

TECHNICAL BULLETIN

**ENVIRONMENTALLY SAFE SUBSTANCES
FOR USE WITH
COMMUNICATIONS-ELECTRONICS EQUIPMENT**

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HEADQUARTERS, DEPARTMENT OF THE ARMY

1 June 1994

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

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CHAPTER 1 INTRODUCTION

Section I. General Information

1-1. SCOPE

The stratospheric ozone layer protects the earth from dangerous ultraviolet-B (UV-B) radiation. Depletion of stratospheric ozone allows more UV-B radiation to penetrate to the earth's surface. Increased radiation, in turn, has been linked to higher incidence of certain skin cancers and cataracts, suppression of the human immune system, damage to crops and aquatic organisms, and increased formation of ground-level ozone. In order to encourage movement away from ozone-depleting substances (ODSs), substitutes that offer lower overall risks to human health and the environment have been identified by the Environmental Protection Agency (EPA).

This technical bulletin lists the currently identified substitutes for ODSs used with Communications-Electronics equipment. In addition, the TB provides generalized instructions for the use of the approved substitutes in maintenance procedures. It also lists Class I ODSs, which will no longer be procured after 1995, and Class II ODSs, some of which will no longer be manufactured after 1999. Provided for information are various obsolete WARNINGS, CAUTIONS and NOTES and their substitutes.

1-2. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS

Refer to the latest issue of DA Pam 25-30 to determine whether there are revisions or changes to this TB.

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS

Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, as contained in Maintenance Management Update.

1-4. DESTRUCTION OF ARMY ELECTRONICS MATERIEL

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-5. REFERENCES

- a. HQ AMC message 141500Z Feb. 90, Subject: Chloroflourocarbons (CFCS)/Halons
- b. DA Memo DAEN-ZCZ-A, 27 Jul. 90, Subject: Eliminating or Minimizing Atmospheric Emissions of Ozone-Depleting Substances
- c. IEA Memo, AMXIS-D, 24 Aug. 90, Subject:: Implementation of Army Policy on Ozone-Depleting Substances
- d. HQ AMC message 161735Z Oct 90, Subject: Implementation of Army Policy on Ozone-Depleting Substances
- e. HQ AMC message 181530Z Oct 90, Subject: Implementation of Army Policy on Ozone-Depleting Substances
- f. Under Secretary of Defense memo, 11 Aug. 92, Subject: Ozone Depleting Chemicals
- g. Executive Order 12843, 23 Apr 93, Subject: Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances
- h. Department of the Army Memo, 20 May 93, Subject: Elimination of Ozone-Depleting Chemicals; Implementation of the requirements of the National Defense Authorization Act for Fiscal Year 1993

- I. Federal Register, Part II, 14 May 93, Subject: Protection of Stratospheric Ozone; Refrigerant Recycling; Final Rule
- j. Executive Order 12856, 3 Aug 93, Subject: Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements
- k. Federal Register, 18 March 1994, Vol. 59, No. 53, Part II, Environmental Protection Agency, Protection of Stratospheric Ozone; Final Rule.

CHAPTER 2

OZONE DEPLETING SUBSTANCES

Section I. Class I ODSs

2-1. OZONE DEPLETING SUBSTANCES COMMONLY USED WITH COMMUNICATIONS-ELECTRONICS EQUIPMENTS

The following three ODSs are those generally used for cleaning electronics equipment. Also listed, for informational purposes, are alternate common names and the military standards which govern them. Existing stocks should be exchanged for an approved substitute as soon as possible, but may be used until depleted.

- a. *Carbon Tetrachloride*: CC, O-F-351, O-F-380, MS36030
- b. *Trichlororifluoroethane*: CFC-113, Freon T, MIL-C-81302, MIL-C-83360
- c. *Methyl Chloroform, 1,1,1 Trichloroethane*: O-T-620, MIL-T-81533, O-T-634, ASTM D4126

2-2. SOLVENT SUBSTITUTE HISTORY

a. The Material Substitution Committee, located at Los Alamos National Laboratory as part of the Waste Minimization Program Office, was formed to gather information on solvent substitutes for machining operations using ODSs and to identify appropriate non-hazardous solvent substitutes for a variety of uses. The Committee has tried to find commercially available and easily accessible replacements.

b. Table A-1 lists 21 solvent substitutes that the Committee tried in various applications, the results of those tests, and the applications for which they can be used. Lower values listed in the Comments/Results column indicate the amount of residue left on surfaces after the tests were completed.

c. The substitutes should be applicable to many cleaning situations; however, any substitute should be tested for each specific application by using a small amount first. If the substitute is found to be effective, continue to use it.

2-3. CORROSION REMOVING COMPOUNDS

The information in the following four table was extracted from The Federal Register, 18 March 1994, Part II Protection of Stratospheric Ozone; Final Rule.

Table 2-1. Corrosion Removing Compounds

Company Name: Chemical Research Corporation				
Product Name	NSN	Unit Issue (UI)	Comments/Uses	Source of Supply
CRC 1205	6850-01-362-3900	1 gal (bulk)		
	6850-01-362-3901	55 gal		
	6850-01-362-4840	5 gal		
Company Name: Dominion Restoration				
DR-9000	6850-01-362-3900	1 gal (bulk)		
	6850-01-362-3901	55 gal		
	6850-01-362-4840	5 gal		
DR-80	6850-01-375-9325	55 gal	Removes rust from metals or mineral deposits from nonmetal surfaces	
	6850-01-375-9326	5 gal		

2-4. SKIN PROTECTIVE COMPOUNDS

Table 2-2. Skin Protective Compounds

Company Name: Benchmark Enterprises, Inc.				
Product Name	NSN	Unit Issue (UI)	Comments/Uses	Source of Supply
804 (Derma Shield)	6850-01-951-7157	(6) 17 oz aerosol	Non-greasy, nontoxic, temporary product used to protect skin from harmful or annoying stimuli.	S9G ¹
800	6850-01-353-0140	(12) 12 oz aerosol	Same as above	S9G ¹
850 (Derma Plus)	6850-01-371-8039	(12) 12 oz aerosol	Same as above	S9G ¹
855 (Derma Plus)	6850-01-371-8040	(6) 17 oz	Same as above	S9G ¹
891 (Derma Med)	6850-01-371-8042	(12) 6 oz	Same as above	S9G ¹
895 (Derma Med)	6850-01-371-8041	(6) 17 oz	Same as above	S9G ¹
Dispenser or use with Skin Protective Compounds				
Dispenser	6850-01-372-8684			S9G ¹

FOOTNOTE:

¹S9G. Defense General Supply Center, Richmond, VA 23297; DSN 695-6054; Comm 804 279-6054; 800 352-2852

2-5. DEICING COMPOUNDS

Table 2-3. Deicing Compounds

Company Name: Cargill Salt				
Product Name	NSN	Unit Issue (UI)	Comments/Uses	Source of Supply
Dyn-o-Melt	6850-01-377-8443 6850-01-377-8444 6850-01-377-8445 6850-01-377-8607 6850-01-377-8606	10 lb bag 25 lb bag 50 lb bag 80 lb bag 100 lb bag	Used on sidewalks, bridges, step, roadways; substitute for Rocksalt Urea, Calcium Chloride, Potassium Chloride.	S9G ¹
CG-90 Surface Saver	6850-01-371-9163 6850-01-371-9164 6850-01-371-9165	Bulk Mini-Bulk Bulk	Used for highway and bridge maintenance; substitute for Urea, Calcium Chloride.	S9G ¹
CG-90 Original Deicer				

FOOTNOTE:

¹S9G Defense General Supply Center, Richmond, VA 23297; DSN 695-6054; Comm 804279-6054; 800 352-2852

2-6. SCALE REMOVING COMPOUND

Table 2-4. Scale Removing Compound

Company Name: Dominion Restoration, Inc.				
Rust Stain Remover	6850-01-380-4314	5 gal	Spray on rust remover for concrete and stone without damage by mineral acids or agitation.	S9G ¹
	6850-01-380-4145	55 gal		

FOOTNOTE:

¹S9G. Defense General Supp Center, Richmond, VA 23297; DSN 695-6054; Comm 804 2796054; 800 352-2852

2-7. CLASS I ODSs

- a. Some of these chemicals will no longer be available in the DOD Supply System beginning in June 1994.

