CR 93.001

NCEL

March 1993

Contract Report

An Investigation Conducted by
Arthur D. Little
Cambridge, MA

SHELF-LIFE SPECIFICATIONS FOR MISSION READINESS

Abstract The Navy disposes of tons of hazardous material as hazardous waste due to the expiration of excessively conservative shelf-life terms. In order to reduce this occurrence, the Navy has started an effort to challenge shelf-life terms assigned to hazardous material currently in the supply system. Fifty-five commodities were selected based on the amount of material disposed of as hazardous waste due to their shelf-life terms. This report documents the results of this study.

NAVAL CIVIL ENGINEERING LABORATORY PORT HUENEME CALIFORNIA 93043-4328

METRIC CONVERSION FACTORS

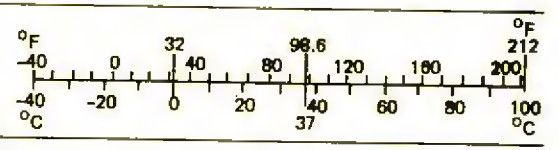
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-018

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 1993	Final; October 1990 - September 1992

4. TITLE AND SUBTITLE
SHELF-LIFE SPECIFICATIONS FOR MISSION READINESS

5. FUNDING NUMBERS
PR - Y0817-004-74-02
C - N47408-89-D-1025

6. AUTHOR(S)
Unknown

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESSE(S)
Arthur D. Little, Inc.
Acorn Park
Cambridge, MA 02140-2390

8. PERFORMING ORGANIZATION REPORT NUMBER
CR 93.001

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESSE(S)
Commander / Naval Civil Engineering Laboratory
Naval Facilities Engineer Command / Pollution Prevention Division
200 Stovall Street / Code L74
Alexandria, VA 2233-2300 / Port Hueneme, CA 93043-4328

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The Navy disposes of tons of hazardous material as hazardous waste due to the expiration of excessively conservative shelf-life terms. In order to reduce this occurrence, the Navy has started an effort to challenge shelf-life terms assigned to hazardous material currently in the supply system. Fifty-five commodities were selected based on the amount of material disposed of as hazardous waste due to their shelf-life terms. This report documents the results of this study.

14. SUBJECT TERMS
Hazardous materials, shelf-life term (SLT), shelf-life action codes (SLAC)

15. NUMBER OF PAGES
128

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

Table of Contents

List of Figures

1.0 Summary

In September 1990, the Naval Civil Engineering Laboratory (NCEL) authorized Arthur D. Little, Inc. to initiate Delivery Order No. 6 entitled "Shelf Life Specifications for Mission Readiness" under Contract No. N47408-89-D-1025. This delivery order (task) involved the examination of fifty five (55) specific commodities (disposed of in large volumes by the U.S. Navy) with respect to their assigned shelf life term (SLT) and testing criteria to allow extension of their shelf life. The objective of such an examination was to determine if the SLTs currently used for each commodity were appropriate, or whether the SLTs should be changed (usually lengthened) based on current technical information. By identifying and modifying incorrect SLTs, the Navy will reduce unnecessary disposal of these commodities, which will be an important step in their overall effort towards waste minimization.

Our approach to this task involved the following: development of an SLT Database; acquiring technical data for each shelf life commodity; analysis of the shelf life information including interviewing Arthur D. Little experts and actual manufacturers; and developing supported recommendations regarding the SLT. The commodities chosen for evaluation were those for which data was available and which were shown to be disposed of in large quantities over two years (1987 and 1989) resulting in high disposal and replacement costs to the Navy.

The guidance documents utilized to evaluate the commodities included FED-STD-793 Depot Storage Standards, Military Specifications, DOD 4140.27-M Shelf-Life Item Management Manual, and Technical Manual NAVAIR 01-1A-75, October 1, 1990. A literature search was also conducted to provide additional information on modes of degradation and previous studies conducted on shelf life. In addition, chemical makeup information from Material Safety Data Sheets and manufacturers for each commodity were obtained from the Hazardous Material Information System (HMIS) CD/ROM disk dated August 1991. These documents often offer conflicting information regarding shelf life terms and extension procedures. Specifically, shelf life extension testing criteria exist in many of these documents, however, it is unclear which procedure should be followed for each commodity.

Furthermore, these documents indicated contradictions regarding the length of the shelf life extension periods. FED-STD-793 indicates that all commodities should be extended by one half of the original shelf life. Yet, the shelf life action codes (SLAC) and some Military Specifications often indicate that the shelf life should be extended by the full original shelf life. Lastly, the shelf life action code for many of the commodities was not indicated in the documentation. These documents should be checked for accuracy and updated with the recommendations provided within this report.

With the assistance of NCEL, Defense Logistics Agency (DLA) and Defense Reutilization and Marketing (DRMS), Arthur D. Little was supplied with computer printouts of all of the hazardous materials disposed of by the Navy at various Defense Retulization and Marketing Offices (DRMOs) during the period from 1987 through 1989 (the time period for which complete sets of data were available). From this data we identified (by National Stock Number) material disposed of that had an aggregate replacement cost of $1,000 or greater. This produced a list of about 600 items. From this list of materials, a new list of 215 items that had been disposed of because of expired shelf

life term was prepared. Next, this list of 215 SLT items was retabulated starting with those items disposed of in the greatest volume and ending with those disposed of in the smallest volumes. Finally, the 55 items with the highest volumes (and replacement dollar value) were selected to have their SLT researched.

A total of 55 commodities were researched. The commodities were organized according to their Federal Supply Code (FSC), which is equivalent to the first four digits of the National Stock Number (NSN). This resulted in ten categories. Figure 1-1 is a summary of the 55 commodities and the recommended action. Of these 55: the shelf life of 30 were challenged indicating a recommendation to be lengthened and one commodity was challenged indicating a recommendation to be reduced; the shelf life of 23 were concurred with indicating a recommendation to remain the same; and one commodity was found to be no longer in use. The shelf life extension criteria for 36 commodities were challenged indicating a recommendation to be revised; 18 were concurred with indicating a recommendation to stay the same; and one commodity was found to be no longer in use. Details of the recommendations for each commodity can be found in Section 4.0 (Shelf Life Data Sheets) of this report.

Some of the items analyzed were purchased in bulk but utilized in small quantities. This type of arrangement increases the chances of premature degradation through frequent opening of the storage container and results in excessive disposal. Other commodities had no chemical degradation, but could absorb moisture, which made them hard and crusty. Changing the packaging would not only help deter moisture penetration, but also allow visual and physical inspection without opening the inner container. These types of instances led to several recommendations to evaluate packaging and purchase quantities.

Evaluation of extension criteria was based on the relevancy of the test to detect or determine whether or not the material was acceptable for use. Much of the documentation describing the extension criteria included discrepancies, specifically regarding the length of time the shelf life could be extended. Many of the items' shelf life extension criteria were outlined in the Military Specifications. Some tests were too comprehensive, others were not appropriate. Recommendations were made to modify the extension criteria to include simpler test procedures that would specifically target the properties of the commodity known to degrade during storage.

The last documents consulted were the DOD Quality Status Lists (QSL), November 1991 through March 1992. This document is published monthly and includes the results of laboratory shelf life extension testing for numerous lots of shelf life items. The results are listed by National Stock Number (NSN) and lot number. The information was utilized to evaluate past performance of specific shelf life items and their history of shelf life extension. Unfortunately, data from only a few months was available. It is recommended that this information be saved each month and analyzed at least semi-annually to provide additional and real life history on the item which the Navy is currently handling. The potential savings in using this data to establish more realistic shelf life specifications should be many times the cost of collecting and analyzing this data.

Figure 1-1: Summary of Recommendations

NSN	NSN Designation	Shelf Life Code	Shelf Life Extension Procedure
6135010714923	Battery, Non-rechargeable	Challenge	Challenge
6750008171364	Developer, Photo	Concur	Challenge
6810001416080	Sodium Phos/Tribasic	Challenge	Challenge
6810001746581	Sodium Hydroxide, Tech.	Concur	Challenge
6810002248353	Methanol, Technical	Challenge	Challenge
6810002331715	Sodium Carbonate	Challenge	Challenge
6810002499354	Sulfuric Acid, Elect.	Challenge	Challenge
6810002709978	Nitric Acid Reagent	Concur	Challenge
6810002709982	Tetrachloroethylene	Concur	Challenge
6810002814163	Mercuric Nitrate Solution	Challenge	Concur
6810005511487	Trichloroethane	Concur	Challenge
6810005844070	Xylene, Technical	Challenge	Challenge
6810008732554	Ion Exchange Compound	Challenge	Challenge
6810009457682	Standard Conduct Solution	Challenge	Challenge
6810009648945	Monoethanolamine	Concur	Concur
6810011093911	Sodium EDTA	Concur	Concur
6810011255234	Hardness Solution	Challenge	Challenge
6840009261481	Insecticide	Concur	Challenge
6850000338851	Cleaning Compound	Concur	Challenge
6850001737243	Scale Preventive Comp.	Concur	Concur

Figure 1-1: Summary of Recommendations (Continued)

NSN	NSN Designation	Shelf Life Code	Shelf Life Extension Procedure
6850001817940	Antifreeze/Coolant	Challenge	Challenge
6850002709986	Fluorescein	Concur	Concur
6850002858012	Dry Cleaning Solvent	Challenge	Challenge
6850002976653	STB, Decontam. Agent	Concur	Challenge
6850007535000	Cleaning Compound	Challenge	Challenge
6850009830282	Cleaning Comp. Solvent	Concur	Challenge
6850010457931	Cleaning Compound	Concur	Challenge
7930002829699	Detergent, General	Challenge	Challenge
7930005599481	Cleaning Compound	Challenge	Challenge
7930007535178	Polish, Automobile	Concur	Challenge
7930009353794	Polish Plastic	Concur	Challenge
8010001605789	Thinner, Paint Prod.	Challenge	Challenge
8010001658557	Primer Coating	Challenge	Concur
8010001817568	Remover, Paint	Challenge	Challenge
8010001818276	Polyurethane Coating	Challenge	Challenge
8010002911069	Paint, Rubber	Challenge	Concur
8010004108460	Epoxy Coating Kit	Challenge	Concur
8010004198541	Paint, Latex	Challenge	Concur
8010004376757	Epoxy Primer Coat. Kit	Challenge	Concur
8010008152692	Paint, Heat Resisting	Challenge	Concur

Figure 1-1: Summary of Recommendations (Continued)

NSN	NSN Designation	Shelf Life Code	Shelf Life Extension Procedure
8010008791103	Paint, Antifouling	Concur	Concur
8010009172256	Enamel, alkyd	Challenge	Concur
8030000087207	Sealing Compound	Concur	Concur
8030001658577	Coating Compound	Concur	Concur
8030007535006	Sealing Compound	Concur	Concur
8030008238039	Corrosion Resist Coat.	Challenge	Challenge
8030009381947	Corosion Resist Comp.	Concur	Challenge
8040002254548	Adhesive*	N/A	N/A
8040005824597	Adhesive, Paste	Challenge	Concur
9150000044535	Cutting Fluid	Challenge	Challenge
9150001497432	Hydraulic Fluid, Fire Res.	Concur	Challenge
9150001818097	Lubrication Oil, Engine	Challenge	Challenge
9150009857099	Lubricating Oil	Challenge	Challenge
9150010355394	Lubricating Oil	Challenge	Concur
9150010805962	Hydraul Fluid, Catapult	Concur	Challenge

* Commodity is no longer in use
N/A - Not applicable

Source: Arthur D. Little, Inc.

2.0 Introduction

Approximately eighty percent (80%) of the hazardous material turned in for disposal by the Navy is unused and in its original packaging.[1] These materials are known to degrade with time, and many times have simply reached the end of their designated shelf life before they are even used. The handling, disposal, and replacement of these items has posed a great expense to the Navy and requires a complicated system for tracking the items' inventory and associated shelf life term.

An item is assigned a shelf life code which is dependent upon the application for which it is used and its stability over time. Many times it is specified by the manufacturer. There are two types of shelf life materials, Type I and Type II. Type I material cannot have its shelf life extended once it has reached its expiration date and is represented with an alpha numeric shelf life code. Type II material can have its shelf life extended if it meets the designated criteria and is represented with a numeric shelf life code. Each commodity is labelled with its shelf life code which indicates the time period for which it can be stored prior to being used or retested.

Figure 2-1 is a summary of the shelf life codes and their associated shelf life terms for both type I and type II items. When an item approaches its shelf life, it must either be discarded if it is type I, or tested if it is type II. The tests are designed to determine whether or not the item is suitable for use even though it has surpassed its original shelf life. The length of the extension is dependent upon each item, and is an item of discrepancy in many of the military guidance documents. For this study, it was assumed that the shelf life extension term was one half of the original shelf life, based on FED-STD-793.

Some of the materials being turned in for disposal by the Navy are not actually hazardous wastes (for example, hardness and conductivity test solutions), but should probably not be reclassified as non-hazardous at this point in time to allow continued tracking of storage stability. Once this data on storage stability has been collected, these materials should be reclassified as non-hazardous.

We used a systematic approach to identify the 55 commodities for evaluation in this study. The approach consisted of the following steps:

1. Identify high value hazardous waste items;
2. Determine which of these items were disposed of due to expired SLTs; and
3. Determine which of these items were disposed of in the largest volumes.

1. Identify high value hazardous waste items.

With the assistance of DLA and DRMS, we performed a data search on DRMS's computerized database known as Rapid Access to Information in DLA (RAID). This search identified all materials disposed of by the Navy as hazardous waste at the various DRMOs. Specifically, the database provided the commodity national stock numbers (NSNs), the annual quantities disposed of, and the value of the materials prior to disposal. For a representative sample we chose to investigate the data from 1987 and

---

[1]Department of the Navy, Naval Supply Systems Command (Washington, D.C.)

1989. These two years were chosen because 1989 was the most recent year that data was available and 1987 was the first year that the complete set of data was available.

Using this database, we identified all materials (by NSN) that had a value prior to disposal of greater than $1,000. For this initial screening we used the value of materials, instead of the volume disposed of, because the database sums the estimated value of the individual entries. Disposal volumes, on the other hand, were provided for each individual entry, but not summed for each commodity. In addition, several units of disposal were listed (e.g., drums, cans, kits) making it difficult to add the entries. Therefore, using the value of the commodity was a quicker way to initially screen the commodities. This screening identified almost 600 items for further evaluation.

2. Determine which of these items were disposed of due to expired SLTs.

The 600 items identified in Step 1 include all hazardous waste materials, which includes not only expired shelf life items but also used materials. To identify which of the 600 materials were disposed of due to expired shelf life, we searched databases available through Defense General Supply Center (DGSC) and DLA. These two agencies are responsible for managing almost all the materials disposed of to the DRMOs and have SLTs. The database for DGSC was obtained from Mike Pipan of DLA and reviewed by Arthur D. Little engineers. For the items managed by DLA, Mr. Pipan reviewed internal databases to determine which items had SLTs.

After reviewing the files, we determined that of the 600 materials disposed of as hazardous waste, 215 of them have SLTs. The items that did not have SLTs were eliminated from our list of potential commodities for evaluation. Figure 2-2 lists the 215 commodities with shelf life terms.

3. Determine which of these items were disposed of in the largest volumes.

Since the overall goal of this program is to reduce waste generation, our final criteria for selecting fifty-five commodities was total quantity of waste material generated due to expired SLT. To determine the volumes generated, we went back to the database generated by DRMS which listed the quantities disposed. Since the reason for disposal was not identified, we assumed that the sole reason for disposal of the 215 materials identified in Step 2 was expired SLT. Based on discussions with individuals from DLA and the DRMOs, this assumption is realistic, as other reasons for disposal (e.g., off-spec material) are usually a small percentage of the overall amount disposed.

The units of disposal for each individual entry in this database varied widely, and included 55-gallon drums, gallons, cans, boxes, quarts, pounds, etc. These units were converted into gallons where this was possible and we used our best judgment where the conversion was not obvious. (For example: Under one NSN for a one pint container of liquid polish were also listed drums, boxes, and cans as units of measure being disposed of.) Since some of the units were approximations and the database itself is somewhat imprecise, the total quantities generated are considered approximations. For the purposes of this study, these approximate values are adequate to select fifty-five commodities. Additional information including the material name and volume of container, etc. were

obtained from the consumer services Division of DLA in Battle Creek, Michigan. Figure 2-3 lists the fifty-five (55) representative materials in order of largest to smallest amount disposed. The list in Figure 2-3 includes all items with a total disposal volume of over 1,000 gallons for the two years (1987 and 1989) sampled.

It was originally anticipated that the list of commodities to be evaluated would contain 50 materials. However, when the list of SLT expired commodities sent to disposal was prepared (Figure 2-2), it was found that within some of the groups of materials (adhesives, paints, cleaners, hydraulic and lube oils) there were subsets of materials that would have different physical and chemical properties that could affect their shelf life and/or the testing procedure for determining extension of shelf life. Likewise, there were cases of different materials [semi-tropical bleach (STB) and calcium hypochlorite] that would have a similar shelf life or stability as well as testing procedures for determining extension of shelf life. To include all the different groups of materials listed in Figure 2-2 in the evaluation, the list in Figure 2-3 was expanded slightly to include 55 items.

