.

c. Individual cans and containers are marked with the following information:

COMPONENT IDENTIFICATION:
Component I - Pigmented Compound or Clear for Aluminizing (as applicable)
Component II - Clear Compound
Specification MIL-C-22750
Color (Name and Number)
Manufacturer's Name or Trademark
Date Manufactured, Month and Year
Mixing, Thinning and Spraying Directions (direction labels shall be clearly legible)

PRECAUTIONS:

1. Surface skin must be absolutely clean (free from oil, dust).
2. Equipment shall be adequately grounded. Clean spray gun, brushes and equipment immediately after use with thinner specified by the manufacturer.
3. The coating will not adhere to wash primer that has blushed Or that has been applied when the relative humidity is below 35 percent (see MIL-C-22751).
4. Mix only that amount which can be used in 1 day.
5. Epoxy-polyamide coatings build up thickness readily. Thick films are detrimental for good adhesion.
6. Epoxy-polyamide coating from one vendor shall never be mixed with that of another.
7. Components are not interchangeable: for example Component I of one color may not be used with Component II of another color.
8. Component I or Component II from one manufacturer shall not be mixed with products of another manufacturer.
9. This coating is intended for use only over primer MIL-P-23377.

THINNING DIRECTIONS:

This is a two package coating which is prepared by adding 1 part Component II to 1 part Component I slowly while stirring. Each component shall be mixed before combining. The manufacturer shall specify the volume of MIL-T-81772 thinner to be employed.

The information below is intended for the tabe 1 for clear epoxy coating packages only:

ALUMINUM EPOXY COATING:

Prepare by incorporating 16 ounces of aluminum paste conforming to TT-P-320, Type II, Class A, in 1 gallon of clear mixed epoxy-polyamide with the aid of thinner, non-photochemically reactive thinner as recommended by the manufacturer. Aluminum powder of comparable fineness, purity, and physical properties may be employed in the production of aluminized finishes. When powder is used, the amount shall be equal to that contained in the amount of aluminum content of the aluminum paste specified.

"Instructions for Use. Important see MIL-C-22751, Coating System, Epoxy-Polyamide, Chemical and Solvent' Resistant, Process for Application of."

d. NSNs for materials which are used on interior surfaces. when applying the CARC system are listed in table C-35.

Table C-35
NSNs for MIL-C-22750

No.	Color/No.	NSN for ea Kit 2-Quart Kit 8010-01-	NSN for ea Kit 2-Gallon Kit 8010-01-
1.	White, 17925	053-2647	082-2439
2.	Green, 24533	211-9645	

C-17. FEDERAL SPECIFICATION TT-E-529. 20 JANUARY 1984, ENAMEL, ALKYD, SEMIGLOSS.

a. This enamel is intended primarily for use as an exterior finish coat on primed wood and metal surfaces. The colors presented in table C-36 are available.

Table C-36
Enamel Colors

Color No.	Color	Color No.	Color	Color No.	Color
20061	Red deck	24277	Green	26251	Accent Gray
20252	Rose	24410	Green	26280	Gray
21136	Red	24424	Green	26293	Gray
23538	Yellow	24441	Green	26306	Sandgray
23594	Light Yellow	24449	Green	26307	Light Gray
'23717	Cream	24491	Light Blue	26329	Gray
24052	Marine Corps Green	24518	Green	26373	Gray
24064	Green	24525	Green	26440	Gray
24087	Olive Drab	24533	Light Green	26492	Gray
24097	Green	25042	Sea Blue	26521	Gray
24148	Green	25053	Royal Blue	26555	Light Gray
24159	Green	25109	Blue	26622	Gray
24172	Green	26132	Slate gray	27038	Black
24233	Green	26134	Gray	27144	Purple
24241	Green	26152	Gray	27875	White
24260	Light Green	26173	Gray	30117	Brown
24272	Pea Green	26250	Gray		
	'Desert Color No. 6				
	Non-Camouflage Forest Green				
	Non-Camouflage Dark Green				

This material is available in three types

Type I - Air drying, suitable for brush or spray application.
Type II - Baking, suitable for spray application.
Type III - Enamel In pressurized dispensers for touch-up of areas to which Type I or Type II enamel has been applied.

b. The solvent composition of this enamel is limited by that presented in table C-37.