Halon-1211 (CF₂Br); Bromochlorodiuoromethane (fire extinguisher)

Halon-1301 (CF₃Br); Bromotrifluoromethane (fire extinguisher)

Carbon Tetrachloride, CCl₄

Chlorofluorocarbon-13 CFC-13 (CF₃Cl); Chlorotifluoromethane (refrigerant)

Halon-2402 (C₂F₄Br₂); Dibromotetrafluoroethane

Chlorofluorocarbon-12 CFC-12 (CF₂C₂); Dichlorodifluoromethane, (refrigerant/freon)

Chlorofluorocarbon-216 CFC 216 (C₃F₆C₁₂); Dichlorohexafluoropropane

Chlorofluorocarbon-114 CFC-114 (C₂F₄Cl₂); Dichlorotetrafluoroethane

Hydrobromouorocarbons (HFBCs); HBFC-22B1 (firefighting agent)

Chlorofluorocarbon-211 CFC 211 (C₃FC₁₇); Heptachlorofluoropropane

Chlorofluorocarbon-212 CFC 212 (C₃F₂C₆); Hexachlorodifluoropropane

Methyl Bromide (CH₃Br) (fumigant and sterilant)

Methyl Chloroform (C₂H₃Cl₃); 1,1,1 Trichloroethane

Chlorofluorocarbon-217 CFC 217 (C₃F₇Cl); Monochloroheptafluoropropane

Chlorofluorocarbon-115 CFC-115 (C₂F₅Cl); Monochloropentafluoroethane

Chlorofluorocarbon-111 CFC-111 (C₂FC₁₅); Penchlorofluoroethane

Chlorofluorocarbon-213 CFC 213 (C₃F₃C₁₅); Pentachlorotrifluoropropane

Chlorofluorocarbon-112 CFC 112 (C₂F₂C₄); Trachlorofluoroethane

Chlorofluorocarbon-214 CFC 214 (C₃F₄Cl₄); Tetrachlorotetrafluoropropane

Chlorofluorocarbon-11 CFC-11 (CFCl₃); Trichlorofluoromethane

Chlorofluorocarbon-215 CFC 215 (C₃F₅C₃); Trichloropentafluoropropane

Chlorofluorocarbon-113 CFC- 113 (C₂F₃C₃); Tchlortrifluoroethane, Freon TF

- b. The following military specifications govern Class I ODSs listed in para. 2-9a, above:

A-A-51738, Dichlorodifluoromethane, technical

DOOD 6050.9 (D), Chlorofluorocarbons (CFCS) and Halons

MIL-C-81302, Rev D, Amd. 1, Ceain, compound, solvent, Trichlorotifluoroethane

MIL-C-83360, Rev C, Amd. 1, Cleaning and Lubricating compound, electrical contact

MILC-85054, Rev A, Corrosion preventive compound, water displacing, clear (AMI Guard)

MIL-C-85447, Rev A, Amd. 1, Cleaning compounds, electrical and electronic components

MIL-I-81533A, Trichloroethane, 1,1,1, (methyl chloroform) inhibited, vapor degreasing thinner

MIL-STD 610, Rev B, Halogenated hydrocarbon compounds and solvents, technical grade (metric)

MIL-T-7003 CANC, Trichloroethylene, stabilized degreasing (superseded by O-T-634)

O-C-1889, Cleaning compound, solvent

O-T-620C, Int. Amd. 3; 1,1,1 - trichoroethane, technical, inhibited, (methyl chloroform)

Section II. Class II ODSs**2-8. CLASS II ODSs**

Although use of Class ODSs is still authorized, they will be phased out in the near future. It is recommended that consideration be given to resupply with approved substitutes when on-hand stocks are exhausted. They are listed here for general information.