Figure 2-1: Shelf Life Codes and Interpretations

Shelf Life Period	Type I (Non Extendable)	Type II (Extendable)	Required Number of Months Shelf-Life Remaining Upon Receipt By the Government
Nondeteriorative	0	0	N/A
1 Month	A	N/A	1
2 Months	B	N/A	2
3 Months	C	1	3
4 Months	D	N/A	3
5 Months	E	N/A	4
6 Months	F	2	5
9 Months	G	3	8
12 Months	H	4	10
15 Months	J	N/A	13
18 Months	K	5	15
21 Months	L	N/A	18
24 Months	M	6	21
27 Months	N	N/A	23
30 Months	P	N/A	26
36 Months	Q	7	31
48 Months	R	8	41
60 Months	S	9	51*
Medical items, parachutes, and IRPOD items with a shelf-life period of greater than 60 months	X	X	Variable based on the shelf life months*

* No more than 12 months expended for elastomeric items of supply.

Source: DOD 4140.27-M, Apendix A

Figure 2-2: Expired SLT Commodities Sent to Disposal

No.	NSN	Material Name	Agency Managing Material	Shelf Life Code*	Volume Disposed (1987)	Replacement Cost at Time of Disposal (1987)	Volume Disposed (1989)	Replacement Cost at Time of Disposal (1989)	Total Volume Disposed 1987 & 1989	Total of 1987 & 1989 Replacement Cost	Liquid, Solid, or Gas	Unit Package	Microfiche Reference Number	Color	Comments
1	9150000044535	Cutting fluid	DGSC	7			55000 GL	$1,002	55000 GL	$1,002			001o0206		
2	9150001818097	Lubrication Oil, Engine	DGSC	6			34000 GL	$33,957	34000 GL	$33,957		55 gal drum	001k0806		Antifoam and Salt Water Resistant
3	6810001416080	Sodium Phos/Tribasic	DGSC	6	660 GL	$2,198	20000 GL	$4,161	20660 GL	$6,359	Solid	Drum 100lb	001i1502		
4	9150001497432	Hydraul Fluid, Fire Res.	DGSC	6	6000 GL	$10,267	8200 GL	$5,659	14200 GL	$15,926		1 gal/Can	001i0603		Visc. 3.5 210 Deg F Min and 2200 -40 Deg F Max
5	6850009830282	Cleaning Comp Solvent	DGSC	7	10000 GL	$8,149			10000 GL	$8,149	Liquid	55 gal/pack	002c1008		
6	9350001536804		DGSC	4	10000 LB	$2,546			10000 LB	$2,546					No Microfiche reference number
7	6850002976653	STB, Decontam agent	DGSC	9	3800 LB	$6,458	3500 LB	$13,638	7300 LB	$20,098	Solid	50 lb drum	002n1004		
8	6810009648945	Monoethanolamine	DGSC	6	5000 GL	$7,167	2100 GL	$4,223	7100 GL	$11,390	Liquid	55 gal/ drum	001a1004		
9	9150010805962	Hydraul Fluid, Catapult	DGSC	6	3000 GL	$12,560	2200 GL	$5,556	5200 GL	$18,116		55 gal/drum	001i0602		Visc. 8100 O Deg F Max and 185 100 F
10	6850002858012	Dry Cleaning Solvent	DGSC	7	4400 GL	$5,632			4400 GL	$5,632	Liquid	55 gal/drum	002h1204		
11	6850002858011	Dry Cleaning Solvent	DGSC	7	2300 GL	$17,691	2000 GL	$6,588	4300 GL	$8,379	Liquid	55 gal/drum	002h1203		Similar to 002h1204
12	6810005987316	Sodium Hypochlorite	DGSC	4			700 BX	$5,451	4200 GL	$5,451		1 bt/Pack	001o1405		Unit Package = 6 gal
13	6850002745421	Dry Cleaning Solvent	DGSC	7	3200 GL	$4,505	1000 GL	$2,674	4200 GL	$7,179	Liquid	5 gal can	002h1202		Similar to 002h1204
14	8010004376757	Epoxy Primer Coat. Kit	GSA	6 or 4	3000 GL	$4,257	810 GL	$11,795	3810 GL	$16,052	Liquid	Kit 2 qt.	001M1003		
15	6810002499054	Sulfuric Acid, Elect	DGSC	7	700 GL	$2,448	3000 GL	$1,524	3700 GL	$3,972		1 gal/bit	001h1601		
16	6810011255234	Hardness Solution	DGSC	M			3700 BT	$2,812	3700 BT	$2,812		150 ml/BT	001b1612		
17	6850010457931	Cleaning Compound	DGSC	7	1500 GL	$22,474	2100 GL	$4,521	3600 GL	$26,995	Liquid	55 gal pack	002d0910		Aircraft Surface, Biodegradeable
18	9150009857099	Lubricating Oil	DGSC	7	3000 GL	$12,249	5000 GL	$1,598	8000 GL	$13,847		1 qt/pack	001c0805		Aircraft Turbine
19	6850001817940	Antifreeze/Coolant	DGSC	7			3300 GL	$4,685	3300 GL	$4,685		55 gal/unit	002i0802		Cooling Systems of Combustion Engines
20	6810001741824	Insecticide	DGSC	7	3200 GL	$46,980			3200 GL	$46,980			na		No Microfiche Ref no.
21	6850011843182	Cleaning Compound	DGSC	7			3200 GL	$4,782	3200 GL	$4,782	Liquid	55 gal/pack	002d0913		Similar to 002d0910
22	8030009381947	Corrosion Resist Comp	GSA	4	600 GL	$1,395	2400 GL	$5,775	3200 GL	$7,170		55 gal/pack	002h1307		Application Type: Cold; Unit Package Drum
23	6810005511487	Trichloroethane	DGSC	9	3100 GL	$2,346			3100 GL	$2,346	Liquid	55 gal/drrum	001c1810		
24	8010001817568	Remover, Paint	GSA	4			3100 GL	$2,033	3100 GL	$2,033	Liquid	Can 1 gal	002n0506		Solvent base
25	9150002431987	Hydraulic Fluid	DGSC	6			3000 GL	$1,045	3000 GL	$1,045		55 gal/ drum	001g0604		Arresting Gear
26	9150001896729	Lubricating Oil, Eng	DGSC	6	3000 GL	$3,939			3000 GL	$3,939		55 gal/drum	001i0805		Antifoam and Antiwear and Corrosion Res
27	7930005599481	Cleaning Compound	GSA	6			3000 CN	$1,126	3000 CN	$1,126	Globular	20 oz/can	001b1310		Toilet Bowl Cleaner
28	6810002709978	Nitric Acid Reagent	DGSC	M			3000 GL	$55,910	3000 GL	$55,910	Liquid	BTL, 32 fl oz	001i1008		
29	9150011132047	Hydraul Fluid, Fire Res	DGSC	6	600 GL	$2,914	2300 GL	$16,128	2900 GL	$19,040		55 gal/drum	001i0611		Basic Ingredient Tertiary-Butyl Phenyl Phosph
30	0681002814163	Mecuric Nitrate Solut	DGSC	M	900 GL	$1,249	2000 GL	$1,356	2900 GL	$2,605	Liquid	1 bottle 4 oz	001d0904		
31	8010004108460	Epoxy Coating Kit	GSA	6 or 4	2400 GL	$8,890	270 GL	$4,086	2670 GL	$12,976	Liquid	Kit 2 qt.	001k0804		
32	8040002254548	Adhesive	GSA	4	2600 KT	$3,604			2600 GL	$3,604	Paste	Kit 12 oz.	003c0908		Silicone Basic MATL 12 oz/kit
33	8010007227119	Primer Coating	GSA	4			2400 GL	$1,818	2400 GL	$1,818			n/a		No Microfiche Ref no.
34	8030000087207	Sealing Compound	GSA	2	2200 GL	$19,731	200 GL	$1,025	2400 GL	$20,756	Liquid	1 pint	002c1508		Rubber, Synthetic MATL
35	8010009261488	Remover, Paint	GSA	4	950 GL	$3,945	1300 GL	$1,478	2250 GL	$5,423	Liquid	Can 1 qt.	002c0505		Solvent Base, Similar to 002n0506
36	9150001866709	Lubricating Oil, Eng	DGSC	6			2200 GL	$1,006	2000 GL	$1,006		55 gal/drum	001i0803		Antifoam and Salt Water Resistant
37	6810002248353	Methanol, technical	DGSC	6	1200 GL	$1,436	940 GL	$1,068	2140 GL	$2,504	Liquid	54 gal/drum	001i0906		99.85 pct methanol min by wt comp
38	8010009172256	Enamel, Alkyd	GSA	6	1400 GL	$2,754	700 GL	$4,202	2100 GL	$6,956	Liquid	Can 5 gal	001i0404	Red	
39	6810008507787	Potassium Hydroxide	DGSC	6	1100 GL	$7,960	1000 GL	$3,027	2100 GL	$10,987			na		No Microfiche Ref no.
40	9350007891749		DGSC	6	2000 LB	$2,576			2000 LB	$2,576					No Microfiche Ref no.
41	8030002441300	Corrosion Prev Comp	GSA	5	1400 GL	$1,274	600 GL	$1,399	2000 GL	$2,673		55 gal/pack	002g1308		Similar to 002h1307
42	8010002911069	Paint, Rubber	GSA	6	2000 GL	$1,780			2000 GL	$1,780	Liquid	Pail 5 gal	001h1713		
43	6840009261481	Insecticide	DGSC	6	1900 GL	$2,440			1900 GL	$2,440	Liquid	54 gal/drum	002i0705		91 pct Malathion
44	6850000338851	Cleaning Compound	DGSC	7	400 GL	$3,779	1500 GL	$14,199	1900 GL	$17,978	Solution	5 gal/pack	002a1010		Unit Package 1 can, solvent Base
45	6850002709986	Fluorescein	DGSC	6	410 PK	$1,886	1460 PK	$6,702	1870 PK	$8,588	Powder	1 per pack	002b1508		Lifeboat and Lifejacket Use, 75 pct Fluorescein Dye

Figure 2-2: Expired SLT Commodities Sent to Disposal (Continued)

No.	NSN	Material Name	Agency Managing Material	Shelf Life Code*	Volume Disposed (1987)	Replacement Cost at Time of Disposal (1987)	Volume Disposed (1988)	Replacement Cost at Time of Disposal (1988)	Total Volume Disposed 1987 & 1988	Total of 1987 & 1988 Replacement Cost	Liquid, Solid, or Gas	Unit Package	Microfiche Reference Number	Color	Comments
46	6810002331715	Sodium Carbonate	DGSC	7	1800 GL	$1,274			1800 GL	$1,274	Powder	100 lb/drum	001d1402		
47	6850000632842	Bleach	DGSC	5	1800 GL	$1,574			1800 GL	$1,574					No Microfiche Ref no.
48	9150007534937	Lubricating Oil	DGSC	7			1700 GL	$6,112	1700 GL	$6,112		55 gal/drum	001a0703		Piston Aircraft
49	9150002359062	Lubricating Oil	DGSC	6	1700 GL	$2,132			1700 GL	$2,132		55 gal	001f1101		Steam Turbine
50	8010004198541	Paint, Latex	GSA	6	1700 GL	$1,573			1700 GL	$1,573		Pail 5 gal	001m1509	White	
51	6810002709982	Tetrachloroethylene	DGSC	6	400 GL	$1,115	1200 GL	$1,802	1600 GL	$2,917	Liquid	55 gal/drum	001n1607		
52	6850009845853	Cleaning Compound	DGSC	7	1200 GL	$3,311	380 GL	$1,202	1580 GL	$4,513	Liquid	5 gal/pack	002a1016		Similar to 002a1010
53	8030008238039	Corrosion Resist Coat	GSA	4	450 GL	$1,046	1000 GL	$3,407	1450 GL	$4,453		1 gal/bil	002k1305		Chemically Treated Aluminum
54	7930009353794	Polish, Plastic	GSA	6	900 GL	$25,828	470 GL	$12,265	1379 GL	$38,093		1 pt/BT	001b1508		
55	8030001658577	Coating Compound	GSA	4	350 GL	$5,541	1000 GL	$1,128	1350 GL	$6,669		4 gal/pack	002j1204		Metal Pretreatment, Resin-Acid
56	8010008152692	Paint, Heat Resisting	GSA	4	350 GL	$2,116	1000 GL	$1,245	1350 GL	$3,361		Can 1 gal	001l1405	Alum.	
57	9150001912772	Lubricating Oil, Eng	DGSC	6	1300 GL	$2,236			1300 GL	$2,236		55 gal drum	001g0803		Antifoam and Antiwear and Corrosion Res
58	8010001658557	Primer Coating	GSA	6			1300 GL	$9,687	1300 GL	$9,687		Pail/1 gal	002j0506		
59	6135009268322	Cecon Amy	DGSC	8	1300 GL	$9,027			1300 GL	$9,027			na		No Microfiche Ref no.
60	6810001746581	Sodium Hydroxide, tech	DGSC	6			1300 GL	$5,019	1300 GL	$5,019		100 lbs/drum	001n1403		96 pct sodium hydroxide
61	7930002829699	Detergent, General	GSA	7			1200 GL	$5,959	1200 GL	$5,959	Liquid	1 gal	001g1310		1 Package Quantity
62	8010005774739	Enamel, Alkyd	GSA	4	1100 GL	$3,052	88 GL	$3,601	1188 GL	$6,653		5 gal	001h0704	White	Similar to 001l0404
63	8010005272045	Enamel, Alkyd	GSA	6	1100 GL	$1,176			1100 GL	$1,176	Liquid	Can 5 gal	001g0609	Yellow	Similar to 001l0404
64	9150010955394	Lubricating Oil	DGSC	6	1100 GL	$3,133			1100 GL	$3,133		55 gal/pack	001h0902		Gear Oil
65	6810009457682	Standard Conduct Soln	DGSC	M	1100 BT	$1,126			1100 BT	$1,126		250 ml/BT	001b1610		
66	6810009305311	Trichloroethane	DGSC	6			1100 GL	$1,643	1100 GL	$1,643	Liquid	12 fl oz/can	001c1805		Similar to 001n1607
67	6850002811985	Dry Cleaning Solvent	DGSC	7	1100 GL	$1,104			1100 GL	$1,104	Liquid	1 gal can	002g1215		Similar to 002n1204
68	9150006815999	Lubricating Oil	DGSC	7	1100 GL	$5,789			1100 GL	$5,789		55 gal	001c0804		Aircraft Turbine
69	8010009261489	Paint Remover	GSA	4	1100 GL	$10,665			1100 GL	$10,665		55 gal	002e0512		Solvent Base, Similar to 002n0508
70	8030007535006	Sealing Compound	GSA	3	1100 KT	$3,077			1100 KT	$3,077	Paste	12 oz	002g1706		Rubber, Polysulfide MATL
71	6810009589970	Monochloroacetic Acid	DGSC	6	350 GL	$1,161	700 GL	$1,096	1050 GL	$2,257		5 gal/CN	001a1003		Monoethanolamine-Chelating
72	6810011093911	Sodium EDTA	DGSC	R	1000 GL	$1,728			1000 GL	$1,728	Powder	25 lb drum	001l1609		
73	6810002550472	Calcium Hypochlorite	DGSC	4	1000 GL	$3,047			1000 GL	$3,047	Granular	100 lb/drum	001a0403		Similar to 002n1004
74	6850007535000	Cleaning Compound	DGSC	6	400 GL	$1,714	600 GL	$4,510	1000 GL	$6,224	Liquid	5 gal/pail	002h0914		For use in Steam Cleaning Machines
75	9150005842560		DGSC	7			1000 GL	$1,649	1000 GL	$1,649			001n0604		No description under Microfiche no.
76	6850001737243	Scale Preventive Comp	DGSC	R	160 CN	$14,516			960 GL	$14,516		6 gal contr	002n1404		Polyelectrolyte
77	7930003000119	Alkali, Laundry	GSA	7	920 GL	$2,100			920 GL	$2,100	Powder	25 lb	001c1214		59 pct sodium oxide, Similar to 001n1403
78	8010002867745	Enamel, Alkyd	GSA	4	300 GL	$3,398	610 GL	$2,469	910 GL	$5,867		Pail 5 gal	001g0707	White	5 gal qty within each package
79	9150000827524	Enamel, Hydraulic Fluid	DGSC	5	900 GL	$1,101			900 GL	$1,101			001c0702		Similar to 001l0602
80	8010000822450	Epoxy Primer Coating	GSA	4	500 GL	$1,570	370 GL	$1,627	870 GL	$3,197			011a1110		Similar to 001k0804
81	8030005468637		GSA	4	850 CN	$1,339			850 CN	$1,339					No Microfice Rel no.
82	6810005844070	Xylene, technical	DGSC	7	800 GL	$3,253			800 GL	$3,253	Liquid	5 gal/pack	001m1704		
83	8030005261805	Corrosion Prev Comp	GSA	5	800 GL	$2,159	200 GL	$1,628	800 GL	$3,787		5 gal/pack	002h1303		Similar to 002h1303
84	6810008732554	Ion Exchange Compound	DGSC	6			800 GL	$1,483	800 GL	$1,483		drum	001m0707		Eight-8 lb 2 oz resin bags per drum
85	9150009268963	Isopropanol/Graphite	DGSC	6			800 BT	$2,443	800 BT	$2,443		2 oz/BT	001k0302		3.3% solids
86	8030010411595	Corrosion Prev Comp	GSA	4			800 GL	$1,393	800 GL	$1,393		16 oz/ pack	002e1308		
87	9150002234134	Hydraulic Fluid	DGSA	6	800 GL	$4,047			800 GL	$4,047		1 gal/can	001b0706		Visc. 2500 -65 Deg F Max and 1 gal 600 -40 Deg F Ma
88	8010008791103	Paint, Antifouling	GSA		760 GL	$2,043			760 GL	$2,043		Can	001i1415	Red	5 gal qty within each pack
89	6810002424770	Calcium Hypochlorite	DGSC	4	750 LB	$7,621			750 LB	$7,621	Granular	3.75 lb/can	001a0401		
90	8030007235343	Sealing Compound	GSA	3	400 KT	$1,891	300 KT	$1,489	700 KT	$3,380	Paste	1 pt/KT	002g1704		Rubber, Polysulfide MATL
91	8010001818080		GSA	7	700 GL	$1,539			700 GL	$1,539			002b0710		1 Gal Quantity within each package