Table C-37
Volatile composition

Ingredients	Percent by volume Maximum
(a) A combination of hydrocarbons, alcohols, aldehydes, esters, ethers, and ketones having an olefinic or cycloolefinic type of unsaturation	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene	8
(c) A combination of ethylbenzene, ketones having branch hydrocarbon structures, or toluene	20
(d) Total of (a) + (b) + (c)	20

Since the solvent content is limited by generic terms, the MSDS for the paint used should be consulted. In addition. the paint may contain lead or chromium VI compounds depending on the pigments present. This information will also need to be retrieved from the MSDS.

c. This material is available in l-quart or l-gallon multiple friction top cans, 5-gallon steel pails, 55-gallon steel drums, or in l-pint aerosol cans. Each container is required to carry the following marking or label:

WARNING

This paint is restricted to nonresidential application. It has not been tested to ensure less than 0.06 percent lead content.

Do not apply on toys and other children's articles, furniture, or interior surfaces of any dwelling or facility which may be occupied or used by children.

Do not apply on such exterior surfaces of dwelling units as window sills, porches, stairs, or railings to which children may be commonly exposed.

Keep out of reach of children.

C-18. FEDERAL SPECIFICATION TT-E-489, 10 MARCH 1980. ENAMEL, ALKYD, GLOSS (FOR EXTERIOR AND INTERIOR SURFACES)..

a. This is a high-grade, alkyd-type high gloss enamel for use on primed exterior and interior wood or metal, particularly on smooth exterior metal. Its main use is for refinishing automobiles and construction equipment. There are two classes of enamel; Class A which may be applied with either brush or spray, and Class B or baking enamel, which is intended for spray applications only. This specification also establishes two types of enamels; Type I, bulk quantities, and Type II, aerosol containers. All Type II aerosol containers contain Class A air-drying enamel.

b. This enamel may or may not contain lead and insoluble chromium VI compounds. This is determined by the pigment used to achieve the desired colors. Therefore, the MSDS for the specific paint should be consulted, since this formulation is available-in approximately 70 different colors.

c. The volatile composition of Type I, Class A and B enamel must meet that presented in table C-38.

Table C-38
Volatile Composition

Ingredient	Percent by volume Maximum
(a) Solvents with an olefinic or cycloolefinic type of unsaturation	5
(b) The total of aromatic compounds with eight or more carbon atoms in the molecule, except ethylbenzene, methylbenzoate, and phenylacetate	8
(c) The total of ethylbenzene. trichloroethylene, toluene. and branched-chain ketones	20
(d) A solvent which may be classified into more than one of the above groups shall be considered a member of the group having the lowest allowable concentration	
(e) Total of (a), (b), and (c)	20

Since the solvent content is limited by generic terms, the used paint MSDS must be consulted.

C-19. MILITARY SPECIFICATION HIL-E-52798, ENAMEL, ALKYD, CAMOUFLAGE.

a .This enamel is a high grade, air drying, alkyd type used as a camouflage coating over new or previously painted surfaces. The enamel is a lusterless coating available in the following colors:

Light Green	Sand
Forest Green	Earth Brown
Dark Green	Earth Red
Olive Drab	Desert Sand
Earth Yellow	Black
Field Drab	

It Is also furnished in Type I formulation which is the standard formulation for all colors and Type II which Is a non-lead formulation for forest green.

b. This enamel is suitable for use under air pollution regulations and the solvent content is limited to that described in table C-39. Since the solvent content is limited by generic terms, the MSDS for the paint used must be consulted.

Table C-39
Volatile composition

Ingredient	Percent of volume Maximum
(a) Aromatic compounds with eight or more carbon atoms except ethylbenzene	8
(b) Ethylbenzene and toluene	20
(c) Solvents with an olefinic or cycloolefinic type of unsaturation	negative
(d) Ketones	negative
(e) Total of (a) and (b)	20

c-20. FEDERAL SPECIFICATION TT-E-485, 17 SEPTEMBER 1968, ENAMEL, SEMIGLOSS, RUST-INHIBITING.

a. This is a semigloss rust-inhibiting enamel for use on metal as a one or two coat primer or finishing system. Four types of enamel are covered by this specification:

Type I - Dip application
Type II - Brush and Spray application
Type III - Roller Coat application
Type IV - Flash Dry application

This enamel will be either olive drab, olive green, Marine Corps green or natural color depending on the pigment present. The pigment used in this enamel contains lead and chromium VI compounds.

b. This formulation may consist of Composition G for general use and Composition L for limited use under air pollution regulations. The volatile portion of all four types is limited to that presented in table C-40.