Hydrochlorofluorocarbon-21 HCFC-21 (CHFCl_2); Dichlorofluoromethane
 Hydrochlorofluorocarbon-22 HCFC-22 (CHF_2Cl); Monochlorodifluoromethane
 Hydrochlorofluorocarbon-31 HCFC-31 (CH_2FCl); Monochlorofluoromethane
 Hydrochlorofluorocarbon-121 HCFC-121 (C_2HFC_4); Tetrachlorofluoroethane
 Hydrochlorofluorocarbon-122 HCFC-122 ($\text{C}_2\text{HF}_2\text{Cl}_3$); Tchlorodifluoroethane
 Hydrochlorofluorocarbon-123 HCFC-123 ($\text{C}_2\text{HF}_3\text{C}_2$); Dichlorotrifluoroethane
 Hydrochlorofluorocarbon-124 HCFC-124 ($\text{C}_2\text{HF}_4\text{Cl}$); Monochlorotetrafluoroethane
 Hydrochlorofluorocarbon-131 HCFC-131 ($\text{C}_2\text{H}_2\text{FC}_3$); Tchlorofluoroethane
 Hydrochlorofluorocarbon-132B HCFC-132B ($\text{C}_2\text{H}_2\text{F}_2\text{C}_2$); Dichlorodifluoroethane
 Hydrochlorofluorocarbon-133A HCFC-133A ($\text{C}_2\text{H}_2\text{F}_3\text{Cl}$); Monochlorotrifluoroethane
 Hydrochlorofluorocarbon-141B HCFC-141B ($\text{C}_2\text{H}_3\text{FC}_2$); Dichlorofluoroethane
 Hydrochlorofluorocarbon-142B HCFC-142B ($\text{C}_2\text{H}_3\text{F}_2\text{Cl}$); Monochlorodifluoroethane
 Hydrochlorofluorocarbon-221 HCFC-221 (C_3HFC_6); Hexachlorofluoropropane
 Hydrochlorofluorocarbon-222 HCFC-222 ($\text{C}_3\text{HF}_2\text{C}_5$); Pentachlorodifluoropropane
 Hydrochlorofluorocarbon-223 HCFC-223 ($\text{C}_3\text{HF}_3\text{C}_4$); Tetrachlorotrifluoropropane
 Hydrochlorofluorocarbon-224 HCFC-224 ($\text{C}_3\text{HF}_4\text{C}_3$); Trichlorotetrafluoropropane
 Hydrochlorofluorocarbon-225CA HCFC-225CA ($\text{C}_3\text{HF}_5\text{Cl}_2$); Dichloropentafluoropropane
 Hydrochlorofluorocarbon-225CB HCFC-225CB ($\text{C}_3\text{HF}_5\text{C}_2$); Dichloropentafluoropropane
 Hydrochlorofluorocarbon-226 HCFC-226 ($\text{C}_3\text{HF}_6\text{Cl}$); Monochlorohexafluoropropane
 Hydrochlorofluorocarbon-231 HCFC-231 ($\text{C}_3\text{H}_2\text{FC}_5$); Pentachlorofluoropropane
 Hydrochlorofluorocarbon-232 HCFC-232 ($\text{C}_3\text{H}_2\text{F}_2\text{C}_4$); Tetrachlorodifluoropropane
 Hydrochlorofluorocarbon-233 HCFC-233 ($\text{C}_3\text{H}_2\text{F}_3\text{Cl}_3$); Trchlorotrifluoropropane
 Hydrochlorofluorocarbon-234 HCFC-234 ($\text{C}_3\text{H}_2\text{F}_4\text{C}_2$); Dichlorotetrafluoropropane
 Hydrochlorofluorocarbon-235 HCFC-235 ($\text{C}_3\text{H}_2\text{F}_5\text{Cl}$); Monochloropentafluoropropane
 Hydrochlorofluorocarbon-241 HCFC-241 ($\text{C}_3\text{H}_3\text{FC}_4$); Tetrachlorofluoropropane
 Hydrochlorofluorocarbon-242 HCFC-242 ($\text{C}_3\text{H}_3\text{F}_2\text{C}_3$); Trchlorodifluoropropane
 Hydrochlorofluorocarbon-243 HCFC-243 ($\text{C}_3\text{H}_3\text{F}_3\text{C}_2$); Dichlorotrifluoropropane
 Hydrochlorofluorocarbon-244 HCFC-244 ($\text{C}_3\text{H}_3\text{F}_4\text{C}$); Monochlorotetrafluoropropane
 Hydrochlorofluorocarbon-251 HCFC-251 ($\text{C}_3\text{H}_4\text{FC}_3$); Tchlorofluoropropane
 Hydrochlorofluorocarbon-252 HCFC-252 ($\text{C}_3\text{H}_4\text{F}_2\text{C}_2$); Dichlorodifluoropropane
 Hydrochlorofluorocarbon-253 HCFC-253 ($\text{C}_3\text{H}_4\text{F}_3\text{Cl}$); Monochlorotrifluoropentane
 Hydrochlorofluorocarbon-261 HCFC-261 ($\text{C}_3\text{H}_5\text{FC}_2$); Dichlorofluoropropane
 Hydrochlorofluorocarbon-262 HCFC-262 ($\text{C}_3\text{H}_5\text{F}_2\text{Cl}$); Monochlorodifluoropropane
 Hydrochlorofluorocarbon-271 HCFC-271 ($\text{C}_3\text{H}_6\text{FCl}$); Monochlorofluoropropane

CHAPTER 3

**MAINTENANCE CLEANING PROCEDURES AND ALTERNATIVE
SOLVENTS SELECTION GUIDANCE
Section I. Obsolete Procedures****3-1. General Information on obsolete procedures**

Solvents such as 1,1,1 trichloroethane and tichlorotrifluoroethane were generally considered "Universal Solvents" They were very effective, non-flammable, rapid drying and were used in numerous processes and on many types of materials. There is no single "drop in" replacement for these solvents. There are many alternatives, each of which has different qualities and effectiveness. Several alternative materials may be required to perform all of the functions that were previously by one of the "Universal Solvents" in the past. The selection of an alternative should include a review of the Material Safety Data Sheet (MSDS) information for that material, with attention to Flammability Ratings, Flash Point Temperatures and Safety Information.

3-2. For your information, following are typical examples of obsolete cleaning procedures which reference the use of ODS solvents.

- a. Remove grease, fungus, and ground-in dirt from surfaces with a clean, lint-free cloth dampened (not wet) with trichlorotrifluoroethane.;
- b. Clean solder connections using trichloroethane. Blow dry.;
- c. Use dry, clean, it-free cloth or brush to remove dust or dirt. If needed, moisten cloth or brush with tricolorotrifluoroethane. After cleaning, wipe with clean dry cloth.;
- d. To remove grease, fungus, or corrosion, use a cloth dampened in Freon TE;
- e. Tape Drive Tape Head Cleaning Method - Soak a lint-less cotton swab with Freon TF or tape head cleaner. Clean the tape head using the cotton swab.

3-3. Following are typical examples of Aqueous Cleaning procedures found in Technical Manuals, also included for your information.

NOTE

These procedures are not obsolete, however, this TB contains expanded recommendations for Aqueous cleaning procedures

- a. Dampen cloth with water, using liquid detergent, if necessary.;
- b. Wash area with strong solution of detergent. Rinse area with warm or hot water Insure that area is dry before applying power to assembly.;
- c. Clean meter faces and control panels with water and a mild detergent.;

SECTION II. REVISED CLEANING PROCEDURES

WARNING

Compressed air is dangerous and can cause serious harm if protective means or methods are not observed to prevent a chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel. Compressed air shall not be used for the cleaning purposes except where reduced to less than 30 pounds per square inch gauge (30 psig) and then only with effective chip guarding and personnel protective equipment (industrial safety glasses and full face shield). DO NOT use compressed air to dry parts when solvent cleaners have been used.

WARNING

Use solvents in well ventilated areas only. Avoid prolonged breathing of vapors. Avoid bodily contact. The use of chemical gloves (solvent resistant) and chemical splash goggles are required when using solvent materials. Do not use near heat, spark or flame. Solvents may be reactive with acids and oxidizers; do not mix or cross-apply with other cleaners or chemicals. Organic vapor respirator with dust and mist filter is recommended when solvent is spray applied. Keep containers closed between applications. Provide mechanical ventilation if used in closed spaces. Coordinate the use of this material with your supporting Industrial Hygiene and Safety Offices. Ensure that you read and understand the Material Safety Data Sheet (MSDS) for the solvent prior to use.

WARNING

Handle solvents as combustible liquids. Store cleaning materials in a well ventilated area away from food or drink and away from heat, sparks and flame. Keep container sealed when not in use. Solvent saturated waste rags must be placed in a sealed metal container after use to avoid the possibility of spontaneous combustion.

3-4. General recommendations for solvent cleaning procedures

- a. Where solvent cleaning is required the least hazardous and the weakest strength material, which will achieve the desired results, should be selected. Ensure that you read and understand the Material Safety Data Sheet (MSDS) for the solvent prior to use.
- b. Solvent cleaning is generally appropriate when rapid drying is required, where material such as paint or adhesives will be applied shortly after cleaning, where electronic components are unsealed or where electrical power will be applied to the equipment shortly after cleaning
- c. Most of the alternative solvent cleaner evaporates (dry) at a much slower rate than the materials they are replacing. In general wiping surfaces dry with a clean cloth, to remove as much solvent material as possible, will speed the drying process. Do not use forced air or heat to speed the drying process unless these procedures have been approved by both technical and Health and Safety personnel.
- d. Solvent cleaning is generally performed using a damp cloth, a saturated soft bristle brush or low pressure spray process. When using cleaning solvent follow all Safety precautions and use the least amount of solvent that will achieve the desired results.