Figure 2-2: Expired SLT Commodities Sent to Disposal (Continued)

No.	NSN	Material Name	Agency Managing Material	Shelf Life Code*	Volume Disposed (1987)	Replacement Cost at Time of Disposal (1987)	Volume Disposed (1988)	Replacement Cost at Time of Disposal (1988)	Total Volume Disposed 1987 & 1988	Total of 1987 & 1988 Replacement Cost	Liquid, Solid, or Gas	Unit Package	Microfiche Reference Number	Color	Comments
92	6850001817594	Cleaning Compound	DGSC	K	300 GL	$1,634	380 GL	$1,227	680 GL	$2,861	Liquid	5 gal contr	002h0907		For Engine Gas Path
93	8040010091562	Adhesive	GSA	2			660 TU	$2,965	660 TU	$2,965	Semi Liq	3 oz/TU	003d1002		Silicone Rubber Basic MATL
94	8030006547042	Coating Compound	GSA	4	550 GL	$2,058	100 GL	$1,902	650 GL	$3,960		5 gal/pail	002g1207		pct solid compound 50; Bitumen Base Asphalt
95	6850006815688	Cleaning Compound	DGSC	7	640 GL	$1,564			640 GL	$1,564	Liquid	55 gal/pack	002c1004		Package type drum
96	8010005774735	Enamel	GSA	4	200 GL	$1,239	430 GL	$2,226	630 GL	$3,465		Pail	001f0707	Green	5 gal qty within each pack
97	8010010401059	Epoxy Coating Kit	GSA	2	600 GL	$4,829			600 GL	$4,829		Kit	002a0605	Gray	
98	6135010714923	Battery, Nc recharg	DGSC	L	580 EA	$8,957			580 EA	$8,957		1 each	001n0208		6V
99	9150001179432	Lubricating Oil	DGSC	6	550 GL	$1,831			550 GL	$1,831		55 gal	001e1109		Visc. 8.2 210 Deg F Min and 82 100 Deg F min
100	8010002869080	Enamel	GSA	4	300 GL	$1,807	220 GL	$1,334	520 GL	$3,141		Pail	001b0712	Black	1 gal qty within each package
101	6810010721978	Gum Ghatti, Technical	DGSC	M			500 GL	$4,054	500 GL	$4,054			001c0713		Hardness Titrating Solution
102	9150009365851	Grease	DGSC	6			500 GL	$6,757	500 GL	$6,757		35 lb/pack	001m0303		Aircraft; -80/350 Deg F
103	8030007535009	Sealing Coumpound	GSA	3	500 KT	$2,258			500 KT	$2,258	Paste	3.5 oz	002h1702		Rubber, Polysulfide MATL
104	8010001818276	Polyurethane Coating	GSA	6	500 GL	$1,140			500 GL	$1,140		Kit/2 qt.	002f0102	Black	Resin mod Polyurethane Basic Formulation
105	6850003190834		DGSC	7			500 GL	$1,688	500 GL	$1,688			002b1005		
106	5610008271651	Latex Paint	GSA	4	490 GL	$7,338			490 GL	$7,338	Liquid	Pail	001h0112		Deck Covering Rubber Latex
107	8030002441293	Corrosion Prev Comp	GSA	5	480 GL	$907			480 FL	$907		5 gal/pack	002g1301		Application Type: Cold
108	8040010913748		GSA	4	450 GL	$2,907			450 GL	$2,907			n/a		
109	8040005824597	Adhesive, Paste	GSA	4			450 GL	$4,462	450 GL	$4,462	Paste	Pail	003k0903		Rubber Base
110	8040002738708	Adhesive	GSA	5	450 GL	$1,739			450 GL	$1,739	Liquid	Can	003b0602		1 gal per pack
111	8010002921813	Enamel	GSA	6	440 GL	$1,798			440 GL	$1,798		Pail	001g0703	Red	5 gal qty within each pack
112	8010001605789	Thinner, Paint Prod	GSA	7			440 GL	$1,511	440 GL	$1,511		Drum	002a0711		55 gal qty within each package
113	8010001429273	Remover, Paint	GSA	4			430 GL	$27,748	430 GL	$27,748	Liquid	Pail	002b0513		Solvent Base
114	6810010721979	Gum Ghatti, Technical	DGSC	M	30 BT	$1,284	400 BT	$4,401	430 BT	$5,658	Powder	500 gm bt	001c0709		Hardness Indicator
115	6850007534998	Cleaning Compound	DGSC	6	430 GL	$2,198			430 GL	$2,198	Liquid	55 gal/drum	002i0902		Used to Steam Cleaning Machines
116	8030002441295	Corrosion Prev Comp	GSA	5	400 GL	$1,226			400 GL	$1,226		55 gal/pack	002g1303		Application Type: Cold
117	8030010427644	Corrosion Resist Comp	GSA	4			400 GL	$2,481	400 GL	$2,481		5 gal	002k1308		Chemically treated Aluminum; Unit Qty=Pail
118	8030002627358	Corrosion Prev Comp	GSA	4			400 GL	$1,280	400 GL	$1,280		5 gal/pack	002g1309		Application Type: Cold
119	7930007535178	Polish, Automobile	GSA	6			380 GL	$9,466	380 GL	$9,466	Liquid	1 pint	001m1408		Plastic Bottle
120	6750008171364	Developer, Photo	DGSC	6			380 PK	$1,497	380 PK	$1,497	Powder	1 gal/pack	003g1105		SGL Unit for Mixing B/W
121	9150007534686	Lubricating Oil	DGSC	6	350 GL	$8,718			350 GL	$8,718		1 gal/pack	001d1110		Antiwear and Corrosion Res and Oxidation Res
122	8010002869083	Enamel	GSA	6	350 GL	$3,919			350 GL	$3,938		Pail	001d0705	Gray	5 gal qty within each package
123	8010004108464	Epoxy Coating Kit	GSA	6 or 4	300 GL	$7,512	32 GL	$1,800	332 GL	$9,312	Black	Kit	001m0710		
124	8010009262045	Paint, Traffic	GSA	4	330 GL	$1,131			330 GL	$1,131		Drum	001b1602	Yellow	30 gal qty within each pack
125	6810002812002	Toluene, Technical	DGSC	7	320 GL	$1,217			320 GL	$1,217	Liquid	1 gal/can	001e1710		SPCL handling Flammable 1
126	8010001658574		GSA	4	300 GL	$1,262			300 GL	$1,262			n/a		
127	8030001742588	Sealing Compound	GSA	4			300 GL	$4,421	300 GL	$4,421	Paste	1 gal/pack	002g1810		Chlorinated Resin MATL
128	9150009448953	Grease	DGSC	6			300 GL	$1,448	300 GL	$1,448		1 lb/pack	001m0304		Aircraft; -80/350 Deg F
129	8010006647468	Paint, Heat Resisting	GSA	4	300 GL	$1,134			300 GL	$1,134		Can	001l1406	Alum.	1 gal qty within each pack
130	6810008796133	Ion Exchange Compound	DGSC	6			270 GL	$1,101	270 GL	$1,101			001m0708		
131	6750010515686	Fixing Bath, Photo	DGSC	6			260 GL	$3,310	260 GL	$3,310	Liquid	5 gal/pack	004j0705		SGL Unit for Mixing
132	8040008495195	Adhesive	GSA	4			260 KT	$1,062	260 KT	$1,062	Liquid	Can	003j0409		1 pt epoxy resin/1/4 pt polyamide
133	8010001697083	Primer Coating	GSA	6			260 GL	$1,323	260 GL	$1,323			002j0508		
134	6840001806069		DGSC	7			250 GL	$1,043	250 GL	$1,043			002h0208		
135	8010005977856	Enamel	GSA	6	250 GL	$1,929			250 GL	$1,929		Pail	001g0707	White	5 gal qty within each pack
136	8040001449774	Adhesive	GSA	2			250 KT	$8,712	250 KT	$8,712		12 oz/KT	003b0909	Gray	Silicone, Paste
137	9150001491593	Grease	DGSC	7			250 GL	$2,085	250 GL	$2,085			001f0402		Water Resistant Service

Figure 2-2: Expired SLT Commodities Sent to Disposal (Continued)

No.	NSN	Material Name	Agency Managing Material	Shelf Life Code*	Volume Disposed (1987)	Replacement Cost at Time of Disposal (1987)	Volume Disposed (1988)	Replacement Cost at Time of Disposal (1988)	Total Volume Disposed 1987 & 1988	Total of 1987 & 1988 Replacement Cost	Liquid, Solid, or Gas	Unit Package	Microfiche Reference Number	Color	Comments
138	8030011549255	Sealing Compound	GSA	3			230 KT	$2,097	230 KT	$2,097	Paste	3.5 fl oz	002i1702		Rubber, Polysulfide MATL
139	6750010484672	Chemical Kit	DGSC	6			220 GL	$1,428	220 GL	$1,428			003j1016		Black/White Processing
140	8010006167486	Enamel	GSA	6			210 GL	$1,005	210 GL	$1,005		Can	001k0513	Red	1 gal qty within eachpack
141	8030009652004	Sealing Compound	GSA	3			200 KT	$1,110	200 KT	$1,110	Liquid	12 oz/KT	003a0106		Rubber, Polysulfide MATL; Unit package= Kit
142	9150005306814	Grease	DGSC	6			200 GL	$1,089	200 GL	$1,089			001f0601		Wire-Rope Exposed Gear
143	8010011177687		GSA	4	200 GL	$1,667			200GL	$1,667			001i0810	Gray	2 qt qty within each pack
144	6840010273865	Insecticide	DGSC	7			200 GL	$1,743	200 GL	$1,743	Liquid	1 gal can	002h0709		Baygon; non-flammable
145	9150001889858	Lubricating Oil, Eng	DGSC	6			200 GL	$1,695	200 GL	$1,695			001i0804		Antifoam and Antiwear and Corrosion Res
146	8010001505788	Thinner, Paint	GSA	7	200 GL	$6,229			200 GL	$6,229		Pail	002b0705		2 gal quantity within each package
147	6810010444188	Hydrogen Peroxide	DGSC	H			200 GL	$1,493	200 GL	$1,493			na		
148	8010002858294	Enamel	GSA	6			190 GL	$1,951	190 GL	$1,951		Pail	002b0710	Black	5 gal qty within each package
149	8010011360697	Epoxy Coating Kit	GSA	6			190 GL	$24,764	190 GL	$24,764		Kit	001a1006	Red	
150	8010010532650	Epoxy Coating Kit	GSA	4	95 GL	$1,639	90 GL	$11,155	185 GL	$12,794		2 qt/kt	001c0707		
151	8010004212435	Epoxy Coating Kit	GSA	6			180 GL	$6,459	180 GL	$6,459			00101012		
152	8030002976677	Sealing Compound	GSA	2	170 KT	$1,082			170 KT	$1,082		12 oz/KT	003j0105		Rubber, Synthetic MATL
153	9150000714712	Lubricating Oil	DGSC	7			170 GL	$1,186	170 GL	$1,186			001c1104		64.7 100 Deg F min and 69.1 100/deg F Max
154	8010002869088	Enamel	GSA	6	150 GL	$1,301	19 GL	$1,277	169 GL	$2,578		Pail	001g0709	White	5 gal qty within each package
155	9150001818229	Lubricating Oil	DGSC	6			150 GL	$1,008	150 GL	$1,008			001k0807		Antifoam and Salt Water Resistant
156	8040001450020	Adhesive	GSA	2			150 TU	$1,638	150 TU	$1,638	Paste	Tube 3 oz	003i0901		Rubber, Synthetic Base
157	8010001818281	Polyurethane Coating	GSA	6	150 GL	$7,556			150 GL	$7,556			002b0407	White	
158	6810010691830	pH Standard	DGSC	M	140 BX	$1,118			140 GL	$1,118			na		
159	6840011691842	Insecticide, Malathion	DGSC	6			140 GL	$14,734	140 GL	$14,734	Liquid	5 gal can	002i0704		91 oct Malathion
160	6750001516035	Developer, Photo	DGSC	6	93 PK	$1,839	40 PK	$1,520	133 PK	$3,359	Liq/Powder	20 gal/pack	003f1105	Black/White	
161	7930009261689		GSA	6	130 GL	$2,652			130 GL	$2,652			n/a		
162	8010002904247	Paint, Antifouling	GSA	4	120 GL	$4,967			120 GL	$4,967		Pail	001i1414	Black	5 gal qty within each package
163	8010002867725	Enamel	GSA	6			120 GL	$1,340	120 GL	$1,340		Pail	001b0711	White	5 gal qty within each package
164	6750010420872	Chemical Kit	DGSC	4			117 KT	$2,956	117 KT	$2,956		5L/KT	003k1009		Photo Color Processing, Specific Use Color Film
165	8010000822438	Epoxy Coating	GSA	4			110 GL	$1,997	110 GL	$1,997			001j1808		
166	8040005508835	Adhesive	GSA	5			100 GL	$2,126	100 GL	$2,126	Liquid	Can	003b0607		1 gal per pack
167	6810012397562		DGSC	M			100 BX	$1,884	100 BX	$1,884			001a1202		
168	8040002738717	Adhesive	GSA	4	100 GL	$1,162			100 GL	$1,162	Liquid	Can	003b0605		1 pt per pack
169	6810005515231		DGSC	7			100 GL	$4,233	100 GL	$4,233			na		
170	8010010532646	Epoxy Coating Kit	GSA	4	100 KT	$1,047			100 GL	$1,047		Kit	001d0909	Gray	Full Gloss
171	6750004841126	Fixing Bath, Photo	DGSC	6			100 GL	$2,164	100 GL	$2,164	Liquid	20 gal/pack	004g0705	Black/	Hardener Additive Function
172	8010001654784		GSA	6	100 GL	$1,807			100 GL	$1,807			002e0206		
173	6750010459093	Developer, Photo	DGSC	6			96 KT	$1,096	96 KT	$1,096	Liquid	3.5 gal/pack	003n1109		SEP Units for Mixing
174	8040010682423	Adhesive	GSA	2			90 EA	$1,589	90 EA	$1,589			n/a		
175	5610006410427	Nonspecific Paint	GSA	4	90 GL	$1,499			90 GL	$1,499	Liquid	1 gal/can	001d0204	Black	Formulated For Rough Finish
176	8010002970802	Enamel	GSA	6			85 GL	$1,006	85 GL	$1,006		Can	001j0313	Gray	1 gal qty within each pack
177	8010001644389	Epoxy Coating Kit	GSA	H			82 GL	$6,252	82 GL	$6,252		Pail	002h1012?		
178	6810010189769	Ammonium Hydroxide	DGSC	M			300 BT	$2,314	75 BT	$2,314	Liquid	32 fl oz/btl	001e0109		Unit Package 1
179	6810001450478	Silver Nitrate	DGSC	M			73 BT	$3,574	73 BT	$3,574			na		
180	8040009591854	Adhesive	GSA	2	70 KT	$1,639			70 KT	$1,639	Paste	Kit	003b0811		Plastic Epoxy Resin
181	6810005768438	Pyridine, Tech	DGSC	5			70 BT	$2,378	70 BT	$2,378		500 gm/bottle	001d1307		
182	8030002629041	Sealing Compound	GSA	4			70 KT	$1,484	70 KT	$1,484	Paste		002i1706		Container Kit Contains 6 fluid ozs of Base Compound
183	8010010789278	Polyurethane Coating	GSA	6			120 KT	$1,167	60 GL	$1,167		Kit 2 qt.	002e1208		

Figure 2-2: Expired SLT Commodities Sent to Disposal (Continued)