Table C-40
Volatile composition

Ingredients	Percent by volume Maximum
(a) Aromatic compounds with eight or more carbon atoms except ethylbenzene	8
(b) Ethylbenzene and toluene	20
(c) Solvents with an olefinic or cycloolefinic type of unsaturation	negative
(d) Ketones	negative
(e) Total of (a) + (b)	20

c-21. MILITARY SPECIFICATION MIL-L-11195, 9 NOVEMBER 1977, LACQUER, LUSTRELESS, HOT SPRAY.

a. This is a cellulose nitrate lustreless lacquer that can be applied at either elevated or room temperatures. There are two types of lacquers-? Composition G for general use and Composition L for use when required by air. pollution regulations. The volatile portion of the material is limited by that presented in table C-41.

Table C-41
Quantitative requirements of volatile portion

Material	Composition G Percent by weight Minimum	Maximum	Composition L Percent by weight Minimum	Maximum
Esters and ketones percent by weight[1]	37.5	--	37.5	--
Alcohols, percent by weight[1]	15	22.5	15	22.5
Aromatic hydrocarbons, percent by weight[3]	--	40	--	20
Aliphatic hydrocarbons	--	--	- -	20

[1] Minimum bojling point; 111 °C.
[2] At least 50 percent of the alcohol content shall have a minimum boiling point of 116 'C.
[3] Minimum boiling point; 135 °C.

Composition L material must also meet table C-42.

Table C-42
Volatile composition

Ingredient	Percent by volume Maximum
(a) Solvents having an olefinic or cycloolefinic type of unsaturation	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbentene	8
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, or toluene	20
(d) Total of (a) + (b) + (c)	20

Since the volatile composition of the lacquer is in generic terms, the MSDS for the material being used must be consulted.

b. This lacquer may be furnished in 1 quart or 1 gallon containers, 5-gallon steel pails, or 55-gallon drums and is available in 19 colors, depending upon the pigment used. When lead chromate pigment is present the container must be marked with the following label:

CAUTION: Contains lead chromate. Take adequate precautions when spraying. Avoid inhalation and repeated or prolonged skin contact.

C-22. MILITARY SPECIFICATION MIL-L-52043, 15 JULY 1972, LACQUER, SEMIGLOSS, CELLULOSE NITRATE.

a. This Is a cellulose nitrate semigloss lacquer that can be applied at either elevated or room temperatures. It is intended for use on chemically treated and/or primed tanks, trucks, automotive components and fire control systems. There are two types of lacquers: Composition G for general use and Composition L for use when required by air pollution regulations. The volatile portion of the material is limited by that presented in table C-43.

Table C-43
Quantitative requirements of volatile portion

Material	Composition G Percent by weight Minimum	Maximum	Composition L Percent by weight Minimum	Maximum
Esters and ketones[1]	37.5	--	37.5	--
Alcohols[2]	15	22.5	15	22.5
Aromatic hydrocarbons[3]	--	40	--	20
Aliphatic hydrocarbons	--	--	--	20

[1] Minimum boiling point; 111 °C.
[2] At least 50 percent of the alcohol content shall have a minimum boiling point of 116 °C.
[3] Minimum boiling point; 135 °C.

Composition L material must also meet table C-44.'

Table C-44
Volatile composition

Inqredients	Percent by volume Maximum
(a) Solvents having an olefinic or cycloolefinic type of unsaturation	5
(b) A combination of aromatic compounds with eight or more carbon atoms to the molecule except ethylbenzene	8
(c) A combination of ethylbenzene, ketones having branched hydrocarbon structures, or toluene	20
(d) Total of (a) + (b) + (c)	20

Since the volatile composition of the lacquer is in'generic terms, the MSDS for the material being used must be consulted.

b. This lacquer may be furnished in 1 quart or 1 gallon friction top containers, S-gallon steel pails, or S-gallon drums and is available in 12 colors, depending on the pigment used. When lead chromate pigment is present the container must be marked with the following warntng:

CAUTION: Contatns lead chromate. Take adequate precautions when spraying. Avoid inhalation and repeated or prolonged skin contact.

C-23. MILITARY SPECIFICATION **MIL-L-14486, 25 MARCH 1964, LACQUER, VINYL** RESIN, SEMIGLOSS.

a. **This lacquer is Intended primarily for use as a finish coat on steel prepared with wash primer and vinyl red lead primer where severe abrasive conditions or intermittent exposure to fresh or salt water may be encountered.** It **is available in either olive drab or white.**

b. The composition of the volatile portion of the lacquer shall conform to that presented in table C-45.