3-5. Typical Solvent Cleaning Procedures

Use the procedure that most closely duplicates the existing procedure in your technical manual

- a. Remove grease, fungus, and ground-in dirt from surfaces with a clean, lint-free cloth dampened (not wet) with a Non-Ozone Depleting Chemical Solvent, (see list of recommended solvents below).

b. Clean solder connections using Non-Ozone Depleting Chemical Solvent, (see list of recommended solvents below). The solvent may be applied using a lint-free cloth dampened (not wet) with the solvent, a brush containing the solvent or a spray solvent application process. Dry area with a clean lint-free cloth.

c. Use dry, clean, lint-free cloth or brush to remove dust or dirt. If needed, moisten cloth or brush with a Non-Ozone Depleting Chemical Solvent, (see list of recommended solvents below). After cleaning, wipe dry with clean dry lint-free cloth.

d. Tape Drive Tape Head Cleaning Method: Soak a lint-less cotton swab with isopropyl alcohol or commercial tape head cleaner. Clean the tape head using the cotton swab. A Non-Ozone Deleting Chemical Solvent (see para. 4-5) may be used in place of the isopropyl alcohol; however, the tape head must be wiped dry with a clean lint-less cotton swab and the head must be allowed to completely dry prior to use.

3-6. Recommended DGSC managed alternative materials

The following solvent substitutes have demonstrated effective cleaning capability and are available through DGSC. The solvents are listed in decreasing order of the Flash Point temperature of the material. Characteristics and notes on the solvents application are listed along with the NSN and packaging information.

CAUTION

These solvents are classified as combustible; appropriate storage and waste disposal procedures should be followed.

Solvent Name: Skysol

Characteristics: Clear Paraffic Hydrocarbon, d-Limonene based Liquid, slow drying, mild citrus odor

Flash Point: 152 F

Water Solubility: No

Notes: Precision cleaning, degreasing. Substitute for 1,1,1 tchloroethane and CFC 113.

NSNs:

6850-01-381-4404 55 gal

6850-01-381-4420 5 gal

Solvent Name: Breakthrough

Characteristics: Clear High Purity Hydrocarbon liquid, slow drying, odorless

Flash Point: 150 F

Water Solubility: No

Comments: Mild solvency, general degeasing, parts cleaning and paint cleanup, substitute for Perchloroethylene degreaser and Stoddard Solvent/Mineral Spirits

NSNs:

6850-01-378-0666 55 gal

6850-01-378-0679 5 gal

6850-01-378-0698 15 gal

Solvent Name: Electron

Characteristics: Clear Oil Distillate Hydcarbon/Terpene liquid, slow drying,

Flash Point: 147 F

Water Solubility: No

Notes: Grease, oil, carbon, organic resins removal. Electrical maintenance, motors, generators and general wipe down cleaning. Substitute for 1,1,1 trichloroethane and CFC 113. Safe on most plastic and rubber materials.

NSNs:

6850-01-375-5553 6 gal pail

6850-01-375-5554 6 x 1 gal pail

6850-01-375-5555 55 gal

6850-01-371-8049 22 oz spray

6850-01-371-8048 15 oz aerosol

Solvent Name: PF-145HP

Characteristics: Clear Naphtha based Liquid, slow drying, Mineral Spirits odor

Flash Point: 145 F
 Water Solubility: No
 Notes: General degreasing, Substitute for 1,1,1 trichloroethane.
 NSNs:

6850-01-378-0044 6 x 1 gal
 6850-01-378-0044 5 gal cont.
 6850-01-378-0044 55 gal drum

Solvent Name: PF solvent degreaser
 Characteristics: clear liquid, slow drying, mild citrus odor
 Flash Point: 144 F

Water Solubility: No
 Notes: Paint preparation, general degreasing, substitute for 1,1,1 trichloroethane. Not recommended for Acrylic materials

NSNs:
 7930-01-328-5959 1 pint
 7930-01-328-0187 1 quart
 7930-01-328-5960 1 gal
 7930-01-328-2030 5 gal
 7930-01-328-4058 55 gal
 8125-01-336-2854 sample 32 oz

CAUTION

X-Ciber solvent has been recommended by the Material Substitution Committee at Los Alamos National Laboratory. This solvent, however, is one of the most aggressive and most expensive solvents on the alternative list. This solvent affects some paints and plastics. This material is not recommended for general cleaning procedures where a less aggressive alternative will be adequate. The use of X-Caliber is recommended for the removal of un-cured resins, paints, polyurethane films and for plastic welding or where other alternatives do not provide adequate cleaning.

Solvent Name: X-Caliber
 Characteristics: Clear liquid, slow drying, mild odor
 Flash Point: 136 F
 Water Solubility: No
 Notes: Paint stripping, resin removal, plastic welding, un-cured polyester resin removal, polyurethane foam removal. Substitute for Methylene Chloride.

NSNs:
 6850-01-378-0582 5 gal
 6850-01-378-0662 55 gal
 6850-01-378-0809 6 x 1 gal

Solvent Name: Citra Safe
 Characteristics: clear liquid, slow drying, mild citrus odor
 Flash Point: 132 F

Water Solubility: No
 Notes: Electronics cleaning, substitute for 1,1,1 trichloroethane. Paint preparation and cleanup, substitute for Toluene/Xylene/Stoddard Solvent/Mineral Spirits. General degreasing, substitute for 1,1,1 trichloroethane/CFC 113.

NSNs:
 6850-01-378-0797 55 gal
 6850-01-378-0616 12 x 15 oz cans
 6850-01-378-0797 6 x 1 gal
 6850-01-378-0564 30 gal
 6850-01-378-0575 5 gal

Solvent Name: Vortex
 Characteristics: Clear liquid, slow drying, mild citrus odor

Flash Point: 119F

Water Solubility: Emulsifiable

Notes: For semi-aqueous application

NSNs:

6850-01-386-8434 5 gal

6850-01-386-8404 6 gal pail

6850-01-386-8405 6 x 1 gal

Solvent Name: Teksol EP

Characteristics: Clear Paraffinic Hydrocarbon/d-Limonene based liquid, slow drying, mild citrus odor

Flash Point: 112 F

Water Solubility: No

Notes: Electronic s cleaning substitute for 1,1,1 trichloroethane. Surface preparation Precision Cleaning, Moors, Brakes, substitute for Toluene/Xylene. General degreasing, substitute for Trichloroethylene.

NSNs:

6850-01-378-0581 6 x 1 gal

6850-01-378-0583 5 gal

6850-01-378-0650 55 gal

6850-01-378-0700 30 gal

Solvent Name: Isoprep

Characteristics: Clear Paraffinic Petroleum Hydrocarbon based liquid, slow drying, mild petroleum odor

Flash Point: 104 F

Water Solubility: No

Notes: Grease, oil, ink, wax removal, substitute for Perchloroethylene.

NSN:

6850-01-378-0706 5 gal

3-7. Commercially available solvent alternatives

a. The following solvent substitutes are available through local purchase. They have high Flash Point temperatures and some are soluble or emulsifiable in water. Where these characteristics are required, information on these materials and source information may be obtained from the manufacturers listed.