No.	NSN	Material Name	Agency Managing Material	Shelf Life Code*	Volume Disposed (1987)	Replacement Cost at Time of Disposal (1987)	Volume Disposed (1989)	Replacement Cost at Time of Disposal (1989)	Total Volume Disposed 1987 & 1989	Total of 1987 & 1989 Replacement Cost	Liquid, Solid, or Gas	Unit Package	Microfiche Reference Number	Color	Comments
184	6810002918392	Formaldehyde Solution	DGSC	6			60 GL	$1,846	60 GL	$1,846		55 gal/pack	001c0602		
185	8010010197947	Epoxy Coating Kit	GSA	4	59 KT	$1,537			59 KT	$1,537		Kit	001h0902	Green	Semi-Gloss
186	8030009923456	Caulking Compound	GSA	6	55 GL	$5,423			55 GL	$5,423		1 gal	002e1208		Catalyst, Epoxy; Polmide, Heavy Oil
187	6810010521651	Hydrazine, Catalyzed	DGSC	M	31 GL	$1,090	20 GL	$1,080	51 GL	$2,170	Liquid	1 gal can	001d0701		
188	6750010265603	Bleach, Photographic	DGSC	6			51 KT	$1,041	51 KT	$1,041	Liquid	3.5 gal/KT	003f1006		
189	6810002550471	Calcium Hypochlorite	DGSC	6	3900 BT	$4,970	2700 BT	$3,495	50 BT	$8,465	Granular	6 AVDP oz	001e0307		Similar to 002n1004
190	8010011177691	Epoxy Coating Kit	GSA	4	50 KT	$1,126			50 GL	$1,126		Kit	001b0803	Blue	2 gal qty within each pack
191	8010001617275	Primer Coating	GSA	6			49 GL	$1,822	49 GL	$1,822		Can	002n0408		5 gal qty within each pack
192	8030009199204	Conductive Coat Comp	GSA	4	49 BT	$3,607			49 GL	$3,607	Liquid	5/oz bll	002a1321		Base MATL Silver Liquid
193	8010005347324	Enamel	GSA	4			46 GL	$1,351	46 GL	$1,351			n/a		
194	8040001032256	Adhesive	GSA	4	46 GN	$1,151			46 GL	$1,151	Powder	2 gal/pack	003n0912		Resin Basic MATL; Plastic, Thermosetting Specific MAT
195	9150001900925		DGSA	0			43 GL	$1,906	43 GL	$1,906					
196	8010001605799	Remover, Paint	GSA	4			42 GL	$3,003	42 GL	$3,003		Can	00200504		1 qt qty within each pack; Organic Solvent
197	6810005593267	Ion Exchange Compound	DGSC	6	40 EA	$1,614			40 GL	$1,614		1/3cl/pack	001m0701		
198	8040000168652	Adhesive	GSA	4			35 KT	$1,155	35 KT	$1,155			003a0706		
199	6750007823851	Developer, Photo	DGSC	9			34 PK	$2,308	34 PK	$2,308	Powder	5 gal/pack	003m1113	Black/	SCL Unit for Mixing
200	8010002910601	Paint, Oil	GSA	6			34 GL	$1,564	24 GL	$1,564		Pail	001c1711	White	Gen Int Specific Use
201	8010007534714		GSA	4	30 GL	$1,104			30 GL	$1,104			002j0512		No Description under Microfiche no.
202	8030005844399	Sealing Compound	GSA	4			30 KT	$1,969	30 KT	$1,969	Liquid		002b1601	Red	6 fluid oz base compound in a 1/2 container
203	9150009857245	Grease	DGSC	6			30 GL	$1,360	30 GL	$1,360		1.7 lb/pack	001b0404		Low Temp Lubricant and Ceiling Agent
204	8010002867836	Enamel	GSA	6	30 GL	$1,444			30 GL	$1,444		Pail	011g0708		5 gal qty within each package
205	8010000822477		GSA	4	27 GN	$2,583			27 GN	$2,583	Can		011a1111		No description under Microfiche no.
206	8010005508305	Primer Coating	GSA	6			26 GL	$1,082	26 GL	$1,082			n/a		No Microfiche no.
207	8010002972136	Paint, Oil	GSA	6			21 GL	$1,265	21 GL	$1,265		Pail	001c1712	White	Eggshell Gloss Designation
208	6750010228410	Bleach, Photographic	DGSC	6			18 PK	$2,012	18 PK	$2,012	Powder	1 gal/pack	003h1010	Color	SCL Unit for Mixing
209	7930010368967	Stain Remover	GSA	6			18 PK	$1,503	18 PK	$1,503	Powder	2 lb/pack	001i1506		
210	8010004591756		GSA	4	12 KT	$2,003			12 GL	$2,003			001j0107		
211	6810006640388	Trichloroethane	DGSC	9	10 CN	$2,678			10 GL	$2,678	Liquid	5 gal/pail	001c1811		Unit Package 1
212	8010004108471	Epoxy Coating Kit	GSA	6 or 4	10 KT	$1,454			10 GL	$1,454		Kit	001a1004	Red	
213	8010012244903	Filler, Seam	GSA	4			9 CN	$14,940	9 CN	$14,940			n/a		
214	8010010172480	Polyurethane Coating	GSA	6			3 GL	$1,487	3 GL	$1,487			002e0204		
215	8010004108465	Epoxy Coating Kit	GSA	6			2 GL	$1,411	2 GL	$1,411		Kit	001b0907	Gray	Epoxy Resin Vehicle MATL

* Refer to Fig 2-1 for shelf life cycle definitions

DGSC - Defense General Supply Center
GSA - General Supply Agency
CN - Can
BT - Bottle
PK - Pack
BX - Box
KT - Kit
GL - Gallon

Source: Arthur D. Little, Inc.

Figure 2-3: High Volume SLT Commodities Sent to Disposal

No.	NSN	Material Name	Agency Managing Material	Shelf* Life Code	Volume Disposed (1987)	Replacement Cost at Time of Disposal (1987)	Volume Disposed (1989)	Replacement Cost at Time of Disposal (1989)	Total of 87 and 89 Replacement Cost	Liquid, Solid or Gas	Unit Package	Microfiche Reference Number	Color	Comments
1	9150000044535	Cutting Fluid	DGSC	7			55000 GL	$1,002	$1,002	Liquid	55 gal drum	001o0206	brown	
2	9150001818097	Lubrication Oil, Engine	DGSC	6			34000 GL	$33,957	$33,957		55 gal drum	001k0806		Antifoam and Salt Water Resistant
3	6810001416080	Sodium Phos/Tribasic	DGSC	6	600 GL	$2,198	20000 GL	$4,161	$6,359	Solid	Drum 100 lb	001i1502		
4	9150001497432	Hydraulic Fluid, Fire Res.	DGSC	6	5000 GL	$10,267	8200 GL	$5,659	$15,926		1 gal/Can	001l0603		Visc.3 5 210 Deg F Min and 2200 -40 Deg F Max
5	6850009830262	Cleaning Comp Solvent	DGSC	7	10000 GL	$8,149			$8,149	Liquid	55 gal/pack	002c1008		
6	9150009857099	Lubricating Oil	DGSC	7	3000 GL	$12,249	5000GL	$1,598	$13,847		1 qt/pack	001c0805		Aircraft Turbine
7	6850002976653	STB, Decontam agent	DGSC	9	3800 LB	$6,458	3500 LB	$13,638	$20,096	Solid	50 lb drum	002n1004		
8	6810009648945	Monoethanolamine	DGSC	6	5000 GL	$7,167	2100 GL	$4,223	$11,390	Liquid	55 gal drum	001a1004		
9	9150010805962	Hydraul Fluid, Catapult	DGSC	6	3000 GL	$12,560	2200 GL	$5,556	$18,116		55 gal/drum	001l0602		Visc. 8100 O Deg F Max and 185 100 F
10	6850002858012	Dry Cleaning Solvent	DGSC	7	4400 GL	$5,632			$5,632	Liquid	55 gal drum	002h1204		
11	8010004376757	Epoxy Primer Coat, kit	GSA	6 or 4	3000 GL	$4,257	810 GL	$11,795	$16,052	Liquid	2 qt Kit	001M1003		
12	6810011255234	Hardness Solution	DGSC	M			3700 BT	$2,812	$2,812		150 ml/BT	001b1612		
13	6810002499354	Sulfuric Acid, Elect	DGSC	7	700 GL	$2,448	3000 GL	$1,524	$3,972		1 gal/btl	001h1601		
14	6850010457931	Cleaning Compound	DGSC	7	1500 GL	$22,474	2100 GL	$4,521	$26,995	Liquid	55 gal pack	002d0910		Aircraft Surface, Biodegradeable
15	6850001817940	Antifreeze/Coolant	DGSC	7			3300 GL	$4,685	$4,685		55 gal/unit	002F0802		Cooling systems for combustion engines
16	8030009381947	Corrosion Resist Comp	GSA	4	800 GL	$1,395	2400 GL	$5,775	$7,170		55 gal/pack	002h1307		Application Type: Cold; Unit Package Drum
17	8010001817568	Remover, Paint	GSA	4			3100 GL	$2,033	$2,033	Liquid	1 gal Can	002n0506		Solvent base
18	6810005511487	Trichloroethane	DGSC	9	3100 GL	$2,346			$2,346	Liquid	55 gal drum	001c1810		
19	7930005599481	Cleaning Compound	GSA	6			3000 CN	$1,126	$1,126	Globular	20 oz/can	001b1310		Toilet Bowl Cleaner
20	6810002709878	Nitric Acid Reagent	DGSC	M			3000 GL	$55,910	$55,910	Liquid	BTL, 32 fl oz	001l1008		
21	6810002814163	Mercuric Nitrate Solut	DGSC	M	900 GL	$1,249	2000 GL	$1,356	$2,605	Liquid	1 bottle 4 oz	001d0904		
22	8010004108480	Epoxy Coating Kit	GSA	6 or 4	2400 GL	$8,890	270 GL	$4,086	$12,976	Liquid	2 qt Kit	001k0804		
23	8040002254548	Adhesive	GSA	4	2600 KT	$3,604			$3,604	Paste	12 oz Kit	003c0908		Silicone Basic MATL 12 oz/KT
24	8030000087207	Sealing Compound	GSA	2	2200 GL	$19,731	200 GL	$1,025	$20,756	Liquid	1 pint	002c1508		Rubber, Synthetic MATL
25	6810002248353	Methanol, technical	DGSC	6	1200 GL	$1,436	940 GL	$1,068	$2,504	Liquid	54 gal/drum	001l0906		99.85 pct methanol min by wt comp
26	8010009172256	Enamel, Alkyd	GSA	6	1400 GL	$2,754	700 GL	$4,202	$6,956	Liquid	Can	001l0404	Red	5 gal qty within each pack
27	8010002911069	Paint, Rubber	GSA	6	2000 GL	$1,780			$1,780	Liquid	Pail 5 gal	001h1713		
28	5850000338851	Cleaning Compound	DGSC	7	400 GL	$3,779	1500 GL	$14,199	$17,978	Solution	5 gal/pack	002a1010		Unit Package 1 can, solvent Base
29	6840009251481	Insecticide	DGSC	6	1900 GL	$2,440			$2,440	Liquid	54 gal/drum	002l0705		91 pct Malathion
30	6850002709986	Fluorescein	DGSC	6	410 PK	$1,886	1460 PK	$6,702	$8,588	Powder	3.4 oz/pack	002b1508		Lifeboat and Lifejacket Use, 75 pct Flourescein D,
31	6810002331715	Sodium Carbonate	DGSC	7	1800 GL	$1,274			$1,274	Powder	100 lb/drum	001d1402		
32	8010004198541	Paint, Latex	GSA	6	1700 GL	$1,573			$1,573		5 gal Pail	001m1509	White	
33	6810002709982	Tetrachloroethylene	DGSC	6	400 GL	$1,115	1200 GL	$1,802	$2,917	Liquid	55 gal/drum	001n1607		
34	8030008238039	Corrosion Resist Coat	GSA	4	450 GL	$1,046	1000 GL	$3,407	$4,453		1 gal/btl	002k1305		Chemically Treated Aluminum
35	7930009353794	Polish, Plastic	GSA	6	900 GL	$25,828	470 GL	$12,265	$38,093		1 PT/BT	001b1508		
36	8030001658577	Coating Compound	GSA	4	350 GL	$5,541	1000 GL	$1,128	$6,669		4 gal/pack	002j1204		Metal Pretreatment, Resin-Acid
37	8010008152692	Paint, Heat Resisting	GSA	4	350 GL	$2,116	1000 GL	$1,245	$3,361		1 gal Can	001l1405	Alum.	
38	8010001658557	Primer Coating	GSA	6			1300 GL	$9,687	$9,687		Pail/1 Gal	002j0506		
39	6810001746581	Sodium Hydroxide, tech	DGSC	6			1300 GL	$5,019	$5,019		100 lbs/drum	001n1403		96 pct sodium hydroxide
40	7930002829699	Detergent, General	GSA	7			1200 GL	$5,959	$5,959	Liquid	1 gal	001g1310		1 Package Quantity
41	9150010355394	Lubricating Oil	DGSC	6	1100 GL	$3,133			$3,133		55 gal/pack	001h0902		Gear Oil

Figure 2-3: High Volume SLT Commodities Sent to Disposal (Continued)

No.	NSN	Material Name	Agency Managing Material	Shelf* Life Code	Volume Disposed (1987)	Replacement Cost at Time of Disposal (1987)	Volume Disposed (1989)	Replacement Cost at Time of Disposal (1989)	Total of 87 and 89 Replacement Cost	Liquid, Solid or Gas	Unit Package	Microfiche Reference Number	Color	Comments
42	8030007535006	Sealing Compound	GSA	3	1100 KT	$3,077			$3,077	Paste	3 oz/KT	002g1706		Rubber, Polysulfide MATL
43	6810009457682	Standard Conduct Soln	DGSC	M	1100 BT	$1,126			$1,126		250 ml/BT	001b1610		
44	6810011093911	Sodium EDTA	DGSC	R	1000 GL	$1,728			$1,728	Powder	25 lb drum	001o1609		
45	6850007535000	Cleaning Compound	DGSC	5	400 GL	$1,714	600 GL	$4,510	$6,224	Liquid	5 gal/pail	002h0914		For use in Steam Cleaning Machines
46	6810008732554	Ion Exchange Compound	DGSC	6			800 GL	$1,483	$1,483		drum	001m0707		eight-8 b 2 oz resin bags per drum
47	6850001737243	Scale Preventive Comp	DGSC	R	960 GL	$14,516			$14,516		6 gal contr	002n1404		Polyelectrolyte
48	6810005844070	Xylene, technical	DGSC	7	800 GL	$3,253			$3,253	Liquid	5 gal/pack	001m1704		
49	8010008791103	Paint, Antifouling	GSA		760 GL	$2,043			$2,043		5 gal Can	001i1415	Red	
50	6135010714923	Battery, Non recharg	DGSC	L	580 EA	$8,957			$8,957		EA	001n0208		6V
51	8010001818276	Polyurethane Coating	GSA	6	500 GL	$1,140			$1,140		Kit 2 qt.	002f0102	Black	Resin mod Polyurethane Basic Formulation
52	8040005824597	Adhesive, Paste	GSA	4			450 GL	$4,462	$4,462	Paste	5 gal Pail	003k0903		Rubber Base
53	8010001605789	Thinner, Paint Prod	GSA	7			440 GL	$1,511	$1,511		Drum	002a0711		55 gal qty within each package
54	6750008171364	Developer, Photo	DGSC	6			380 PK	$1,497	$1,497	Powder	1 gal/pack	003g1105		SGL Unit for Mixing
55	7930007535178	Polish, Automobile	GSA	6				$9,466	$9,466	Liquid	1 pint	001m1408		Plastic Bottle

* Refer to Fig. 2-1 for shelf life cycle definitions.

DGSC - Defense General Supply Center
GSA - General Supply Agency
BT - Bottle
BX - Box
CN - Can
GL - Gallon
KT - Kit

Source: Arthur D. Little, Inc.

3.0 Approach

The procedure followed to study each of the 55 commodities is outlined in the block flow diagram shown in Figure 3-1. The items are organized by NSN for easier reference. The items were categorized according to their FSC (the first four digits of the NSN), resulting in ten categories. The shelf life code, shelf life extension criteria, manufacturer(s), chemical makeup as listed in the Material Safety Data Sheets, Military Specification and any pertinent literature was acquired for each of these 55 commodities. This information can be found for each commodity in 10 labelled binders (shipped to NCEL under separate cover).

A literature review was conducted to provide additional information regarding the mode of degradation of each item as well as other shelf life studies previously conducted. Personnel within Arthur D. Little who were knowledgeable on the item were interviewed. One or more manufacturers were also contacted for each commodity. Each of these people were asked specific questions regarding the current shelf life classification of each material, the cause of degradation over time, possible alternatives, and other specific information helpful to our analysis. All of this information was utilized to develop recommendations regarding the shelf life term and extension criteria. Figure 3-2 is a summary of our recommendations including the original and recommended shelf life term and extension criteria.