Table C-45
Composition of volatile vehicles

Ingredient	Percent by weight Maximum	Minimum
(a) Ketones	--	50
(b) Aromatic hydrocarbons	50	--

Since the solvent content of the material is in generic terms, the MSDS for the material being used must be consulted.

b. **This lacquer may be furnished in l-quart or 1-gallon friction top containers, 5-gallon steel pails, or 55-gallon steel drums. When the material contains lead pigments the following marking must be placed on each container:**

CAUTION: **This lacquer contains toxic pigments. Adequate precautions should be taken when spraying.**

Section IV
-Thinners

C-24. MILITARY SPECIFICATIONS MIL-T-6095, 29 OCTOBER 1969, THINNER, CELLULOSE NITRATE DOPE, BLUSH-RETARDING.

a. This thinner is intended for use as a blush-retarding thinner for cellulose nitrate dopes and lacquers only. The composition is presented in table C-46.

Table C-46
Composition

Ingredients	Percent by weight
(a) Butyl Acetate	39.2 - 40.8
(b) Butyl Alcohol	24.5 - 25.5
(c) Naptha, Aromatic Type II	24.5 - 25.5
(d) Amyl Acetate	9.8 - 10.2

b. This material is furnished in 5-gallon containers or 55-gallon drums. Each container will be marked with the following nomenclature: Thinner, Cellulose Nitrate Dope, Blush Retarding. Each container is also marked with the following instructions: Directions: Use only if required to eliminate blushing of Cellulose Nitrate Dopes and Lacquers.

C-25. FEDERAL SPECIFICATION TT-T-266, INTERIM AMENDMENT-2 (GSA-FSS), 14 JUNE 1978, THINNER, DOPE AND LACQUER (CELLULOSE-NITRATE).

a. This thlnner is Intended for use with lacquers and dopes. The composition is presented in table C-47.

b. This material may be furnished in l-pint, l-quart, or l-gallon metal cans, S-gallon palls, or 55-gallon drums. Markings shall include the following: This thinner contains highly volatile solvent. Avoid prolonged breathing of vapors. Provide good ventilation when using. Keep thinner-away from open flame.

Table C-47
Composition

Ingredients	Minimum Volume Percent Allowed	Maximum Volume Percent Allowed
(a) Compounds with olefinic or cycloolefinic type of unsaturation		5
(b) Aromatic compounds wlth eight or more'carbon atoms to the molecule, except ethylbenzene		8
(c) Ethylbenzene, toluene, and branched chain ketones		20
(d) Total of all nonexempt compounds (a)+ (b) + (c)		20
(e) Total alcohol		30
(f) Aliphatic naptha		17
(g) Total ester or ketone	42	
(h) Isobutyl acetate or n-butyl acetate	30	
(i) Isobutyl alcohol or n-butyl alcohol	10	

C-26. FEDERAL SPECIFICATION TT-T-291, 30'NOVEMBER 1978, THINNER. PAINT, MINERAL SPIRITS, REGULAR AND ODORLESS.

a. This thinner is provided in three types, all of which meet pollution control standards for the emission of solvents into the atmosphere. Type I is regular mineral spirits, Type II Is high flash (or 60 percent) mineral spirits, and Type III is odorless mineral spirits. The composition is presented in table C-48.

Table C-48
Composition of Types I, II, & III

Ingredients	Percent by volume Maximum
(a) Solvent with olefinic or cycloolefinic unsaturation	5
(b) Aromatic compounds with eight or more carbon atoms in molecule, except ethylbenzene, methyl benzoate. and phenyl acetate	8
(c) Total of ethylbenzene, toluene, and branched chain ketones	20
(d) Total of (a) + (b) + (c)	

b. Minimum flashpoint for Type I and Type III is 38 °C, and the minimum flashpoint for Type II is 60 °C.

c. This material is intended for use as a solvent or thinner for coatings such as paints, primers, and natural or synthetic enamels or the vehicle components They are used generally where thinners of high solvency power are not required. Types I and II are conventional- mineral spirits. Type II is used where a thinner with a higher flashpoint and slower evaporation rate is required. Type III is used where a relatively low odor thinner Is required.

d. This material is provided in l-quart and l-gallon metal cans, 5-gallon metal pails. and 55-gallon drums. -Special markings are required on all unit containers.

C-27. MILITARY SPECIFICATION MIL-T-81772. 29 JANUARY 1986, THINNER, AIRCRAFT COATING.

a. This material is furnished in three types. Type I which is a polyurethane thinner, Type II which is an epoxy thinner, and Type III which is an acrylic and alkyd thinner. Composition of the thinners is limited by that presented in table.C-49.