Solvent Name: Bioact 280

Type: Aliphatic Esters

Characteristics: Clear liquid, slow drying, mild odor

Flash Point: 285 F

Water Solubility: Emulsifiable

Notes: General precision cleaning, Can be heated

Manufacturer: Petroferm Inc., 5400 First Coast Hwy, Fernandina Beach, FL 32034, (904) 261-8286

Solvent Name: Ionox BC

Characteristics: Clear Non-Linear Alcohol based liquid, slow drying, mild odor

Flash Point: 183 F

Water Solubility: No

Notes: Solvent wipe cleaning, Not for Acrylic, PET or Urethane rubber

Manufacturer: Kyzen Corporation, 430 Harding Industrial Drive, Nashville, TN 37211, (615) 831-0888

Solvent Name: Micropure CDF

Characteristics: Pyrolidone based light yellow/clear liquid, slow drying, mild odor

Flash Point: 191 F

Water Solubility: Yes

Notes: Precision Semi-Aqueous Cleaning, PCBs, Electronics cleaning, Ink removal

Manufacturer: Ecolink, Sentry Chemical Company, 1481 Mountain Blvd., Stone Mountain, GA 30086, (404) 621-8240

b. Additional substitute solvents which have been identified by the Material Substitution Committee at Los Alamos National Laboratory are listed in Appendix A.

3-8. General recommendations for aqueous cleaning procedures

a. Preference should be given to the use of aqueous cleaning procedures when equipment, space and materials are available and when the items to be cleaned are not susceptible to damage from moisture. Follow detergent manufacturers solution mixture recommendations. The weakest detergent solution should be used which will achieve the desired results.

b. Aqueous cleaning is generally appropriate for cleaning painted surfaces, bare (non-ferrous) metal surfaces and some electronics equipment which is sealed from water intrusion or damage.

c. The use of immersion trays is acceptable for items which are not susceptible to damage from immersion in water.

3-9. Typical Aqueous Cleaning Procedures

These procedures are to be used only if they duplicate existing technical manual procedures.

a. Wash area with a mild solution of detergent and water. A cloth or soft bristle brush may be used to dislodge dirt. Rinse area at least twice or rinse with steady flow of water. If possible rinse area with warm or hot water. On electronics equipment use De-Ionized or distilled water for final rinse. Insure that electronic assemblies are completely dry before applying power.

b. Wipe area to be cleaned with a damp cloth containing a mild detergent solution. To rinse the area, wipe area with a clean damp cloth containing only water. Repeat rinse wipe process at least twice.

3-10. Recommended Aqueous Cleaning Materials

a. Aqueous cleaning materials used in general shop procedures are appropriate for most aqueous cleaning procedures. Alkaline Degreasers such as those listed below are appropriate for either cold or hot parts cleaning.

Degreaser Name: Daraclean 282

Notes: Alkaline all purpose cleaning.

NSNs:

6850-01-364-8328 5 gal

6850-01-364-8329 55 gal

Degreaser Name: Hurri-Safe Special Formula Degreaser

Notes: Cold parts washing, metal cleaning and degreasing, wipe-on/wipe-off surface preparation.

NSNs:

6850-01-369-2474 1 gal

6850-01-369-2475 55 gal

6850-01-369-9303 5 gal

Degreaser Name: Hurri-Safe Hot Immersion Degreaser

Notes: Hot immersion tank cleaning, steam cleaning, high pressure washers.

NSNs:

6850-01-373-5866 5 gal

6850-01-373-5867 55 gal

b. Phosphate free, Non-Alkaline (or mild alkaline) detergents should be used for cleaning electronics equipment. This includes some mild aqueous degreasers, some mild dish washing soaps and the cleaners listed below

Detergent Name: Detergent 8

Manufacturer: Alconox Inc., 9 E. 40th Street, No. 200, New York, NY 10016, (212) 5324040

Detergent Name: Armakleen

Manufacturer: Church & Dwight Co., Inc., 469 North Harrison Street, Princeton, NJ 08543, (800) 824-0866

APPENDIX A

ALTERNATE SOLVENT SUBSTITUTES

A-1. The information in the following tables was extracted from the Hazardous Technical Information Services Bulletins from Fall 1993 and Jan-Feb 1994. Lower values listed in the Comments/Results column indicate the amount of residue left on surfaces after the tests were completed.

One identified substitute, "X-Caliber, had some of the lowest test result readings, and was shown to be one of the most efficient, versatile substitutes tested. Two other substitutes, "PF Degreaser" and "Siege," are also very good cleaners, if something other than X-Caliber is needed. Another product, "Blue-Gold", is very efficient for ultrasonic cleaning in electroplating, replacing methyl chloroform, which is usually used in the vapor-degreasing step. PF Degreaser is also efficient in cleaning vacuum components.

CAUTION

X-Caliber is one of the most aggressive and expensive solvents available. This solvent affects some paints and plastics. This material is not recommended for general cleaning procedures where a less aggressive alternative will be adequate. The use of X-Caliber is recommended for the removal of un-cured resins, pin, polyurethane foams and for plastic welding or where other alternatives do not provide adequate cleaning.

TABLE A-1. ALTERNATE SOLVENT SUBSTITUTES

Material Name (Mfr.)	Pertinent Material Information	Potential Substitute for:	Original Application	Comments/ Test Results	NSNs	Source of Supply
Blue-Gold (Carroll Company)	Soluble in water Flash Point (FP) = None pH = 13 Evap. Rate (ER) = N/A	1,1,1 Trichloroethane	Dip Tank Ultrasonic cleaning (electroplating)	Unsuitable for dip tank Works well for ultrasonic/N/A	N/A	
Citragold (3D, Inc.)	Soluble in water FP = 180°F pH = N/A ER = 3 (water = 1)	1,1,1 Trichloroethane	Cleaner Degreaser/Dip Tank	Strong odor Unsuitable for dip tank/N/A	N/A	
DBE (Dupont)	Basically insoluble FP = 272°F pH = N/A ER = <0.01	1,1,1 Trichloroethane	Degreasing/Dip Tank	Adequate Unsuitable for dip tank/8.694	N/A	
De-Solv-It (Orange-Sol, Inc.)	Basically Insoluble FP = 205°F pH = N/A ER = 0.06	1,1,1 Trichloroethane	Degreasing/Dip Tank	Adequate Unsuitable for dip tank/7.048	6520-01-341-2764	S9G ¹
EPA 2000 (Western Chemical Int., Inc.)	Insoluble in water FP = 143°F pH = 6.8-7.6 ER > 1	1,1,1 Trichloroethane	Cleaning machines Dip Tank	Removes oil and evaporates slowly/6.516	N/A	
Exxate 1000 (Exxon Chemical, Americas)	Basically Insoluble FP = 212°F pH = N/A ER = 0	1,1,1 Trichloroethane	Cleaner Degreaser Dip Tank	Strong odor, can be used in a wash dip tank, but not excellent cleaner/6.620	N/A	

Table A-1. Alternate Solvent Substitutes (Continued)