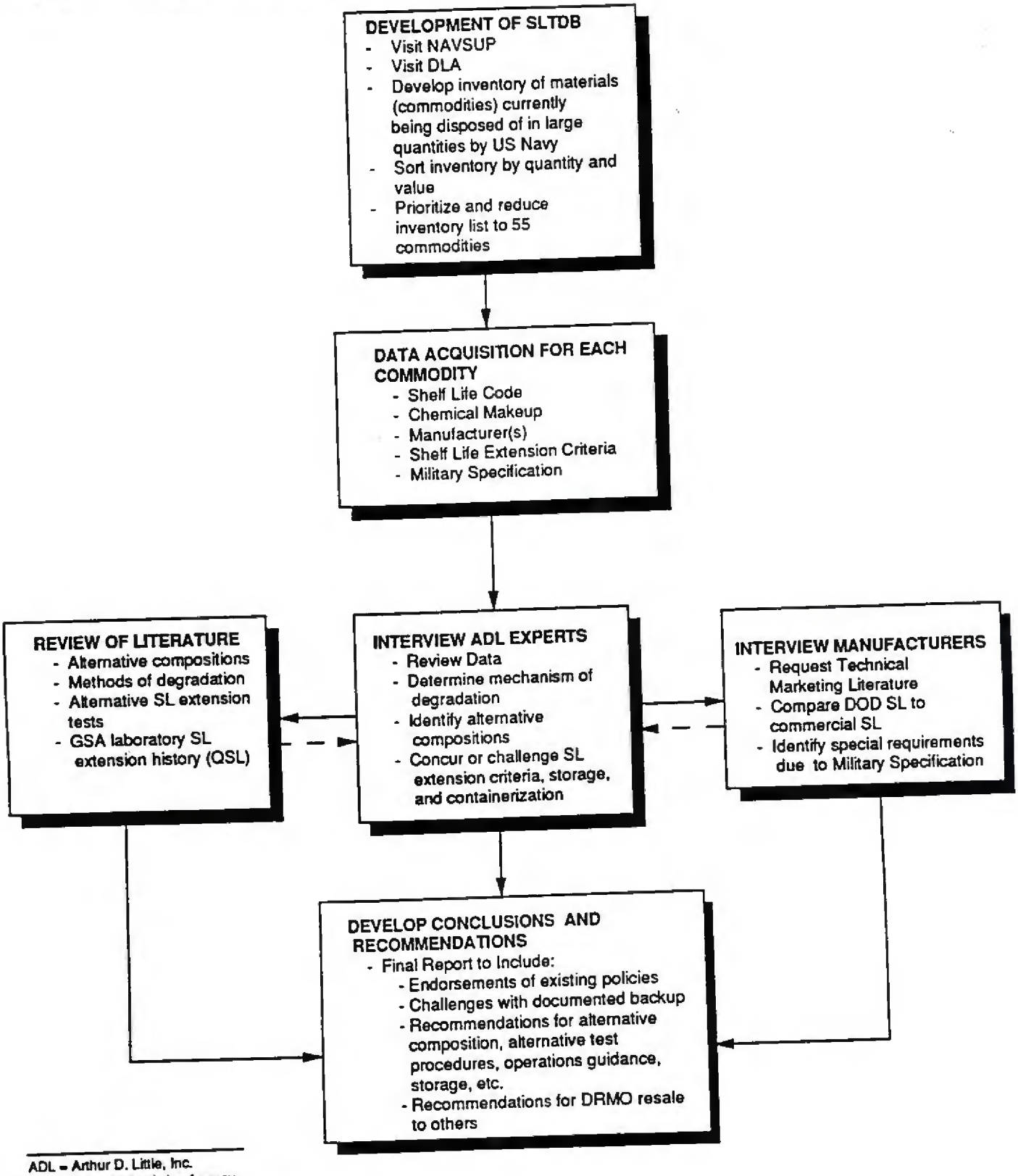
Figure 3-3 is an example of the interview form utilized when speaking with both in-house Arthur D. Little experts and the manufacturers. Specific information requested included the mode of degradation for each item, whether the existing shelf life code was reasonable and accurate, whether the extension test was reasonable and accurate, and any recommendations. A summary of the information obtained and recommendations are provided for each commodity in the following section.

We have defined "Shelf Life" in this report to mean the initial shelf life of a commodity in an unopened container. (We propose that previously opened containers be inspected or tested just prior to use, or if this is not practical, disposed of.). For several commodities, we have recommended that the shelf life be extended to non-deteriorative (no specified shelf life) and the commodities be visually or analytically tested (according to the Military Specifications) just prior to use.

The only available extension criteria in many cases was the Military Specifications for procurement which contained many tests that were appropriate for the original purchase (chemical analysis and engine tests, for example), but are not appropriate for determining degradation during storage. We have tried to indicate in a number of cases which of the tests in the procurement Military Specifications would be the best indicators of commodity degradation.

In many instances, where FED-STD-793 was used as a criteria for shelf life extension and a shelf life extension of 1/2 the initial shelf life was indicated, we have proposed extension for a period equal to the full initial shelf life.

Figure 3-1: Overall Technical Approach



ADL = Arthur D. Little, Inc.
DLA = Defense Logistics Agency
DOD = Department of Defense
DRMO = Defense Reutilization and Marketing Office
GSA = General Services Administration
NAVSUP = Naval Supply Systems Command
QSL = Quality Status List
SL = Shelf Life
SLTDB = Shelf Life Term Database

SOURCE: Arthur D. Little, Inc.

Figure 3-2: Summary of Recommendations

NSN	NSN Designation	Current Shelf Life Code	Recommended Shelf Life Code	Test Procedure
6135010714923	Battery, Non-rechargeable	L	4	N/A-Challenge
6750008171364	Developer, Photo	6	6	Unknown/Challenge
6810001416080	Sodium Phos/Tribasic	6	0	0-S-642F/Challenge
6810001746581	Sodium Hydroxide, Tech	6	6	793K-1/Challenge
6810002248353	Methanol, Technical	6	0	O-M-232J/Challenge
6810002331715	Sodium Carbonate	7	9	0-S-571F/Challenge
6810002499354	Sulfuric Acid, Elect	7	0	0-S-801E/Challenge
6810002709978	Nitric Acid Reagent	M	M	N/A-Challenge
6810002709982	Tetrachloroethylene	6	6	0-T-236C/Challenge
6810002814163	Mercuric Nitrate Solution	M	R	N/A-Concur

Figure 3-2: Summary of Recommendations (Continued)

NSN	NSN Designation	Current Shelf Life Code	Recommended Shelf Life Code	Test Procedure
6810005511487	Trichloroethane	9	9	793K-1/Challenge
6810005844070	Xylene, Technical	7	9	Unknown/Challenge
6810008732554	Ion Exchange Compound	6	9	0-1-279A/Challenge
6810009457682	Standard Conduct Solution	M	0	N/A-Challenge
6810009648945	Monoethanolamine	6	6	MIL-M-23573B/Concur
6810011093911	Sodium EDTA	R	R	N/A-Concur
6810011255234	Hardness Solution	M	Q	N/A-Challenge
6840009261481	Insecticide	6	6	DOD-1-51064D/Challenge
6850000338851	Cleaning Compound	7	7	MIL-C-81302D/Challenge
6850001737243	Scale Preventive Comp.	R	R	N/A-Concur

Figure 3-2: Summary of Recommendations (Continued)

NSN	NSN Designation	Current Shelf Life Code	Recommended Shelf Life Code	Test Procedure
6850001817940	Antifreeze/Coolant	7	8	MIL-A-46153B/Challenge
6850002709986	Fluorescein	6	6	MIL-S-17980D/Concur
6850002858012	Dry Cleaning Solvent	7	9	P-D-680A/Challenge
6850002976653	STB, Decontam Agent	9	9	MIL-D-12468C/Challenge
6850007535000	Cleaning Compound	6	7	793M-1/Challenge
6850009830282	Cleaning Comp. Solvent	7	7	MIL-C-81302D/Challenge
6850010457931	Cleaning Compound	7	7	MIL-C-43616C/Challenge
7930002829699	Detergent, General	7	8	MIL-D-16791F/Challenge
7930005599481	Cleaning Compound	M	9	N/A-Challenge

Figure 3-2: Summary of Recommendations (Continued)

NSN	NSN Designation	Current Shelf Life Code	Recommended Shelf Life Code	Test Procedure
7930007535178	Polish, Automobile	6	6	A-A-15/Challenge
7930009353794	Polish, Plastic	6	6	793R-1/Challenge
8010001605789	Thinner, Paint Prod	7	9	793S-2/Challenge
8010001658557	Primer Coating	6	8	TT-P-645B/Concur
8010001817568	Remover, Paint	4	0	793S-1/Challenge
8010001818276	Polyurethane Coating	4	9	MIL-C-83286B/Concur
8010002911069	Paint, Rubber	6	6	TT-P-95C/Concur
8010004108460	Epoxy coating Kit	6 or 4	8	MIL-P-24441A/Concur
8010004198541	Paint, Latex	6	8	TT-P-19D/Concur
8010004376757	Epoxy Primer Coat. Kit	6	8	MIL-P-24441A/Concur

Figure 3-2: Summary of Recommendations (Continued)

NSN	NSN Designation	Current Shelf Life Code	Recommended Shelf Life Code	Test Procedure
8010008152692	Paint, Heat Resisting	4	6	TT-P-28G/Concur
8010008791103	Paint, Antifouling	4	4	793S-2/Concur
8010009172256	Enamel, Alkyd	6	9	TT-E-490E/Concur
8030000087207	Sealing Compound	2	2	793T-1/Concur
8030001658577	Coating Compound	4	4	DOD-P-15328D/Concur
8030007535006	Sealing Compound	3	3	793T-1/Concur
8030008238039	Corrosion Resist Coat.	4	7	MIL-C-81706/Challenge
8030009381947	Corosion Resist Comp.	4	4	MIL-C-81309D/Challenge
8040002254548	Adhesive*	4	N/A	N/A

* Commodity no Longer in use

Figure 3-2: Summary of Recommendations (Continued)

NSN	NSN Designation	Current Shelf Life Code	Recommended Shelf Life Code	Test Procedure
8040005824597	Adhesive, Paste	4	5	793U-1/Concur
9150000044535	Cutting Fluid	7	9	MIL-C-46149/Challenge
9150001497432	Hydraulic Fluid, Fire Res.	6	6	MIL-H-83282C/Challenge
9150001818097	Lubrication Oil, Engine	6	7	MIL-L-9000H/Challenge
9150009857099	Lubricating Oil	7	9	MIL-L-23699D/Challenge
9150010355394	Lubricating Oil	6	7	MIL-L-2105D/Concur
9150010805962	Hydraul Fluid, Catapult	6	6	MIL-H-22072C/Challenge

N/A=Not Applicable

Source: Arthur D. Little, Inc.

FIGURE 3-3: Sample Questionnaire

PAGE ___ OF ___

INTERVIEWEE:
INTERVIEW NO:

ADDRESS:

PHONE/EXT:

SHELF LIFE ANALYSIS WORKSHEET

DATE:

SHELF LIFE ITEM:
NSN:
DESCRIPTION:

INTENDED USE:

APPLICABLE MIL SPECS:

SHELF LIFE CODE AND INTERPRETATION:

SHELF LIFE EXTENSION TEST PROCEDURE:

SHELF LIFE EXTENSION HISTORY:

1. IS SHELF LIFE REASONABLE AND ACCURATE?

2. IS SHELF LIFE EXTENSION TEST REASONABLE AND ACCURATE?

FIGURE 3-3: Sample Questionnaire

PAGE ___ OF ___

3. WHAT ARE THE MECHANISMS OF DEGRADATION WHICH MAKE SHELF LIFE IMPORTANT?
(for example: packaging, storage conditions, or chemistry)

4. WHAT IS THE MANUFACTURER'S RECOMMENDED SHELF LIFE?
DOES THIS MATCH THE NAVY SHELF LIFE?
IS THIS THE SAME AS THAT RECOMMENDED FOR COMMERCIAL CUSTOMERS?
IF NOT, WHY? TOO STRINGENT A SPEC?

5. RECOMMENDATIONS:

Source: Arthur D. Little, Inc.

4.0 Shelf Life Data Sheets

The following data sheets summarize all the information gathered for each commodity, and the final conclusions and recommendations made with respect to the commodity's SLT and its shelf life extension test criteria. Figure 4-1 is a summary listing of manufacturers and points of contact for the 55 commodities. In addition, the data sheets include the supporting information utilized to make these recommendations. For each FSC which includes more than one NSN, a general summary has been prepared (when appropriate). The 55 commodities are organized by FSC into the following ten categories:

6135	Batteries
6750	Photographic Supplies
6810	Chemicals
6840	Pest Control and Disinfectants
6850	Miscellaneous Chemical Specialties
7930	Cleaning/Polishing Compounds
8010	Paints and Related Products
8030	Sealing Compounds
8040	Adhesives
9150	Oils, Greases, Lubricants

Figure 4-1: Summary Listing of Manufacturers and Points of Contact for 55 Commodities

NSN	NSN Designation	Manufacturer	Contact/Phone #
6135010714923	Battery, Non rechargeable	Power Conversion	Richard Dratler 201-796-1606
6750008171364	Developer, Photo	Eastman Kodak	Matt Rogers 800-242-2424
6810001416080	Sodium Phos/Tribasic	FMC Corporation	Jerry Hagquist 215-299-6000
6810001746581	Sodium Hydroxide,tech	Olin Corporation	Michael Fortin 615-336-4684
6810002248353	Methanol, technical	Lyondell Petrochemical Company	Phil Lispanitano 713-652-7200
6810002331715	Sodium Carbonate	General Chemical	Jim Shepard 302-792-8591
6810002499354	Sulfuric Acid, Elect	Exide Corporation	John Bear 215-378-0816
6810002709978	Nitric Acid Reagent	Polysciences	Mark Eckard 215-343-6484
6810002709982	Tetrachloroethylene	Dow Chemical	Bart Burza 1-800-258-2436
6810002814163	Mercuric Nitrate Solution	Chemical Commodities	Charles Eisenhard 714-864-2310
6810005511487	Trichloroethane	Ashland Chemical Dow Chemical	Rick Layman 614-889-3083 Bart Burza 1-800-258-2436

Figure 4-1: Summary Listing of Manufacturers and Points of Contact for 55 Commodities (Continued)

NSN	NSN Designation	Manufacturer	Contact/Phone #
6810005844070	Xylene, technical	Ashland Chemical	Rick Layman 614-889-3083
6810008732554	Ion Exchange Compound	Purolite Co.	Norman Tourtellott 1-800-343-1500
6810009457682	Standard Conduct Soln	Polysciences	Mark Eckard 215-343-6484
6810009648945	Monoethanolamine	Dow Chemical	Bart Burza
6810011093911	Sodium EDTA	Dow Chemical	Bart Burza 1-800-258-2436
6810011255234	Hardness Solution	Polysciences	Mark Eckard 215-343-6484
6840009261481	Insecticide	American Cyanide Prentiss	Chuck Galley 201-835-3100 Jeff Miller 515-326-1919
6850000338851	Cleaning Compound	Allied Chemical Co. Dupont Dupont	Dick Boberg 201-455-3153 Carroll Smiley 919-248-5076 John Burris 302-999-5072
6850001737243	Scale Preventive Comp	Drew Chem. Corp. Allied Enterprises, Inc.	John Wolf 201-263-7600 Mike Birkan 804-489-8282

Figure 4-1: Summary Listing of Manufacturers and Points of Contact for 55 Commodities (Continued)

NSN	NSN Designation	Manufacturer	Contact/Phone #
6850001817940	Antifreeze/Coolant	Texaco	Dave Miller 512-483-0173
		BASF	John Conville 313-282-3300
6850002709986	Fluorescein	Presto-Dyechem	Jack Jones 215-627-1864
		Abbey Co.	Al Alfano 215-739-9960
6850002858012	Dry Cleaning Solvent	Exxon	Marla Dunckinson 800-443-9966
		Occidential Chemical Corp	Robert Bonk 800-733-1165
6850002976653	STB, Decontam Agent	Octagon Process, Inc.	John Wakelin 201-945-9400
6850007535000	Cleaning Compound	Penetone	Charles Good 201-567-3000
		Eldorado Chemical	Herb Rice 512-653-9323
6850009830282	Cleaning Comp Solvent	Dupont	Carroll Smiley 919-248-5076
		Dupont	John Burris 302-999-5072
		Allied Chemical	Dick Boberg 201-455-3153

Figure 4-1: Summary Listing of Manufacturers and Points of Contact for 55 Commodities (Continued)

NSN	NSN Designation	Manufacturer	Contact/Phone #
6850010457931	Cleaning Compound	Eldorado Chemical	Herb Rice 512-653-9323
		Coral International	George Tupper 800-228-4646
		Crest Indust. Chem. Co.	Pat Stair 713-780-1828
7930002829699	Detergent, General	Lighthouse for the Blind	Rudy Oppenheim 314-423-4333
		Union Carbide	Kim Fisher 800-752-1827
7930005599481	Cleaning Compound	Jones-Hamilton	Carl Knueven 419-666-9838
7930007535178	Polish, Automobile	RALKEM	Steven Fine 313-661-0260
7930009353794	Polish Plastic	RALKEM	Steven Fine 313-661-0260
		Permatex Industrial	Janet Reed 203-280-3826
8010001605789	Thinner, Paint Prod	Ashland Chemical	Rick Layman 614-889-3083
8010001658557	Primer Coating	Coronado Paint Co.	Mark Stene 904-428-6461
8010001817568	Remover, Paint	Turco Products, Inc.	John Jones 714-890-3600
8010001818276	Polyurethane Coating	Deft Chemical Coatings	Norm Gaul 714-474-0400

Figure 4-1: Summary Listing of Manufacturers and Points of Contact for 55 Commodities (Continued)

NSN	NSN Designation	Manufacturer	Contact/Phone #
8010002911069	Paint, Rubber	Baker Sealants & Coating Company	Charles Freidman 201-333-6986
8010004108460	Epoxy coating Kit	Devoe Coating Company	Louis Holzknecht 502-589-9340
8010004198541	Paint, Latex	Coronado Paint Co.	Mark Stene 904-428-6461
8010004376757	Epoxy Primer Coat. Kit	Devoe Coating Company	Louis Holzknecht 502-589-9340
8010008152692	Paint, Heat Resisting	Sentry Paint	Carl Kernader 215-522-1900
8010008791103	Paint, antifouling	Devoe Coating Company	Louis Holzknecht 502-589-9340
8010009172256	Enamel, alkyd	Coronado Paint Co.	Mark Stene 904-428-6461
8030000087207	Sealing compound	P.R.C.	Bill Keller 818-240-2060
8030001658577	Coating Compound	Pratt and Lambert Randolph Products	Doug Hoff 316-733-1361 Saadat Ullah 201-438-3700
8030007535006	Sealing Compound	FlameMaster	Ed Hernandez 818-982-1650

Figure 4-1: Summary Listing of Manufacturers and Points of Contact for 55 Commodities (Continued)

NSN	NSN Designation	Manufacturer	Contact/Phone #
8030008238039	Corrosion Resist Coat	Turco Products	John Granger 714-890-3600
		Turco Products	John Jones 714-890-3600
		Parker-Amchem	David Moseley 714-864-2310
8030009381947	Corosion Resist Comp	Spray On Products	Rich Miller 800-777-2966
		Alox Corp.	Fred Cuneo 716-282-1295
8040002254548	Adhesive*	GE Silicone Products Dept.	Bill Bouchard 518-237-3830
8040005824597	Adhesive, Paste	W.W. Henry Co.	Jerry Jerski 213-583-4961
9150000044535	Cutting Fluid	David Howland Oil	Lawrence Klepper 716-473-6650
		Convoy Oil	Frank Roddy 215-739-5281
9150001497432	Hydraulic Fluid, Fire Res.	Lubricating Specialties	Brock Bazzell 213-928-3311
		Castrol, Bray Products	Julia Smith 714-660-9414
		Royal Lubricants	Bill Schneider 201-887-7410

* Commodity no longer in use

Figure 4-1: Summary Listing of Manufacturers and Points of Contact for 55 Commodities (Continued)

NSN	NSN Designation	Manufacturer	Contact/Phone #
9150001818097	Lubrication Oil, Engine	Imperial Oil Co., Inc. Lubricating Specialties	Bill Mahoney 908-591-9400 Brock Bazzell 213-928-3311
9150009857099	Lubricating Oil	Castrol, Bray Products Royal Lubricants	Julia Smith 714-660-9414 Bill Schneider 201-887-7410
9150010355394	Lubricating Oil	Castrol, Bray Products Imperial Oil Co., Inc. Lubricating Specialties	Julia Smith 714-660-9414 Bill Mahoney 908-591-9400 Brock Bazzell 213-928-3311
9150010805962	Hydraul Fluid, Catapult	E.F. Houghton	Peter Skoog 215-666-4105

Source: Arthur D. Little, Inc.