Table C-49
Thinner Composition

Ingredients	Percent by volume		
	Type I	Type II	Type III
(a) Methyl ethyl ketone	30 min.	50 min.	30 min.
(b) Methyl isobutyl ketone	--	20 max.	--
(c) Ethyl acetate	--	--	30 min.
(d) Butyl acetate	10 min.	--	--
(e) Propylene glycol methyl ether acetate	40 min.	--	20 min.
(f) Propylene glycol methyl ether	--	30 min.	--
(g) Toluene	12 max.	--	12 max.
(h) Xylene	8 max.	--	8 max.

b. Type I thinner is used to reduce the viscosity of MIL-C-46168. two component PUP, Type I and Type II. In areas where VOC compliance is not required MIL-L-53039. single component, polyurethane may be thinned with Type I thinner. Type I thinner may be used to thin epoxy coatings if Type II thinner is not available.

c. Type II thinner is used to thin MIL-C-22750, EPE. The primers, MIL-P-53022, MIL-P-52192, and MIL-P-23377, Type I are thinned with Type II thinner. If Type II is not available then Type I can be used.

d. Type III thinner is an acrylic and alkyd thinner for-use with acrylic-nitrocellulose lacquer.

e. This material is normally contained in l-gallon cans; however, larger containers may be stipulated. NSNs for Type I and Type II Thinners are presented in table C-46.

Table C-50
NSNs for MIL-T-81772 Type I ard Type II Formulation

Type	NSN for container		
	Gallon 8010-00-	5 Gallon 8010-00-	55 Gallon 8010-00-
MIL-T-81772 Type I	181-8080	181-8079	280-1751
MIL-T-81772 Type II	200-2637	212-1704	

APPENDIX D
SPRAY BOOTH INFORMATION AND EVALUATION METHODOLOGY

D-1. Spray booths or spray rooms must be constructed of noncombustible material (29 CFR 1910.94, and 29 CFR 1910.107). Spray painting with CARC and/or PUP and other dual component coatings should only be conducted in spray booths meeting the requirements of 29 CFR 1910.107 and other appropriate fire, safety and health regulations.

D-2. Airflow determinations should be made when the booth is empty. Airflow should be determined by dividing the cross-sectional area of the booth into 16 equal areas. This should be located in the middle third of- the booth or where the majority of the painting is performed. Anemometer readings should be taken in the center of each of these areas. These 16 values are averaged to obtain the mean feet per minute flow through the booth. This value is compared with the established requirements in appendix G or 29 CFR 1910.94.

D-3. With down-draft booths, the same procedure is used except that the floor area is divided into 16 equal areas. Anemometer readings are taken 4 feet above the floor in the center of these areas. These 16 values are averaged to obtain the mean feet per minute flow through the booth. The airflow requirements for down-draft booths are the same as for horizontal flow booths.

D-4. Paint booths or paint rooms should be under a slight negative pressure, 0.05 inch of H_2O gauge, or greater as long as negative pressures do not become so great that door opening and closings are affected.

D-5. Make-up air into the booth should be introduced in a manner which will provide uniform flow through the process areas and should not be introduced at velocities greater than 200 feet per minute (ANSI Standard Z9.3-1985 and 29 CFR 1910.94). Airflow patterns can be observed by using smoke candles or smoke tubes.

D-6. Make-up air should be heated if outdoor temperatures are expected to remain below 55 °F for appreciable periods of time during operation, except where adequate and safe means of radiant heating is provided. When heating is required, the replacement air will be maintained at not less than 65 °F at the point of entry into the spray area. Alternately, the building in which the spray area is contained may be maintained at 65 °F. (See ANSI 29.3-1985 and 29 CFR 1910.94).

D-7. Dry filters or water-wash spray booths are used to clean exhaust or make-up air. When water-wash booths are used and are constructed of steel, the material must be 18 gauge or heavier and protected against corrosion. Chambers must create and maintain a scrubbing action for removing particulate matter. Collecting tanks should be of welded steel construction or other noncombustible material. If pits are used they should be of concrete-or masonry construction. The collecting tanks should have weirs, skimmers or screens designed to prevent sludge from entering the pump. The water level. should be maintained by means of automatic controls. The fresh water inlets should not be submerged--terminate at least one pipe diameter above the overflow level of the tank (29 CFR 1910.94).