Material Name (Mfr.)	Pertinent Material Information	Potential Substitute for:	Original Application	Comments/ Test Results	NSNs	Source of Supply
FO425A (Fine Organics Corp.)	Basically Insoluble FP = 212°F pH = N/A ER = 0	1,1,1 Trichloroethane	Cleaner/Degreaser Dip Tank	Does not work well/6.026	N/A	
Isopar M (Exxon Co.)	Basically Insoluble FP = 160°F pH = 7 ER < 0.1	1,1,1 Trichloroethane	Degreasing/Dip Tank	Adequate Unsuitable for dip tank/5.719	9150-00-663-1360 9150-01-261-4688 9150-00-322-9367	S9G ¹
FO425VR (Fine Organics Corp.)	Basically insoluble FP=210°F pH = N/A ER = 0.1	1,1,1 Trichloroethane	Cleaner/Degreaser Dip Tank	Does not work well/9.019	N/A	
MOK	Soluble in water FP = 230°F pH = N/A ER = 0.2	1,1,1 Trichloroethane	Not good as cleaner Strong weld but slow set	Oil from machined parts weld for Lucite/ Lexan plastics/ N/A	N/A	
PF-145 HP Solvent (PF Degreaser) (P.T Technologies)	Insoluble in water FP = 145°F pH = 7 ER = N/A	1,1,1 Trichloroethane		Stable Strong oxidizing agents	6850-01-378-0044 6850-01-377-9710 6850-01-377-9368	S9G ¹
PF Solvent (P.T Technologies)	Insoluble in water FP = 144°F pH = 7 ER similar to water	1,1,1 Trichloroethane	Copper Degreasing/cleaning Cleaning vacuum components	Works very well/7.546	7930-01-328-5959 7930-01-330-0187 7930-01-328-5960 7930-01-328-2030 7930-01-328-4058	GSA ²
Planisol (Planisol, Inc.)	Soluble in water FP = None pH = N/A ER = N/A	1,1,1 Trichloroethane	Cleaning machines Dip tank	Excellent cleaner Unsuitable for dip tank/N/A	N/A	
PF 5060 (3M Chemical Product Div.)	Basically Insoluble FP = None pH = N/A ER = 1	1,1,1 Trichloroethane Acetone	Cleaner/Degreaser	Adequate degreaser Unsuitable for dip tank/6.495	N/A	
Precision Clean (LPS Laboratory)	Soluble in water FP = None pH = N/A ER similar to water	1,1,1 Trichloroethane Acetone	Cleaner Degreaser Dip tank	Adequate degreaser Unsuitable for dip tank/82.520	N/A	
Siege (3D, Inc.)	Soluble in water FP = None pH = N/A ER = 1	1,1,1 Trichloroethane	Cleaning machines Dip tank	Excellent cleaner Unsuitable for dip tank/81.142	N/A	
Simple Green (Sunshine Makers, Inc.)	Soluble in water FP = None pH = 9.5 ER = N/A	1,1,1 Trichloroethane Alcohol	Degreaser/cleaner Uranium parts	Adequate if residue/drying time unimportant; unacceptable alcohol sub./69.705	7930-01-508-8369 7930-01-342-5317 7930-01-342-4145	GSA ²

TABLE A-1. ALTERNATE SOLVENT SUBSTITUTES (CONTINUED)

Material Name (Mfr.)	Pertinent Material Information	Potential Substitute for:	Original Application	Comments/ Test Results	NSNs	Source of Supply
Tuff Job Degreaser (Cooke Industries, Inc.)	Soluble in water FP = None pH = N/A ER < 1	1,1,1 Trichloroethane	Cleaner Degreaser Dip Tank	Good in spray bottle application Unsuitable for dip tank/115.024	7930-01-336-7197 7930-01-356-7198 7930-01-619-5373	GSA ²
Uniclean VII (Uniclean Products, Inc.)	Soluble in water FP = None pH = N/A ER = 0.7	1,1,1 Trichloroethane	Cleaning Machines Dip tank	Good cleaner Unsuitable for dip tanks/85.099	N/A	
X-Caliber (Inland Technology)	Slightly soluble FP = 155°F pH = N/A ER < 0.1	1,1,1 Trichloroethane Methylene Chloride Acetone	Cleaning finished parts (oil removal); paint/ink remover; cutting fluid for Molybdenum, Tantalum; plastics welding/gluing; dip tank	Excellent cleaner; good for oil removal; good if 24 hrs drying time allowed; works well; thin layer requires 4 hrs. evaporation time/1.738	6850-01-378-0809 6850-01-378-0582 6650-01-378-0662	GSA ²
3D Supreme (3D, Inc.)	Soluble in water FP = None pH = N/A ER > 1	1,1,1 Trichloroethane	Cleaner/Degreaser Dip tank	Unsuitable for dip tank/84.714	N/A	

FOOTNOTES: ¹S9G: Defense General Supply Center, Richmond, VA 23217; DSN 695-6054; Comm 804 279-6054 or 800 352-2852 ²GSA: General Service Administration, Washington, DC 20406

A-2. CLEANING COMPOUNDS AND SOLVENTS

Table A-2 lists Defense General Supply Center-managed NSNs recently introduced to the Federal Supply System. These materials are more "environmentally acceptable" substitutes for some chemicals currently being used or for those being phased out of production. For more information on the following items, contact Mr. Cliff Myers, DSN 695-3995 or Mr. Stephen Perez, COMM 804-279-6054 or DSN 695-6054. Check for acceptance authority within your chain of command before using and/or ordering any of these items.

TABLE A-2. DGSC-MANAGED SOLVENT SUBSTITUTES

Company Name: Allied Enterprises					
Product Name	NSN	Unit Issue (UI)	Comments/Uses	Source of Supply	
Impact Concentrated Industrial Degreaser	6850-01-380-4053 6850-01-380-4369 6850-01-384-0618	55 gal 5 gal (12) 1 qt	Used as wipe, spray, in high-pressure system to clean machinery, trucks, road equipment, engine blocks, roofing equipment, masonry, building & maintenance equipment; substitute for 1,1,1 TCA¹, other chlorinated solvents, and petroleum distillates.	S9G ²	
Company Name: Ecolink Inc. (Sentry Chemical)					
Electron	6850-01-371-8048	15 oz (aerosol)	Nonaqueous; used in electrical maintenance, motors, generators, & general wipe down; substitute for 1,1,1 TCA¹, CFC-113	S9G ²	

Table A-2. DGSC-Managed Solvent Substitutes (Continued)