FSC	Category
6135	Batteries

NSN: 6135010714923
Name: Battery, non-rechargeable
Description: Six volt lithium/sulfur dioxide non-rechargeable battery
Intended Use: Intended to power the AN/PRC-96 radio onboard ships
Military Specification: MIL-B-28857
Shelf Life Code: L = 21 months
Shelf Life Extension Procedure: Non-Extendable

Summary

Shelf Life: Challenge - Change shelf life to type II, code 4 = 12 months.
Extension Criteria: Challenge - Utilize Open circuit voltage, rise time, and discharge tests.

Background

Currently the Navy utilizes more than 200 types of batteries. It has been reported that the Navy is attempting to standardize their battery requirements to reduce the number of types of batteries in use. This 6 volt lithium/sulfur dioxide battery is generally used for communication equipment and is not commercially available. All batteries have self discharge characteristics but this type degrades more slowly than others. However, over time a thin film forms on the lithium electrode causing a slight voltage delay. As the process continues, this "passivating film" covers the electrode, exponentially slowing the rate of this reaction so there is a limit to the film build up. The voltage delay which is created is insignificant to the performance for most applications. Nonetheless, due to the critical nature of communication equipment to military operations, the shelf life determination is a matter of risk assessment.

Discussion of Shelf Life

The current Navy shelf life of this product (21 months non-extendable) appears to be overly cautious, despite the critical nature of this application. The shelf life of this battery could likely be greater than ten years. In addition, there is a discrepancy between the stated shelf life of 21 months non-extendable and the Military Specification. Paragraph 3.2.3.5, "Storage," of MIL-B-28857 states that the battery must meet certain specifications even after five years of storage.

Discussion of Extension Criteria

There is a discrepancy between the label of Type I non-extendable which appears to be overly cautious and the Military Specification. Paragraph 3.2.3.5, "Storage," details tests to be performed at intervals of 1 year, 2 years, and 5 years to determine whether or not to extend the shelf life. These tests are the open circuit voltage, rise time, and discharge tests.

Recommendations

Change the shelf life from type I, non-extendable to type II, shelf life code 4. Follow the Military Specification with respect to the outlined shelf life and extension procedures on representative samples of the battery inventory. Those batteries used to conduct shelf life extension tests must be discarded since they are non-rechargeable. Limit the number of extensions to a total of ten years assuming all the specified tests are passed.

FSC	Category
6750	Photographic Supplies

NSN: 6750008171364
Name: Developer, Photo
Description: Tan colored, odorless powder
Intended Use: Intended for use as a photographic developer
Military Specification: MIL-STD-129
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: Unknown

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Utilize color, caking, pH, developing ability, and specific gravity tests.

Background

This powder is meant to be stored dry until the time of use at which point it is mixed with water to produce a film developing solution. The solution itself can be reused several times and stored, assuming it is tightly sealed to prevent oxygen penetration. Exposed to air, the solution turns from clear to yellow indicating degradation. The powder can be stored for an extremely long time if no moisture is allowed to contaminate it. Moisture causes caking as well as the oxidation of the hydroquinone and metol. When hydroquinone is oxidized, it forms quinone which produces a brown coloring. This process is irreversible.

Discussion of Shelf Life

Two years appears to be an appropriate shelf life for this material. The manufacturer recommends the same shelf life for commercial customers as for the military.

Discussion of Extension Criteria

Since no Military Specification exists for this item, the required tests for extension are not known. However, the following five tests are recommended: color, caking, developing ability, pH of the solution, and specific gravity of the solution. The developing ability test could be performed by preparing the solution as specified, placing a strip of exposed film into the solution for the specified amount of time, and comparing the exposure to a control strip or gray scale. If all of these simple requirements are met there is no reason to put a limit on the number of extension periods.

Recommendations

Perform the five recommended tests in order to determine shelf life extensions.
Do not limit the number of extension periods.

FSC	Category
6810	Chemicals

NSN: 6810001416080
Name: Sodium Phosphate/Tribasic
Description: Strong alkaline hydroscopic white crystals (Type I)
Intended Use: Washing, cleaning, and scouring with or without soap
Military Specification: FED-SPEC-O-S-642F
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-SPEC-O-S-642F

Summary

Shelf Life: Challenge - Change to nondeteriorative, Type II.
Extension Criteria: Challenge - Change to Not Applicable.

Background

Trisodium phosphate (TSP) is an anhydrous white material which can exist in a powder, granular, flake, or crystalline form. The material is highly alkaline and should only be handled by personnel wearing appropriate hand protection. The product is dissolved in water and used as a washing/cleaning solution. The primary method of degradation is absorption of moisture which causes hardening.

Discussion of Shelf Life

The manufacturer has arbitrarily given the product a 12 month shelf life since sodium phosphate will absorb moisture if left open to the air. The product is packaged in a fiber drum lined with a kraft paper insert and a 0.0005" polyethylene bag to reduce moisture penetration. The moisture may cause the product to become lumpy which can decrease the rate of dissolution in water. The manufacturer states that the theoretical shelf life is infinite. Absorption of moisture will vary depending on storage conditions and the frequency with which the package is opened. Shelf life should be extended to nondeteriorative and the product used as long as it will dissolve in water in a reasonable period of time. This recommendation is further supported by the products shelf life extension history as seen in the DOD Quality Status List dated November 1991 through March 1992, which shows that all of the lots tested were extended.

Storage temperatures should be below 85°F to lower the potential effects of high moisture levels in ambient air. Freezing will not hurt product integrity.

The manufacturer's recommended shelf life of 12 months for this item is inappropriate for its intended use as a cleaning detergent.

Discussion of Extension Criteria

If the product is reclassified as having a shelf life code of 0 indicating nondeteriorative, then the current shelf life extension test procedure becomes not applicable. The end user should determine if the product is usable based on whether it dissolves in a reasonable period of time.

Recommendations

Be sure the polyethylene bag is tightly sealed when the material is being stored. Change the shelf life to nondeteriorative and eliminate the formal shelf life extension test procedure.

NSN: 6810001746581
Name: Sodium Hydroxide, Technical
Description: Strong alkaline, white flakes (Type I), causes severe burns
Intended Use: Cleaning, washing, and scouring processes, with or without soap
Military Specification: FED-SPEC-O-S-598B
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-STD-793, Appendix K-1

Summary

Shelf Life: Concur - If packaged in an inner polyethylene bag.
Extension Criteria: Challenge - Physical inspection, do not limit the number of extensions.

Background

The product is supplied in a steel can or drum in the form of flakes, lump, powder, or beads in accordance with the type of material specified. Minimum sodium hydroxide (NaOH) assay is 96.0% by weight. Exposure to moist air will cause the dry chemical to absorb water which may cause the product to harden. The material is dissolved in water prior to use as a cleaning solution.

Discussion of Shelf Life

We recommend a 24 month shelf life since the only method of degradation is contact with moisture or carbon dioxide both of which may harden the product beyond use. Periodic inspection at intervals of two years is reasonable. Moisture will dilute the product but will not change it chemically. Carbon dioxide will react chemically with the product to form sodium carbonate. The product is usable as long as it can be physically handled and dissolved in water within a reasonable period of time. Opening of the steel container to inspect the product for the shelf life extension test will only introduce moisture and carbon dioxide which will shorten the products usable shelf life. The manufacturer issues the product with an unlimited shelf life.

Storage conditions should be at 85°F or lower to limit the level of moisture in ambient air. Freezing will not degrade the product. The container should be kept tightly sealed until time of use.

The manufacturer's recommended shelf life of nondeteriorative for this item is the same for both government and commercial customers.

Discussion of Extension Criteria

Current test procedures require that the packaging be opened to collect a sample of the product. This will only introduce moisture and carbon dioxide which leads to product degradation. The sampling portion of the test method as stated in paragraphs 3.1 and 3.2 should be eliminated leaving only the visual checks as outlined in Appendix K-1. The Military Specification for packaging for the procurement of the sodium hydroxide flakes, lump, powder or beads should be changed to include an inner packaging of a 4 mil polyethylene bag, such as used for sodium carbonate (NSN 6810002331715). This would allow periodic inspection (both visual and manual) of the bag contents without opening the bag and exposing it to moisture which will cause its degradation.

Recommendations

Store the product below 85°F to limit the level of atmospheric moisture and do not open package until time of use. The Military Specifications for the purchase of this material should be changed, however, to include an inner polyethylene bag. This would allow periodic inspection of the material for solidification without exposing it to moisture which will cause it to solidify.

NSN: 6810002248353
Name: Methanol, Technical, Grade A
Description: Clear, flammable liquid with an alcohol smell
Intended Use: Cleaning solvent
Military Specification: FED-SPEC-O-M-232J
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-SPEC-O-M-232J

Summary

Shelf Life: Challenge - Change to nondeteriorative, Type II.
Extension Criteria: Challenge - Change to include inspection of the container only.

Background

Grade A methanol is 99.85% pure by weight with a maximum water content of 0.15%. It is shipped in 55 gallon steel drums and is used as a solvent.

Discussion of Shelf Life

All alcohols will readily evaporate or absorb water unless stored in a tightly sealed container. Storage conditions should be below 85°F to reduce the possibility of evaporation. Freezing will not degrade the product. The container should remain tightly sealed to limit moisture from entering the drum or evaporation of the methanol. Methanol remains chemically stable over time and has no degradation products. We therefore recommend that the shelf life for methanol be changed to nondeteriorative. This recommendation is further supported by the products shelf life extension history as seen in the DOD Quality Status List dated November 1991 through March 1992, which shows that all 46 lots tested were extended.

The manufacturer's recommended shelf life of nondeteriorative for this item is the same for both government and commercial customers.

Discussion of Extension Criteria

The current shelf life extension test procedure is correct under an extension condition, but if shelf life is increased to nondeteriorative this procedure becomes not applicable.

Recommendations

Change the shelf life to nondeteriorative and store the chemical below 85°F. Freezing will not degrade the product. Keep container tightly sealed to prevent absorption of moisture. Modify the extension criteria to include only an inspection of the container to determine if it is still intact.

NSN: 6810002331715
Name: Sodium Carbonate, Anhydrous
Description: Highly alkaline, odorless white powder, Type II
Intended Use: General washing and cleaning, acid neutralization
Military Specification: FED-SPEC-O-S-571F
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: FED-SPEC-O-S-571F

Summary

Shelf Life: Challenge - Lengthen to 60 months.
Extension Criteria: Challenge - For the above applications, the only extension criteria should be whether the material has become physically difficult to handle (become lumpy or solid).

Background

Sodium carbonate is a dry white powder or granular material. It is highly alkaline. A 0.1N solution has a pH of 11.6. Contact with skin and eyes, and inhalation of dust should be avoided. The product is shipped in 100 pound quantities packaged in a polyethylene bag enclosed in a steel drum to prevent moisture infiltration. It is purchased as a type II material per FED-SPEC-O-S-571E meaning that it is a medium soda ash product.

Discussion of Shelf Life

The manufacturer uses a 12 month shelf life due to moisture causing the powder to become lumpy. Moisture will reduce the effective strength of the product due to dilution and may cause the powder to become lumpy or solid but will not chemically change the product. Sodium carbonate will probably have an indefinite shelf life if the intended use is as a cleaning or washing solution. The only limiting factor would be the length of time required for the product to dissolve in water. If the intended use is acid neutralization, then the product should be a powder without lumps to allow for rapid and complete spreading over the acid spill. We feel that the shelf life should be lengthened to 60 months if the product is stored in a dry location and the polyethylene bag within the drum is kept closed to prevent atmospheric moisture from wetting the powder. The storage temperature is not critical, but conditions below 85°F are recommended to limit the amount of available moisture carried in ambient air. Freezing will not degrade the product.

The manufacturer's recommended shelf life of 12 months for this item is based on moisture causing the powder to become unusable.

Discussion of Extension Criteria

The procedures outlined in steps 4.2.4.1 through 4.2.4.4 of Federal Specification O-S-571E, while appropriate for procurement of the sodium carbonate, are not required for determining shelf life extension. The only mode of deterioration of this material is absorption of moisture which will cause solidification of the product. The only meaningful extension test is, therefore, opening the steel drum to visually (and manually) check the contents of the polyethylene bag for solidification (without opening the bag).

Recommendations

Store product below 85°F and keep tightly sealed within the polyethylene bag to limit the introduction of ambient moisture. Lengthen shelf life from 36 months to 60 months and change the extension criteria to include only visual and manual inspection of the contents of the polyethylene bag.

NSN: 6810002499354
Name: Sulfuric Acid, Electrolyte
Description: Clear, odorless, corrosive liquid, Class 4
Intended Use: Electrolyte for use in lead storage batteries
Military Specification: FED-SPEC-O-S-801E
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: FED-SPEC-O-S-801E

Summary

Shelf Life: Challenge - Change to nondeteriorative.
Extension Criteria: Challenge - Measure the specific gravity per FED-SPEC-O-S-801E Section 4.2.4.4.

Background

The product is a Class 4 dilute non-fuming sulfuric acid with a specific gravity of 1.2 and an acid concentration of 28% by weight. The packaging is a 1 gallon glass or polyethylene bottle. The intended use is as an electrolyte for lead acid batteries. The specific gravity is checked immediately prior to filling batteries to assure that the acid is of proper concentration.

Discussion of Shelf Life

Sulfuric acid does not chemically degrade with time. If the acid is allowed to absorb moisture the only effect will be dilution which can be directly measured by a specific gravity reading. Since the acid is used as a battery electrolyte which requires that the specific gravity be checked prior to battery filling, we recommend that the shelf life be changed to nondeteriorative. This recommendation is further supported by the products shelf life extension history as seen in the DOD Quality Status List dated November 1991 through March 1992.

The manufacturer's recommended shelf life of nondeteriorative for this item is the same for both government and commercial customers.

Discussion of Extension Criteria

Section 4.2.4 of FED-SPEC-O-S-801E lists numerous tests for determining color, acid content, organic matter, and other contaminants, but the only test of value is determining the specific gravity as stated in paragraph 4.2.4.4. Since this test is currently performed immediately prior to battery filling, a shelf life value of nondeteriorative should be assigned.

Recommendations

Store product below 90°F. Change the shelf life from 36 months to nondeteriorative and continue to check the specific gravity of the acid when filling batteries.

NSN: 6810002709978
Name: Nitric Acid, Reagent
Description: Clear, colorless, acidic liquid, pungent odor
Intended Use: Testing shipboard boiler water and feed water
Military Specification: MIL-W-15000
Shelf Life Code: M = 24 months
Shelf Life Extension Procedure: Non-Extendable

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Develop an extension test based on the color of the product.

Background

The nitric acid is currently packaged in 1 quart bottles. The concentration does not exceed 7% by wt. and the specific gravity is 1.03. The product is used as a test analysis chemical. Nitric acid will naturally breakdown over time to form nitrous oxides which turns the product from clear to a yellow color. Exposure to light may accelerate the decomposition process.

Discussion of Shelf Life

Light and time will naturally breakdown nitric acid into nitrous oxides which appear yellowish in color. If the acid has a yellow appearance it should be properly disposed of. The product should be stored in a dark environment to slow the degradation process. Storage temperatures should be below 85°F since heat may accelerate the formation of nitrous oxides. Freezing will not degrade nitric acid but may fracture the glass container at temperatures below 24°F. We recommend that the current 24 month shelf life be retained.

The manufacturer's recommended shelf life of 12 months for this item is the same for both government and commercial customers.

Discussion of Extension Criteria

No current shelf life extension test exists. Since the method of degradation is the formation of nitrous oxides which change the acid from clear to yellow, we recommend looking into the feasibility of a color or clarity test as an extension criteria. This test must reliably confirm product integrity.

Recommendations

Store the product below 85°F. Retain the current 24 month shelf life. Investigate the reliability of a color test to determine the level of nitrous oxide formation as a shelf life extension criteria.

NSN: 6810002709982
Name: Tetrachloroethylene, also called perchloroethylene
Description: Clear, drycleaning grade solvent
Intended Use: Drycleaning
Military Specification: FED-SPEC-O-T-236C
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-SPEC-O-T-236C

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Implement ASTM Acid Acceptance Test Method #D-2942.