D-8. When dry filters are used, they must be in a location easily accessible for inspection, cleaning or replacement. The supports and holders should be of a noncombustible material. A pressure gauge must be installed to show the pressure drop across the filters. This gauge must be marked to indicate the pressure drop at which the filters require cleaning or replacement. Maintenance procedures must be established to assure filter replacement before excessive restriction to airflow occurs. All discarded filter pads and filter rolls must be removed to a safe, well-detached location or placed in a water-filled metal container and disposed of at the end of a day's operation unless maintained completely in water (29 CFR 1910.107).

D-9. Each spray booth should have an independent exhaust duct system discharging to the exterior of the building, except when multiple booths are used for the same process and the total frontage area does not exceed 18 square feet. In this instance, a common exhaust is permissible. Exhaust from booths must be directed to assure it will not contaminate incoming air or create a nuisance. Air from spray areas will not be recirculated (29 CFR 1910.107).

APPENDIX E
VENTILATION DESIGN

Table. Spray Paint Ventilation Rates/Flow Rates

	(cfm/sq ft face area)			
	Air Spray		Airless Spray	
	Design	Operating Range	Design	Operating Range
Spray Cabinet*				
<4 sq ft face	200	175 - 225	125	100 - 150
>4 sq ft face	150	125 - 175	100	75 - 125
Booth: Vehicular	100	75 - 125	75	75 - 100
Walk-in	150	125 - 175	100	75 - 125

*Cabinet located above floor, usually at waist level. Worker's face does not enter the cabinet.

Note:

The values specified in this table are equal to or greater than those listed in table G-10, 29 CFR 1910.94.

APPENDIX F
PAINTING IN CONFINED SPACES

(This appendix is provided as information only and not to be considered as an all encompassing document on confined space work.)
Note: The term open space is any area not meeting the definition of confined space.

F-1. INTRODUCTION.

a. Confined space. as defined in the glossary, is subject to the accumulation of toxic or comubustible gases or the development of an oxygen deficient or enriched atmosphere. Therefore, respiratory protection is required when working in a confined space. The type of respiratory protective equipment depends on the type of confined space encountered. See the glossary for the definitions of oxygen deficient atmosphere, oxygen enrichedatmosphere, combustible atmosphere, toxic atmosphere, immediately dangerous to life or health (IDLH) atmosphere, and not immediately dangerous to life or health (NIDLH) atmosphere.

b. Confined spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, and open top spaces more than 4 feet in depth such as pits, tubs, vaults, and vessels.

c. Confined spaces may also include areas in and under vehicles or equipment where airflow is restricted.

d. When painting indoors and not in paint booths, a confined space is defined as an area which as a volume of less than 10,000 cubic feet or a celling height less than 16 feet.

e. Confined spaces outdoors is an area where the painter is enclosed and dilution ventilation cannot occur. This includes painting in shelters with a ceiling height less than 16 feet or areas where three sides are enclosed and airflow is limited.

F-2. STEPS TO BE TAKEN.

a. Employees will be instructed in the nature of the hazards involved, the necessary precautions to be taken, and in the use of PPE and emergency equipment required.

b. Prior to employee entry into areas where an IDLH is likely to occur, appropriate tests of the atmosphere will, be conducted to determine the oxygen content, and if combustible gas or toxic levels have been exceeded. Testing will be conducted in the above order prescribed.

c. Prior to employee entry into potential IDLH areas where contents of tanks or vessels may be accidently filled, electrical control circuits will be locked-out and pipe flanges will be blanked (sealed) or pipes will be completely disconnected.

. d. If the tests performed indicate the atmosphere is unsafe, it will be ventilated until the hazardous atmosphere is removed prior to employee entry.

e. Precautions will be continued and atmospheric tests made during operations to prevent the occurrence of a hazardous atmosphere while an employee is in the confined space.

f. Confined space entry into potential IDLH areas requires specific standard operating procedures. Supervisory authorization will be obtained before entering a confined space. A trained attendant will be posted outside the confined space entrance to observe and provide assistance as necessary. Periodic communication will be maintained between the attendant and personnel in the confined space. The establishment of an entry permit system is recommended.

g. In the absence of ventilation or testing, or if air sample results are above the established air contaminant levels, only trained personnel equipped with proper PPE will be allowed entry into potential IDLH areas. Entry requires the use of a supplied air respirator with an auxillary air supply or a self-contained breathing apparatus, appropriate protective clothing, a safety harness and a lifeline. Protective clothing will provide protection against skin contact and absorption of hazardous materials encountered in the confined space. All equipment that will be used in an explosive atmosphere will be approved as explosion proof or non-sparking or intrinsically safe for the atmosphere involved.

h. Means will be provided for quick removal of employee(s) in case of emergency. Safety harnesses and lifelines will be used for quick removal of an employee's body from the confined space.