Company Name: Ecolink Inc. (Sentry Chemical) (Continued)				
Electron 22	6850-01-371-8049	22 oz pump	Same as above	S9G ²
Electron 0296-06	6850-01-375-5553	6 gal	Same as above	S9G ²
Electron 0296-01	6850-01-375-5554	1 gal	Same as above	S9G ²
Electron 0296-55	6850-01-375-5555	55 gal	Same as above	S9G ²
Company Name: Golden Technology				
Bio-T	6850-01-380-2062 6850-01-380-4216 6850-01-380-4298	(4) 1 gal 5 gal 55 gal	Noncorrosive, biodegradable cleaner/degreaser made w/natural terpenes & non-ionic surfactants. Applicable to metal working, institutional printing, automotive & food processing end-uses.	S9G ²
Bio-T Foam	6850-01-381-1012	(6) 17 oz (aerosol)	Same as above	S9G ²
Bio-T Max	6850-01-381-3785 6850-01-381-3930 6850-01-381-3944	(4) 1 gal 5 gal 55 gal	Same as above	S9G ²
Company Name: Hurri Kleen Corporation				
Hurri-Safe Special Formula Degreaser	6850-01-369-2474 6850-01-369-2475 6850-01-369-9303	1 gal 55 gal 5 gal	Used in cold parts washing for metal cleaning & degreasing; ultrasonic degreasers used at ambient temperatures; wipe on/wipe-off process to remove contaminants from metals prior to painting; substitute for 1,1,1 TCA¹, MEK³, Toluene, various petroleum solvents.	S9G ²
Hurri-Safe Hot Immersion Degreaser	6850-01-373-5866 6850-01-373-5867	5 gal 55 gal	Used in heated immersion tanks; recirculating in-line wash systems, heated ultrasonic degreasers, steam cleaners, and high-pressure washers; substitute for 1,1,1 TCA¹, MEK³, CFCs, various petroleum solvents.	S9G ²
Hurri-Safe HK-188 (Aircraft Exterior Wash)	6850-010-373-5865	55 gal	Used in wipe-on/wipe-off cleaning of aircraft metal parts and surfaces prior to painting, bonding, priming, or using adhesives; substitute for MEK³, Toluene.	S9G ²
Company Name: Inland Technology				
Breakthrough	6850-01-378-0666 6850-01-378-0679 6850-01-378-0698	55 gal 5 gal 15 gal	For washing parts in paint cleanup, substitute for Stoddard Solvent/Mineral Spirits. For degreasing, substitute for Perchloroethylene.	S9G ²
Aero-Strip	6850-01-381-3193 6850-01-381-3640	55 gal 5 gal		S9G ²

Table A-2. DGSC-Managed Solvent Substitutes (Continued)

Company Name: Inland Technology (Continued)				
Citra-Safe	6850-01-378-0564 6850-01-378-0575 6850-01-378-0616 6850-01-378-0797 6850-01-378-0886	30 gal 5 gal (12) 15 oz aerosol 55 gal (6) 1 gal	Electronic & electrical cleaning. Also for metal preparation, substitute for 1,1,1 TCA¹ . Surface preparation for printing/welding substitute for MEK/Toluene/Xylene. For washing parts in paint cleanup, substitute for Stoddard Solvent/Mineral Spirits. For degreasing, substitute for Trichlorethylene. For vapor degreasing/precision cleaning, substitute for 1,1,1, TCA¹ or CFC-113 .	S9G ²
Citra-Safe (deodorized)	6850-01-381-7081 6850-01-381-7169	55 gal 5 gal	Same as above	S9G ²
Citrex	6850-01-378-0618 6850-01-378-0838	5 gal (6) 1 gal	For cleaning fiberglass & epoxy resins, substitute for Acetone. For paint stripping; cold tank soak; resin removal; substitute for Methylene Chloride .	S9G ²
Citrex-EB	6850-01-378-0599	5 gal	Same as above	S9G ²
Citrex Soak	6850-01-378-0649 6850-01-378-0687	5 gal 55 gal	Same as above	S9G ²
EP-921	6850-01-381-3300 6850-01-381-4408	5 gal 55 gal	For paint gun cleanup; substitute for MEK³	S9G ²
Iso-Prep	6850-01-378-0706	5 gal	For degreasing; substitute for Perchloroethylene .	S9G ²
Ink Solv N	6850-01-381-5108 6850-01-381-5117	5 gal 55 gal		S9G ²
Partsmaster 140	6850-01-378-0610	55 gal		S9G ²
Partsmaster 143	6850-01-378-0601	55 gal		S9G ²
Safety Prep	6850-01-381-5088 6850-01-381-5139	55 gal 5 gal	For surface preparation for painting or welding; substitute for Toluene/Xylene/MEK³	S9G ²
Samurai	6850-01-381-4419 6850-01-381-4426	5 gal 55 gal	For non-caustic steam cleaning & preserve washing compound.	S9G ²
Silkscreen B	6850-01-381-7220 6850-01-381-7151	5 gal 55 gal		S9G ²
Skysol	6850-01-381-4420 6850-01-381-4404	5 gal 55 gal	For vapor degreasing; precision cleaning; substitute for 1,1,1 TCA¹ or CFC-113	S9G ²
Skysol 100	6850-01-381-4423 6850-01-381-4401	5 gal 55 gal	Same as above	S9G ²
Skysol 200	6850-01-381-4427 6850-01-381-4410	5 gal 55 gal	Same as above	S9G ²

Table A-2. DGSC-Managed Solvent Substitutes (Continued)

Company Name: Inland Technology (Continued)				
Skysol 300	6850-01-381-4429 6850-01-381-4417	5 gal 55 gal	Same as above	S9G ²
Skysol 500	6850-01-381-4400 6850-01-381-4412	5 gal 55 gal	Same as above	S9G ²
Teksol EP	6850-01-378-0581 6850-01-378-0583 6850-01-378-0700 6850-01-378-0650	1 gal 5 gal 30 gal 55 gal	For electronic & electrical cleaning, metal preparation, substitute for 1,1,1, TCA¹ . For surface preparation for painting or welding, substitute for Toluene/Xylene/MEK³ . For degreasing & resin removal, substitute for Trichloroethylene .	S9G ²
X-Caliber	6850-01-378-0582 6850-01-378-0809 6850-01-378-0662	5 gal (6) 1 gal 55 gal	For paint stripping, cold tank soak; resin removal, substitute for Methylene Chloride .	S9G ²
Company Name: JAD Chemical, Inc				
MA 102	6850-01-378-0402 6850-01-378-0425 6850-01-378-0401	16 oz 5 gal 55 gal	Removes heavy soils, grease, and oil from aircraft surfaces, leaves no residue. Meets or exceeds MIL-C-85570, TYII	S9G ²
Company Name: W. R. Grace				
Daraclean 282	6850-01-364-8328 6850-01-364-8329	5 gal 55 gal	Alkaline all-purpose cleaning; multi-metal safe/effective between 80-200°F.	S9G ²

FOOTNOTES: ¹1,1,1 TCA is abbreviation for 1,1,1 trichloroethane ²S9G: Defense General Supply Center, Richmond, VA 23297; DSN 695-6054; Comm 804 279-6054; 800 352-2852 ³MEK: is abbreviation for methyl ethyl ketone.

APPENDIX B**WARNINGS AND CAUTIONS**

Section I. Current Notices**B-1. OBSOLETE WARNINGS**

The following WARNINGS, which have traditionally appeared in TMs 11, are obsolete.

WARNING

Compressed air is dangerous and can cause serious bodily harm if protective means or methods are not observed to prevent a chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 pounds per square inch gauge (30 psig) and then only with effective chip guarding and personnel protective equipment (industrial safety glasses and full faceshield). **DO NOT** use compressed air to dry parts when TRICHLOROTRIFLUOROETHANE has been used.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Avoid prolonged breathing of vapor. The solvent should not be used near heat or flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, avoid prolonged contact with skin. The use of chemical gloves (solvent resistant), chemical splash goggles and full faceshield are required when using TRICHLOROTRIFLUOROETHANE. **DO NOT** use compressed air to dry parts when TRICHLOROTRIFLUOROETHANE has been used. TRICHLOROTRIFLUOROETHANE is an ozone-depleting substance.