Background

Grade A Tetrachloroethylene, also called perchloroethylene, is a clear, colorless liquid typically used as a dry cleaning solvent. There is an acid inhibitor present in the solvent to reduce the effects of moisture-induced hydrochloric acid formation. The solvent is currently packaged in 5 gallon metal cans. The specific gravity is 1.620 and the solvent is listed as a carcinogen by National Toxicology Program (NTP) and International Association for Research on Cancer (IARC). The recommended 24 month shelf life is due to the formation of moisture induced hydrochloric acid.

Discussion of Shelf Life

The introduction of moisture will eventually react with the chlorine to form hydrochloric acid (HCl). An acid inhibitor present in the solvent will slow the acidification process, but if excess moisture is present HCl formation will proceed. Hydrochloric acid will eventually attack the products metal storage can and possibly lead to leakage. We therefore recommend a shelf life of 24 months due to the moisture induced formation of hydrochloric acid.

The manufacturer's recommended shelf life of 24 months for this item is the same for both government and commercial customers.

Discussion of Extension Criteria

Current shelf life extension test procedures look at odor, color, nonvolatile matter, pH, and water content, as outlined in section 4.2 of FED-SPEC-O-T-236C. The logical test to determine shelf life extension should be an acid acceptance test such as ASTM Method #D-2942. This test is used in FED-SPEC-O-T-236C under step 4.2.3.6 but only for a Grade B tetrachloroethylene which is a vapor degreasing solvent. We recommend implementation of this acid acceptance test as the shelf life extension criteria, and the elimination of the above mentioned tests.

Recommendations

Store the product below 85°F. Retain the current 24 month shelf life and implement ASTM Acid Acceptance Test Method #D-2942 as the shelf life extension test procedure.

NSN: 6810002814163
Name: Mercuric Nitrate Solution, Class B, Type I
Description: Liquid oxidizing material in a water solution
Intended Use: Testing of shipboard boiler water and feedwater
Military Specification: MIL-W-15000
Shelf Life Code: M = 24 months
Shelf Life Extension Procedure: Non-Extendable

Summary

Shelf Life: Challenge - Lengthen to 48 months.
Extension Criteria: Concur.

Background

The product is a clear, odorless solution composed of 92.48% water, 7.5% mercuric nitrate, and 0.02% nitric acid. The solution is a nasal and respiratory irritant and is highly toxic if ingested. The solution is packaged in a 4 fluid ounce amber colored glass bottle. The manufacturer does not know what the degradation mechanisms are.

Discussion of Shelf Life

Since the degradation mechanisms are unknown, we agree with the manufacturer and recommend a 48 month shelf life, based on storage conditions between 50°F and 70°F. The manufacturer did state that they analyzed a 10 year old solution and found that there was only a 2% loss of mercuric nitrate concentration.

The manufacturer's recommended shelf life of 48 months for this item is the same for both government and commercial customers.

Discussion of Extension Criteria

Not Applicable.

Further work could be conducted to determine the degradation mechanisms of this product and determine whether or not the shelf life could be extended further. Also, if a shelf life extension test were available, the shelf life could be changed from type I, non extendable, to type II, extendable.

Recommendations

Store solution between 50°F and 70°F and lengthen shelf life to 48 months. Investigate the development of a titration test to verify the mercuric nitrate concentration. If a reliable test is developed, change the shelf life code from type I to type II. Also, the specific tests for which this solution is used should be identified to determine if other tests are available which do not require a shelf life restricted commodity.

NSN: 6810005511487
Name: 1,1,1 Trichloroethane, Technical (also called Methylchloroform)
Description: Clear, reactively stable solvent
Intended Use: Cleaning and degreasing operations
Military Specification: FED-SPEC-O-T-620C
Shelf Life Code: 9 = 60 months
Shelf Life Extension Procedure: FED-STD-793, Appendix K-1

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - ASTM Acid Acceptance Test Procedure D-2942 should be used in addition to FED-STD-793, Appendix K-1.

Background

Trichloroethane is a clear liquid purchased in 55 gallon drums. The product contains an acid inhibitor to reduce the potential formation of moisture-induced acid. Moisture and heat are the primary factors affecting product degradation. Moisture, which is introduced every time the container is opened, will react with chlorine to form hydrochloric acid. Heat will simply accelerate this acid formation process.

Discussion of Shelf Life

Opening the drum will introduce atmospheric moisture to the product which the inhibitor will initially absorb. Once the available inhibitor is consumed, the moisture will react with the trichloroethane to form hydrochloric acid. The formation of acid is accelerated by high temperature. Freezing will not degrade the product. The shelf life of 60 months is satisfactory for unopened containers, however, opened containers will likely show evidence of corrosion in less than 60 months. Opened containers should be inspected and tested by pH or ASTM Acid Acceptance Test Procedure D-2942 at least annually.

The manufacturer's recommended shelf life of 24 months for this item is the same for both government and commercial customers.

It should be noted that NSN 6810009306311 shown in Figure 2-2 as item No. 66 is also listed as trichloroethane with a shelf life of 24 months. This may be due to a difference in its intended use, however, it further supports the need to inspect opened containers more frequently.

Discussion of Extension Criteria

Since the product degrades through the formation of acid, the extension test should include ASTM Acid Acceptance Test Procedure D-2942 in addition to the container integrity inspection discussed in FED-STD-793 Appendix K-1.

Recommendations

The containers should be opened for as short a time as possible and tightly resealed when finished to prevent the introduction of excessive amounts of atmospheric moisture. The containers which are opened for testing should be used before the unopened containers. Storage temperatures should be below 80°F to reduce the potential of acid formation. Freezing will not degrade the product. Shelf life extension tests should be modified to use ASTM Acid Acceptance Test Procedure D-2942 in addition to the container integrity inspection discussed in FED-STD-793 Appendix K-1.

NSN: 6810005844070
Name: Xylene, Technical
Description: Clear, flammable, aromatic hydrocarbon
Intended Use: Paint thinner and cleaner, Grade B
Military Specification: ASTM D846-84, FED-SPEC-TT-X-916
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: Unknown

Summary

Shelf Life: Challenge - Lengthen to 60 months.
Extension Criteria: Challenge - Utilize a container inspection test, a color test, and/or evaporation residue test.

Background

Xylene is a clear, flammable, aromatic chemical primarily used to thin oil based paints and clean up paint brushes and spills. Product degradation occurs by chemical polymerization which is accelerated by high temperature.

Discussion of Shelf Life

Xylene will begin to degrade by the formation of long hydrocarbon chains. When this happens, the chemical will begin to appear yellow in color and the evaporation residue will resemble a varnish or polyurethane material. Heat will accelerate this degradation process. Freezing will not affect product integrity.

The manufacturer's recommended shelf life of 24 to 60 months based on storage conditions for this item, is the same for both government and commercial customers.

Discussion of Extension Criteria

The extension test procedure has not been identified. The use of a color test or evaporation residue test to identify the formation of hydrocarbon chains would be the most appropriate method.

Recommendations

Store xylene below 80°F and lengthen the shelf life from 24 months to 60 months. Implement an extension test involving the inspection of the container and a color or evaporation residue test. Further research may be required to develop the actual color test and determine its reliability.

NSN: 6810008732554
Name: Ion Exchange Compound
Description: Odorless, amber spherical beads, Class 1
Intended Use: Water treatment and demineralization
Military Specification: FED-SPEC-O-I-1279A
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-SPEC-O-I-1279A

Summary

Shelf Life: Challenge - Change packaging from nylon to polypropylene and lengthen to 60 months.
Extension Criteria: Challenge - Concur with Step 4.2.4 of FED-SPEC-O-I-1279A only.

Background

The Class 1 ion exchange material is a sulfur based product that is packaged in a nylon mesh bag. Degradation occurs when the sulfur attacks the nylon packaging which limits the shelf life to approximately 24 months.

Discussion of Shelf Life

The Military Specification requires that a nylon mesh be used to package the ion exchange resin material. The current shelf life is 24 months because the sulfur in the resin chemically attacks the nylon mesh and dissolves the packaging. If polypropylene packaging was used instead of the nylon, not only would the product be less expensive but the shelf life would also be lengthened to 60 to 120 months. Storage temperatures above 85°F accelerate the nylon degradation process.

Commercial customers use the polypropylene packaging and avoid the nylon due to the higher product cost and shorter shelf life.

The manufacturer's recommended shelf life of 60 months for this item packaged in polypropylene is the same for both government and commercial customers. In addition, all 58 of the lots listed on the DOD Quality Status List were extended.

Discussion of Extension Criteria

Step 4.2.4 of FED-SPEC-O-I-1279A (Examination of Filter Containers) is the only appropriate shelf life extension test for the ion exchange resin packaged in nylon bags since degradation of the package is the only known mode of failure.

Recommendations

Store material below 85°F. Change the specification to package the ion exchange material in a polypropylene mesh material which is both less expensive and more durable than the nylon that is currently being used, then lengthen the shelf life from 24 months to 60 months. Modify the extension criteria to include step 4.2.4 of FED-SPEC-O-I-1279A only.

NSN: 6810009457682
Name: Standard Conductivity Solution
Description: Clear, odorless solution containing potassium chloride
Intended Use: Instrument calibration for shipboard boiler water and feedwater testing
Military Specification: DOD-R-23679
Shelf Life Code: M = 24 months
Shelf Life Extension Procedure: Non-Extendable

Summary

Shelf Life: Challenge - Change to nondeteriorative, Type II, for unopened containers showing no leakage.
Extension Criteria: Challenge - As long as the packaging is intact, visual inspection at time of use should be used as the extension test.

Background

The conductivity solution contains potassium chloride at a specific concentration which provides a specific conductivity value. After the container is opened, evaporation of the water will change the concentration of the potassium chloride which in turn changes the solutions conductivity value.

Discussion of Shelf Life

The solution contains potassium chloride dissolved in water. The concentration of potassium chloride directly determines the conductivity value of the solution. The solution integrity will be lost if the water is allowed to evaporate or freeze. If the product is stored in an unheated warehouse, it will enhance the chance of potassium chloride crystallization so the potassium chloride crystals must be redissolved to return the solution to its original conductivity value. The potassium chloride itself is extremely stable and there is no mechanism for its degradation within the normal storage temperature range (40-110°F). The type of packaging can, however, influence the accuracy of the conductivity solution. For example, if common soda glass is used for packaging, sodium compounds might be extracted from the glass that would affect the conductivity of the solution. If this did happen, however, the greatest change would occur within the first 12-24 months and then the rate of change would become progressively less. Thus, extending the shelf life beyond the 24 months would not result in any significant further deterioration of the solution. This whole problem might be avoided, however, if the conductivity solution were packaged in a polyethylene bottle.

Despite the fact that the manufacturer's recommended shelf life of 12 months for this item is the same for both government and commercial customers, we recommend the shelf life be changed to nondeteriorative for unopened containers. Opened containers should be consumed within 6 months or discarded.

Discussion of Extension Criteria

Not Applicable.

Recommendations

Keep container tightly sealed to prevent evaporation. Store product between 40°F and 85°F to prevent freezing and reduce the occurrence of crystallization. Include a qualification at the time of use which states that if a precipitate is present that does not redissolve with shaking at room temperature or if there is any evidence of container leakage, the product should be discarded.

NSN: 6810009648945
Name: Monoethanolamine - Chelating Agent
Description: Colorless, flammable liquid, slight ammonia odor
Intended Use: Removal of carbon dioxide from air
Military Specification: MIL-M-23573B
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: MIL-M-23573B

Summary

Shelf Life: Concur.
Extension Criteria: Concur.

Background

The material is a clear, homogeneous solution of monoethanolamine and a chelating agent of monosodium salt of N, N-dihydroxyethyl glycine, with a slight ammonia odor. Exposure to air will initiate oxidation, while exposure to heat will lead to chemical breakdown.

Discussion of Shelf Life

The supplier states that exposure to heat will initiate and accelerate a chemical breakdown process that causes the product to change from clear to a yellow color. Contact with air will allow the product to oxidize and this usually will degrade the product significantly within 18 months if sufficient quantities of air are available. However, the data available in the DOD Quality Status List (November 1991 through March 1992) indicates that the packaging for this item sufficiently prevents air leakage and that several batches have actually had their shelf life extended. Therefore, based on the information provided in the DOD Quality Status List (November 1991 through March 1992), the current shelf life is appropriate.

The manufacturer's recommended shelf life of 18 months for this item is the same for both government and commercial customers.

Discussion of Extension Criteria

The test procedures outlined in MIL-M-23573B are appropriate.

Recommendations

Store the product below 90°F, and keep tightly sealed in shipping drum to reduce the potential for oxidation until time of use.

NSN: 6810011093911
Name: Sodium EDTA
Description: White powder
Intended Use: Chelating chemical for testing boiler water iron levels and cleaning boiler water
Military Specification: MIL-T-24494
Shelf Life Code: R = 48 months
Shelf Life Extension Procedure: Non-Extendable

Summary

Shelf Life: Concur.
Extension Criteria: Concur.

Background

Sodium EDTA is a tetrasodium salt of ethylenediaminetetraacetic acid typically in a 99% pure state. The product is highly hygroscopic and although moisture will not lead to chemical degradation it may create handling difficulties due to caking or solidification. The primary methods of degradation are oxidation due to exposure to air and chemical decomposition when exposed to temperatures above 100°F. Decomposition by heat may generate carbon dioxide and/or ammonia fumes. The product is typically packaged in 25 pound drums.

Discussion of Shelf Life

Storage temperatures above 100°F will promote chemical degradation. Contact with moisture will have no degradation effect but may make handling and use more difficult. The current 48 month shelf life is appropriate for containers stored under proper conditions which do not allow air and water permeation. Once the container has been opened, the risk of accelerating moisture absorption and oxidation increases and the shelf life is significantly shortened. If the material has caked or become colored, it should not be used, but should be discarded.

The manufacturer's recommended shelf life of 24 months for this item is the same for both government and commercial customers, but this seems unrealistic for material appropriately packaged and stored to prevent exposure to moisture or heat.

Discussion of Extension Criteria

Not Applicable.

Recommendations

Keep package tightly sealed to reduce effect of oxidation and moisture absorption, and store product below 100°F. Purchase this chemical in packages sized for single use applications, if possible, rather than in bulk.

NSN: 6810011255234
Name: Hardness Solution
Description: Clear, odorless liquid, Class E
Intended Use: Water quality monitoring
Military Specification: DOD-R-23679
Shelf Life Code: M = 24 months
Shelf Life Extension Procedure: Non-Extendable

Summary

Shelf Life: Challenge - Initially lengthen to 36 months, then if extension history verifies stability, change to nondeteriorative
Extension Criteria: Challenge - As long as the packaging is intact (and there is no leakage), visual inspection at time of use should be used as the extension test.

Background

The solution is packaged in 150 ml bottles as a clear, odorless liquid. The only chemical present is 0.1% calcium chloride dissolved in water. The only method of degradation would be precipitation of the carbonate.

Discussion of Shelf Life

The calcium may precipitate out of solution due to the formation of carbonate which may be accelerated if exposed to temperatures above 90°F. ($CaCO_3$ has an inverse solubility curve.)

The manufacturer's recommended shelf life, which is 12 months for this item for both government and commercial customers, appears to be unduly conservative since it should be stable indefinitely as long as the container is intact and tightly sealed.

Discussion of Extension Criteria

Not Applicable.

Recommendations

Lengthen shelf life first to code 7 (= 36 months) and then, if supported by the extension history, change to nondeteriorative. Store the product above freezing but below 90°F to limit the rate of carbonate precipitation. Keep the product tightly sealed to prevent evaporation from increasing the effective concentration of the salt. Utilize opened containers first, and include a qualification at the time of use which states that if precipitate is present, the product should be disposed of.

FSC	Category
6840	Pest Control and Disinfectants

NSN: 6840009261481
Name: Insecticide
Description: 91% pure, clear brown to colorless liquid with a mercaptan odor.
Intended Use: Intended for use against adult mosquitoes, flies, forest insects, and agricultural crop insects
Military Specification: DOD-I-51064D
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: DOD-I-51064D

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Utilize clarity, viscosity, and pH tests.

Background

The chemical name for Malathion is o,o-dimethyl phosphorodithioate of diethyl mercaptosuccinate. When exposed to the combination of sunlight, heat, and moisture, Malathion is intended to breakdown into its byproducts. Shelf life, on the other hand, is determined by many factors, such as moisture, pH, temperature, and packaging. The principle mechanism of degradation is hydrolysis which occurs readily if the pH is below 5 or above 7.[1] If this occurs, Diethyl fumarate and Dimethyl thiophosphate are generated. Diethyl fumarate can then be hydrolyzed into fumaric acid and alcohol.

Malathion is available in several formulations including dust, emulsifiable concentrate (EC) and water dispersable powder (WDP). Document DOD-I-51064D specifies a minimum concentration of 91% Malathion which is an emulsifiable concentrate. Water dispersable powders tend to degrade more quickly than emulsifiable concentrates because metal impurities in the solid formulation tend to catalyze the degradation process.[2] Along with formulation, the concentration of Malathion also tends to be an indicator of the rate of degradation. For example, premium grade Malathion which is specified in DOD-I-51064 remains practically unchanged after two years.[3] Whereas, after only 15 months, 50% Malathion (EC) reached its minimum marketable percentage of active ingredient, 48.5%.[4] Storage conditions and packaging, therefore, are the most important factors in the shelf life of this material, for several reasons. Extreme temperature changes could cause moisture to be absorbed into the drum. High temperatures could also cause the material to break down and create gas. Packaging is also important because if the inside of the metal drum is not properly coated with resin, Malathion would come in contact with the metal, resulting in an iron catalyzed breakdown and corrosion of the drum itself.