APPENDIX G
RESPIRATORY PROTECTION REQUIREMENTS

G-1. SPRAY PAINTING INDOORS.

a. An approved or accepted pressure demand or continuous flow Type C, full-facepiece hood or helmet supplied-air respirator Is the standard respirator to be worn when spray painting indoors. However, alternatives are permitted when authorized by preventive medicine personnel. Table G-l must be reviewed to determine acceptable respiratory protectlon.

b. In all cases, the alternative respirator system must be approved for protection of contaminants at the levels documented.

G-2. SPRAY PAINTING OUTDOORS.

a. An approved or accepted pressure demand or continuous flow, Type C, full-facepiece hood or helmet supplied-air respirator must be worn when--

(1) spray painting outdoors and solvent concentrations exceed the limits of an applicable organic vapor cartridge* respirator system, or

(2) worklng in a confined space (see para G-4).

b. Alternatives are permitted when authorized by preventive medicine personnel. Table G-l must be reviewed to determine acceptable respiratory protection.

c. In all cases, the alternative respirator system must be approved for protection of contaminants at the levels documented.

G-3. BRUSH/ROLLER PAINTING INDOORS AND OUTDOORS.

a. Respiratory protectlon Is not requlreb when painting In open spaces and authorized by preventive medicine personnel.

b. An approved half-mask respirator with organic vapor cartridge* with paint prefilter (or HEPA filter if required) wlll be required If solvent or pigment atmospheric concentrations exceed standards (see Table G-l).

c. An approved or accepted pressure demand or continuous flow, Type C, full-facepiece hood or helmet supplied-atr respirator is required If diisocyanate atmospheric concentrations exceed the standards.

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*A cartridge or canister.

G-4. SPRAY/BRUSH/ROLLER PAINTING IN ALL CONFINED- $-PACES.

a. An approved or accepted pressure demand or continuous flow; Type C, full-facepiece hood or helmet supplied-air respirator may be used in spray, brush, or roller painting in both indoor and outdoor confined space (NIDLH) operations.

b. An approved or accepted pressure demand or continuous flow, Type C, full-facepiece supplied-air respirator with auxiliary self-contained afr supply is required in operations when an-

(1) individual cannot imnediately exit a confined space safely if the primary air supply is interrupted, or

(2) imnediately life threatening toxic environment is present (i.e., IDLH).

c. Alternative respiratory protection for brush and roller operations only are permitted when authorized by preventive medicine personnel (see Table G-l).

Selection chart for respiratory protection devices

Condition[1]	Approved or accepted respiratory protective equipment: Supplied air	Full face organic vapor cartridge[7] with paint prefilter	Half-mask organic vapor cartridge[7] with paint prefilter	None
1. Spray painting indoors				
a. Walk-in or vehicular booth				
(1) HDI concentrations exceed standard.	X			
(2) HDI concentrations are below standard.		X		
(3) Solvent or pigment concentrations greater than standard but less than 10X standard.	X	X[2]	X[2]	
(4) Solvent or pigment concentrations greater than 10X standard with solvent concentration exceeding limits of the organic vapor cartridge.[7]	X			
(5) Solvents or pigment concentrations greater than 10X standard but solvent concentrations do not exceed limits of the organic vapor cartridge.[7]	X	X[2]		
b. Spray cabinet or conveyor-booth.				
(1) If all contaminant levels are below standards.				X
(2) HDI concentrations exceed standard.	X			
(3) Solvent or pigment concentrations greater than standard but less than 10X standard.	X	X[2]	X[2]	
(4) Solvent or pigment concentrations greater than 10X standard with solvent concentration exceeding limits of the organic vapor cartridge.[7]	X			

[continued on next page]