B-2. REPLACEMENT WARNING

The following WARNING replace the two WARNINGS listed above.

WARNING

Compressed air is dangerous and can cause serious bodily harm if protective means or methods are not observed to prevent a chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 pounds per square inch gauge (30 psig) and then only with effective chip guarding and personnel protective equipment (industrial safety glasses and full faceshield). **DO NOT** use compressed air to dry parts when solvent cleaners have been used.

WARNING

TRICHLOROTRIFLUOROETHANE, TRICHLOROETHANE and similar chemical solvents will no longer be used for ordinary cleaning of equipment. These substances threaten public health and the environment by destroying ozone in the earth's upper atmosphere. Suitable non-hazardous cleaning materials will be used instead, such as a clean cloth, water and mild detergent or an approved substitute solvent, such as isopropyl alcohol.

Section II. Cleaning Solvent WARNING Statements**B-3. USE WITH CITRA SAFE, TEKSOL EP, ELECTRON, MICROPURE CDF, PF DEGREASER, PF-145-HP VORTEX, KYZEN IONOX****WARNING**

Use this solvent in well ventilated areas only. Avoid prolonged breathing of vapors. Avoid bodily contact. The use of chemical gloves (solvent resistant) and chemical splash goggles are required when using this material. Do not use near heat, spark or flame. This solvent is reactive with acids and oxidizers; do not mix or cross-apply with other cleaners or chemicals. Organic vapor respirator with dust and mist filter is recommended when solvent is spray applied. Keep containers closed between applications. Provide mechanical ventilation if used in confined spaces. Coordinate the use of this material with your supporting Industrial Hygiene and Safety Offices. Ensure you read and understand the Material Safety Data Sheet (MSDS) for this solvent prior to use.

Storage of materials

Handle solvent as a combustible liquid. Store away from heat, sparks and flame. Keep container sealed when not in use. Solvent saturated waste rags must be placed in a metal sealable container after use to avoid the possibility of spontaneous combustion.

B-4. USE WITH DARACLEAN 282.**WARNING**

Use this solvent in well ventilated areas only. Avoid prolonged breathing of vapors. Respiratory irritation may result from breathing spray mist of this product. Organic vapor respirator with dust and mist filter is recommended when solvent is spray-mist applied. Avoid bodily contact. The use of chemical gloves (solvent resistant) and chemical splash goggles are required when using this material. This product is reactive with acids, nitrites and oxidizers; do not mix or cross-apply with other cleaners or chemicals. This product is extremely slippery when spilled. Ensure proper clean-up procedures are executed if product is spilled. Coordinate the use of this material with your supporting Industrial Hygiene and Safety Offices. Ensure you read and understand the Material Safety Data Sheet (MSDS) for this solvent prior to use.

Storage of materials**B-5. USE WITH HURRI-SAFE ORIGINAL FORMULA DEGREASER AND BLEND 300 AQUEOUS SOLVENT****WARNING**

Use this solvent in well ventilated areas only. Avoid prolonged breathing of vapors. The use of chemical gloves (solvent resistant) and chemical splash goggles are required when using this material. This product is reactive with oxidizers, do not mix or cross-apply with other cleaners or chemicals. Avoid inhalation of mist if spray-applied. Coordinate the use of this material with your support Industrial Hygiene and Safety Offices. Ensure you read and understand the Material Safety Data Sheet (MSDS) for this solvent prior to use.

Storage of Materials

Store in well ventilated area away from food and drink. Avoid storing in areas of excessive heat or cold. Keep containers closed.

Store in well ventilated area away from food or drink. Avoid storing in areas of excessive heat or cold. Keep containers closed.

Section III. Sample WARNING Statements for ODSs

B-6. USE WITH CFC-12, CFC-113, HCFC-22, HALON 1211, AND HALON 1301

WARNING

Environmental Control Unit contains CFC-12, a substance which harms public health and environment by destroying ozone in the upper atmosphere.

WARNING

Environmental Control Unit contains HCFC-22, a substance which harms public health and environment by destroying ozone in the upper atmosphere.

WARNING

Environmental Control Unit contains 1, 1, 1, trichloroethane, a substance which harms public health and environment by destroying ozone in the upper atmosphere.

WARNING

Portable fire extinguisher contains Halon 1211, a substance which harms public health and environment by destroying ozone in the upper atmosphere.

WARNING

Portable fire extinguisher contains Halon 1301, a substance which harms public health and environment by destroying ozone in the upper atmosphere.

WARNING

Portable fire extinguisher system contains Halon 1301, a substance which harms public health and environment by destroying ozone in the upper atmosphere.

B-7. USE WHEN PERSONAL PROTECTIVE EQUIPMENT MUST BE USED

WARNING

Personal protective equipment (PPE), such as face shields, splash goggles and solvent resistant gloves, must be used if there is a potential for exposure when using chemical. If PPE is recommended, coordinating is **required** with the supporting Safety Office/Officer, Industrial Hygienist or preventive Medicine Office/Officer. Appropriate PPE is listed on the Material Safety Data Sheet (MSDS) for the chemical. All PPE must meet applicable ANSI, ASTM or NIOSH/MSHA requirements, or equivalent. Eye protection must meet the requirements of ANSIZ87.1 For hand protection, use disposable chemical/solvent resistant gloves.

The following PPE is recommended for use:

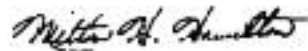
a. Use the following face shield, or equivalent: NSN 4240-00-202-9473, SOS: S9G (Defense General Supply Center, Richmond, VA 23297; DSN 695-5717 or commercial 804 279-571. An alternative face shield is NSN 4240-00-542-2048, SOS: GFO (FSA General Product Commodity Center 819 Taylor ., Ft. Worth, TX 76102; commercial 817 334-2501 or 800 -69-6557.

b. Use the chemical splash goggles, or equivalent: NSN 4240-00-190-6432, SOS: S9G. An alternative chemical splash goggle is NSN 4240-01-292-2818, SOS: GFO.

By Order of the Secretary of the Army:

Gordon R. Sullivan
General, United States Army
Chief of Staff

Official:



MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army

Distribution:

To be distributed in accordance with DA Form 12-34-E, block 4551 requirements for TB 43-0135.

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RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM, CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER

TM 11-5825-270-10

PUBLICATION DATE

23 Jul 81

PUBLICATION TITLE

Radio Frequency R-2176/FRN

BE EXACT... PIN-POINT WHERE IT IS

PAGE NO.

PARA. GRAPH

FIGURE NO.

TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TEAR ALONG PERFORATED LINE

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2 JUL 79

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

THE METRIC SYSTEM AND EQUIVALENTS

WEIGHT MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
 1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
 1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
 1 Kilogram = 1000 Grams = 2.2 lb.
 1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
 1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
 1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
 1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

TEMPERATURE

$5/9(^{\circ}\text{F} - 32) = ^{\circ}\text{C}$
 212° Fahrenheit is equivalent to 100° Celsius
 90° Fahrenheit is equivalent to 32.2° Celsius
 32° Fahrenheit is equivalent to 0° Celsius
 $9/5^{\circ}\text{C} + 32 = ^{\circ}\text{F}$

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
its	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
ometers per Liter	Miles per Gallon	2.354
ometers per Hour	Miles per Hour	0.621



PIN: 072736-000