Condition[1]	Approved or accepted respiratory protective equipment: Supplied air	Full face organic vapor cartridge[7] with paint prefilter	Half-mask organic vapor cartridge[7] with paint prefilter	None
(5) Solvent or pigment concentrations greater than 10X standard but solvent concentrations do not exceed limits of the organic vapor cartridge.[1]	X	X[2]		
2. Spray painting outdoors (open spaces).				
a. HDI concentrations exceed standard.	X			
b. Solvent or pigment concentrations greater than 10X standard with solvent concentration exceeding limits of the organic vapor cartridge.[1]	X			
c. Solvent or pigment concentrations greater than 10X standard but solvent concentrations do not exceed limits of the organic vapor cartridge.[7]	X	X[2]		
d. Solvent or pigment concentrations greater than standard but less than 10X standard.	X	X[2]	X[2]	
e. If all contaminant levels are below standards.		X	X	X[3]
3. Brush/roller painting Indoors and outdoors (open spaces).	X[5]		X[2,4]	X[3]
4. Spray/brush/roller painting In all confined spaces.				
a. Spray operations	X[5]			
b. Brush/roller operations	X[5,6]			

[1] Standard refers to either ACGIH or OSHA whichever Is more stringent.
[2] HEPA filter on resptrator svstem is required if lead and chromate concentrations are greater than the standard and/or the particulate TLV Or PEL is less than or equal to 0.05 mg/m^3.
[3] Only when authorized by preventive medicine personnel.
[4] Required if solvent or pigment atmospheric concentrations are greater than the standards.
[5] A pressure demand or continuous flow, Type C. supplied air respirator with auxiliary self-contained air supply to allow entry or exit to confined spaces safely is required if the primary air supply is Interrupted or an IDLH atmosphere is possible. A pressure demand or continuous flow, Type C, full facepiece hood or helmet can be used in NIDLH atmospheres.
[6] Alternative respiratory protection permitted when authorized by preventive medicine Personnel.
[7] Cartridge or canister.

GLOSSARY

SECTION I
ABBREVIATIONS

ACGI H	American Conference of Governmental Industrlal Hygienists
ANSI	American National Standards Institute
CARC	chemical agent resistant coating
DHEW	Department of Health, Education, and Welfare
D H H S	Department of Health and Human Sciences
EP	extraction-procedure
EPA	U.S. Envlronmental Protection Agency
EPE	epoxy polyamide enamel
FEV_1	forced expiratory volume in second
FVC	forced vital capacity
HDI	hexamethylene diisocyanate
HEPA	high efficiency particulate air
HMIS	Hazardous Materials Information System
HW	hazardous waste
IDLH	immediately dangerous to life or health
IMA	installation medical authority
MEK	methyl ethyl ketone
MIL STD	military standard
MSDS	material safety data sheet
NFPA	National Fire Protection Association
NIDLH	not immediately dangerous to life or health

NIOSH	National Instltute of Occupational Safety and Health
NSN	national stock number
OHMIS	Occupational Health Management Information System
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PPE	personal protective equipment
PUP	polyurethane paint
RCRA	Resource Conservation and Recovery Act
TG	technical guide
TLV	threshold limit values
TWA	time-weighted average
USAEHA	U.S. Army Environmental Hygiene Agency
VOC	volatile organic compound

SECTION II
TERMS

Approved
Tested and listed as satisfactory according to standards established by a competent authority (such as NIOSH, Mine Safety and Health Administration, or host country agency) to provide respiratory protection against the particular hazard for which it is designed. (Approved authority may be specified by law.)

Confined space
A space having limited means of entry or egress (exit) and so enclosed that adequate dilution ventilation is not obtained by natural air movement or mechanically induced movement.

Combustible atmosphere
An atmosphere in excess of 10 percent of the lower explosive limit.

Immediately dangerous to life or health atmosphere
A condition posing an immediate threat to life or health, or an immediate threat of severe exposure to contaminants likely to have adverse delayed effects on health. This condition includes atmospheres where oxygen content by volume is less than 16 percent (29 CFR 1910.134g(5)).

Installation-medical authority
The unit surgeon, command chief surgeon, MEDDAC and/or MEDCEN commanders, and the Director of Health Services or his or her representative responsible for provision of medical support at the unit, command, or installation concerned.

NIDLH atmosphere
Any atmosphere which may produce physical discomfort immediately, chronic poisoning after repeated exposure, or acute physiological symptoms after prolonged exposure.

Open space
Any area not meeting the definition of confined spaces.

Oxygen deficient atmosphere
An atmosphere where the oxygen concentration is less than 19.5 percent by volume..

Oxygen enriched atmosphere
An atmosphere with greater than 21 percent oxygen by volume.

Paint system
The protective paint barrier which covers a painted object and consists of a pretreatment coat, primer coats, and finish or top coats.

Painting
Refers to the application of surface coatings such as CARC.

Toxic atmosphere
An atmosphere where air contaminants are in excess of their respective standard.