---

1 "Insect Control Technology," Encyclopedia of Chemical Technology. vol 13, p.441.

2 Singh, Kalyan and Sheo Prasad, "Shelf-life of Pesticide Formulations Alone and in Combination with Agrochemicals," Pesticides; 16(4):5-7,1982.

3 "Malathion," Farm Chemicals Handbook. 1989.

4 Nettar, Govind and N. Andrew, "Shelf-life studies on Pesticide Formulations," Pesticides; 14(12):11-14, 1980.

Discussion of Shelf Life

A shelf life of 24 months is appropriate assuming that the material is stored unopened in a cool environment. The Farm Chemicals Handbook recommends a storage temperature of 68-86° F. However, FED-STD-793 states that the storage temperature should be 32-110°F. The manufacturers recommend the same shelf life for the military as for commercial customers.

Discussion of Extension Criteria

It should be determined whether or not FED-STD-793 Appendix L applies to this item because although Federal Supply Code 6840 is listed, it is entitled "Disinfectant, Disinfectant-Detergent, and Sanitizer-Detergent." In addition, this particular NSN is not listed. If this document is used to determine shelf life extensions, clarity, viscosity, and pH tests should be added to the stated tests for this NSN. Conversely, if the Military Specification is used to determine shelf life extension, the procedure outlined is unreasonable. Many of the tests listed in DOD-I-5146D are irrelevant.

The DOD Quality Status List for November 1991 through March 1992, shows that this item was extended for two years. This is inconsistent with the policy of extending the shelf life for a period of half the stated shelf life, therefore, the policy should be reviewed.

In addition, it should be determined whether breakdown of the Malathion results in the formation of any (plant) toxic or nonemulsifying or nondispensable by-products, or whether the activity of the Malathion is merely diluted. If it is merely diluted, it should still be usable at a slightly higher concentration, rather than being disposed of.

Recommendations

Determine which tests are mandated for the shelf life extension for this NSN and modify them to include the three most relevant tests; clarity, viscosity, and pH. Determine the byproducts of Malathim degradation to determine whether partially degraded inventory can be used at higher concentrations with the same effect.

FSC	Category
6850	Miscellaneous Chemical Specialties

FSC: 6850
Name: Miscellaneous Chemical Specialties - General Overview

Background

This federal supply code contains a number of commodities which have performance specifications as opposed to composition specifications, resulting in a wide variety of chemical compositions (as listed in their MSDS) for a single NSN. For example, NSN 6850007535000 has at least five different formulations with widely different components, such as silicates, alkali hydroxides, and carbonates, tar acids, fatty acid soaps, polyethers, EDTA, sulfonates etc. For two of the items (two different grades of trichlorotrifluoroethane: NSN 6850009830282 Type I and 6850000338851 Type II), we have recommended increasing the shelf life extension period. We also recommend that substitute materials be evaluated to replace them since production of this chlorofluorocarbon (CFC) will be banned in 1995.

Discussion of Shelf Life

In general, the shelf life designations for these items are appropriate.

Discussion of Extension Criteria

There were discrepancies between the extension criteria in the Military Specifications and Federal Standard 793. For example, Federal Standard 793 Appendix M supposedly covers all of FSC 6850, but specifically mentions only one NSN, 6850007535000, high-pressure cleaning compound. Therefore, it was generally assumed that the correct extension criteria was that given in the Military Specifications, rather than in Federal Standard 793, except for the high-pressure cleaning compound which was specifically listed in Federal Standard 793, Appendix M.

NSN: 6850000338851(Type II) and 6850009830282(Type I)
Name: Cleaning Compound, solvent (Trichlorotrifluoroethane)
Description: Clear, colorless liquid with a faint ethereal odor
Intended Use: Type I solvent is ultra clean and is intended for use in the cleaning of space vehicle components, precision assemblies, oxygen systems and electronic equipment by the processes of spraying, flushing, vapor degreasing, or ultrasonics. Type II is used when the requirements for purity and cleanliness are less stringent than those of a cleaning process using Type I solvent.
Military Specification: MIL-C-81302
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: MIL-C-81302

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Change the extension period to three years.

Background

Chlorofluorocarbons (CFCs) are currently widely used in commercial and government facilities for both cold and vapor cleaning of parts and equipment.

The upcoming (1995) worldwide production ban on CFCs includes trichlorotrifluoroethane, however, there is a considerable effort underway to find acceptable substitutes. Among the substitutes proposed for cleaning agents are:

Halogenated	Oxygenated	Hydrocarbons	Aqueous
Trichloroethylene	Alcohols	Aliphatic	Water
Perchloroethylene	Ketones	Aromatic	Water and Additives
Methylene chloride			
Hydrochlorofluorocarbons (HCFCs)			
Hydrofluorocarbons (HFCs)			

Source: E.I.DuPont Co.

None of the above substitutes, however, can match all the favorable characteristics of the chlorofluorocarbons. For example, the proposed halogenated hydrocarbons are, in general, higher in human toxicity. The oxygenated and plain hydrocarbons are higher in flammability and the water-based cleaners require special equipment and present a potential water pollution problem.

Until substitute cleaners (and their associated equipment) are accepted by industry and government installations, the chlorofluorocarbons will continue to be used with much greater emphasis placed on preventing chlorofluorocarbon losses.

Discussion of Shelf Life

The chlorofluorocarbons are very stable compounds. As a consequence, the only major mechanism for degradation is contamination. Contamination with water may also result in particulate contamination from corrosion of the metal container (5-gallon can or 55-gallon drum). For sealed containers that show no external corrosion, the shelf life could be very well in excess of 36 months, so an initial shelf life of 36 months is quite reasonable. Because of its high stability, the shelf life extension period should be increased as noted below.

Discussion of Extension Criteria

The shelf life extension period should be changed from half of the stated shelf life to the full shelf life. The DOD Quality Status List (November 1991 to March 1992) supports this policy because 45 of 50 lots were extended for the full three years. It should not be necessary to carry out all the tests listed in MIL-C-81302 to determine if the shelf life should be extended, since the change in many of these specifications would not be detectable if the commodity were to degrade or become contaminated. For the Type I (Ultra-clean) trichlorotrifluoroethane (CFC), the pertinent tests for contamination or degradation for determining shelf life extension are moisture content, acid number, residue and particulate matter (MIL-C-81302 D para 4.4.3, 4.4.5, 4.4.6, and 4.4.7). For the Type II (Standard) CFC, the pertinent tests for contamination or degradation are moisture content and acid number (MIL-C-81302 para 4.4.3 and 4.4.5). In addition, the container for both types should be inspected for damage or leakage.

Alternatives

DuPont has proposed "Axarel" as an alternative to trichlorotrifluoroethane as a cleaner and Allied has proposed Genesolve 2000 and 2004 which is really HCFC 141B. (Product listings and information have been provided in Appendix A. DuPont has an 800 telephone number (1-800-283-2327) which can be used to request literature on alternatives to ozone depleting chemical cleaning agents.)

Although several alternatives have been developed, none of them are exact or "drop in" replacements. No one product performs all the functions. Caution should be taken before using the alternative for a direct replacement. For instance, Allied's HCFC 141B performs most of the same functions as trichlorofluoroethane but may not be suitable for cleaning oxygen systems unless the system is evacuated after cleaning because the hydrogen rich compound may react with the pure oxygen to cause an explosion.

However, it has been reported that by November 1992 the EPA will have published a list of appropriate alternatives for each function. This project is called "SNAP" or Significant New Applications Program.

Recommendations

Research alternative products which perform the same function. In addition, consider changing the shelf life extension period to the full three years. Reduce the number of tests used for determining shelf life extension to four for the Type I CFC and two for the Type II CFC.

NSN: 6850001737243
Name: Scale Preventive Compound
Description: Clear to slightly hazy, yellow to amber liquid with a mild odor
Intended Use: Intended for scale prevention for submerged tube, basket, and flash-type naval evaporators
Military Specification: DOD-D-24577
Shelf Life Code: R = 48 months
Shelf Life Extension Procedure: Non-Extendable

Summary

Shelf Life: Concur.
Extension Criteria: Concur.

Background

Two main modes of degradation exist for the different formulations of this commodity. First and most significant is polymerization which diminishes its ability to perform. Second, freezing and thawing caused by uncontrolled storage conditions can cause solids to precipitate out of solution. The fumes given off by this product make it unusable on submarines. However, one of the manufacturers noted that there are several newer versions of this product which do not fit the Military Specification DOD-D-24577 but that perform the same function more efficiently. Drew Chemical's "Ameroyal Evaporator Treatment #0024406" is a combination of different polymers which allows it to do the same job as the scale preventive compound with a smaller concentration. In addition, "Ameroyal" could be used on all types of ships, including submarines, because it does not give off fumes.

Discussion of Shelf Life

Since Military Specification DOD-D-24577 is a performance specification rather than a composition specification, there are a large number of product formulations covered by the MSDS sheets for this one NSN. It is, therefore, difficult to assign one shelf life that would be optimum for all the formulations. Nevertheless, a (minimum) shelf life of 48 months seems to be appropriate for all of the formulations in view of the fact that use of this shelf life term has apparently not resulted in failure of the products to meet performance specifications.

Discussion of Extension Criteria

Currently, Type I, non-extendable, appears to be the most appropriate classification for this commodity, since testing each lot in the supply system according to the military purchase specification would be extremely costly. For longer-term usage, however, the different formulations should be tested for their storage stability and for indicators of loss in activity (such as increased viscosity, phase separation, color change, etc.).

Recommendations

Survey commercial industry for new scale prevention products that might have better performance characteristics and a longer shelf life term (SLT). Retest currently used formulations for efficiencies in their given applications, and test their storage stability taking note of any indicators (viscosity, etc.) of commodity degradation. Consider tightening the Military Specification for this commodity to include only those products that perform well and have good storage stability.

NSN: 6850001817940
Name: Antifreeze/Coolant
Description: Slightly hazy blue-green liquid
Intended Use: Intended for use in the cooling systems of liquid-cooled internal combustion engines, other than aircraft, for protection against freezing. It may also be used as a coolant in some types of automatic guns.
Military Specification: MIL-A-46153
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: MIL-A-46153

Summary

Shelf Life: Challenge - Lengthen initial shelf life to four years.
Extension Criteria: Challenge - Utilize a four year shelf life extension period.

Background

The main forms of breakdown reported by the supplier are biological degradation of the ethylene glycol or oxidation of the compound into organic acids, which is unlikely if the package is properly sealed. Therefore, this product is fairly stable. It was noted, however, that the Military Specification calls for a very outdated formulation of this product. Texaco suggests changing the Military Specification to a newer formulation to allow for better products with longer shelf lives. Texaco is almost done testing a new formulation (ETX6280) which is an excellent corrosion inhibitor with a longer potential shelf life. There would be no precipitation of the inhibitor so the product could last indefinitely, although tests have not yet been performed to confirm this. This new formulation has extended performance in vehicles from the average life in use of 30,000 miles to a new lifetime of 70,000 miles. Texaco has tested their product with General Motors and is now going to test the product on heavy equipment through Caterpillar. Product information is included in Appendix A.

Discussion of Shelf Life

The 36 month initial shelf life designated for this product should be increased to 48 months.

Discussion of Extension Criteria

The product should have its shelf life extended for the full 48 months if it passes all the specified tests. This is supported by the DOD Quality Status List (November 1991 through March 1992) which states that 118 of 129 lots tested were extended for the full current stated shelf life of 36 months.

Recommendations

Change the extension period to the full stated shelf life. Consider revising the Military Specification to qualify newer formulations if the newer formulations prove to have equal or greater storage stability. Lengthen the initial shelf life period to 48 months for sealed, intact containers if future tests of old (or new) formulations continue to indicate that there is little or no degradation.

NSN: 6850002709986
Name: Fluorescein
Description: Orange powder
Intended Use: Intended for use in attracting the attention of rescuers to personnel forced down or adrift at sea, by forming a bright yellow/green area in the water
Military Specification: MIL-S-17980
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: MIL-S-17980

Summary

Shelf Life: Concur.
Extension Criteria: Concur.

Background

Fluorescein dye is used in this product as a sea marker. It is enclosed in a cloth bag which is in turn enclosed in an envelope made up of the same cloth with a vinyl coating. At the time of use, the outer, vinyl coated envelope is torn open to expose the cloth bag. Water then flows through the cloth bag and forms a solution with the powder dye. Due to the design of this product, the shelf life should be determined with two distinct components in mind, the dye itself and the outer envelope packaging.

Discussion of Shelf Life

Arthur D. Little's experience with the fluorescein dye indicates that the dye itself is very stable and has found the dye to be unchanged after 25 years of storage in glass. According to the manufacturer, the most likely form of degradation of the dye itself would be contamination by moisture causing the powder to cake up. Regardless, this would not prevent it from performing its intended use. It would simply take longer for it to dissolve. Preliminary tests should be performed to determine if the decrease in the rate dissolution as a function of moisture contamination greatly affects the ability to mark the area.

Due to the fact that the Military Specification covers the sea marker as a unit and not just the dye, the limiting factor of the shelf life is the packaging rather than the dye itself. Normal wear and tear, evaporation of plasticizer from the vinyl coating, and mildew could cause cracking and degradation of the packaging. Compromised packaging could cause the dye to fall out or come in contact with moisture and harden up.

Discussion of Extension Criteria

The extension criteria for inspection of the assembled package outlined in the Military Specification are appropriate. The visual inspection should focus on mildew build up, flexibility of the outer envelope, and the texture of the dye.

Recommendations

Focus shelf life extension tests on the degradation of the packaging. Explore the possibility of using a different plastic material as a moisture barrier in the packaging. Perform tests to determine the effect of a decreased dissolution rate.

NSN: 6850002858012
Name: Dry Cleaning and Degreasing Solvent
Description: Liquid, Type I, Stoddard solvent.
Intended Use: Intended for dry cleaning, spot and stain removing, and for degreasing of machine parts in equipment maintenance
Military Specification: P-D-680A
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: P-D-680A

Summary

Shelf Life: Challenge - Lengthen to five years.
Extension Criteria: Challenge - Utilize moisture content and evaporation residue tests, and extend the extension period to the full stated shelf life.

Background

The Military Specification for this product covers three different types of solvents, each of which includes several NSN numbers. Type I covers Stoddard solvents, (Military Symbol SD-1). Type II covers high flash point solvents known as 140°F solvent, (Military Symbol SD-2). Type III was added to the specification in July 1990. It covers odorless solvents with very high flash points over 200°F. NSN 6850002858012 is a Type I solvent according to the Military Specification. However, the MSDS sheets acquired from the DOD HMIS CD/ROM disk also show some formulations that fit Type II requirements. For instance, some are chlorinated solvents and some have high flash points. For this reason, it was very difficult to assign one shelf life term to a variety of formulations covered by the NSN.

Despite the confusion caused by multiple NSNs being covered by one Military Specification or multiple MSDS (composition) sheets being listed for one NSN, it appears in this case that the commodity referred to under NSN 6850002858012 is Stoddard solvent so the shelf life was evaluated on this basis.

Discussion of Shelf Life

There is no apparent reason why the petroleum distillates should degrade so the shelf life designation of 36 months seems unreasonable. The shelf life could be extended to at least five years.

Discussion of Extension Criteria

Performing all of the tests outlined in the Military Specification seems unnecessary. The only relevant extension test in the Military Specification is moisture content. To this should be added a test for evaporation residue. In addition, the extension period should be changed to the full stated shelf life.

Recommendations

Lengthen the shelf life for petroleum distillates to at least 5 years; change the extension period to the full stated shelf life; and perform two basic extension tests, moisture content, and evaporation residue.

NSN: 6850002976653
Name: STB, Decontaminating Agent
Description: White powder with a strong chlorine odor
Intended Use: Intended for use in destroying or converting certain chemical agents into harmless or less toxic compounds
Military Specification: MIL-D-12468
Shelf Life Code: 9 = 60 months
Shelf Life Extension Procedure: MIL-D-12468

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Perform only visual examination of the packaging; extend extension period to the full shelf life.

Background

This compound is simply a bleach prepared by adding quicklime to semitropical bleach (STB). (Semitropical bleach is prepared by contacting chlorine gas, in air, with hydrated lime.) If exposed to moisture and/or heat, the STB may decompose and the cleaning power is diminished. If moisture contaminates the powder, it may also cause it to harden and cake up. However, if the packaging is not compromised and the storage temperature is kept below 150°F, the shelf life should be indefinite. STB is packaged in a double lined container. There is a polyethylene bag inside a steel drum lined with wax. The drum is then sealed with a bottled ring cover. Therefore, contamination and leakage are unlikely.

If the STB is heated to above 160°F it may decompose evolving oxygen and some chlorine. Decomposition of the hypochlorite is exothermic. If the temperature reaches approximately 356°F, it will become self sustaining and spread through the entire batch.

Discussion of Shelf Life

Although the shelf life should be indefinite if the packaging is uncompromised, five years is an appropriate time period for an examination of the packaging.

Discussion of Extension Criteria

The only necessary tests are a visual examination of the packaging and of the powder itself. If the top of the powder has become caked and hardened, it indicates that some of the chlorine has dissociated. The shelf life extension period should be lengthened to the full stated shelf life. This is supported by the DOD Quality Status List (November 1991 through March 1992) which states that 404 of 470 lots were extended for five years.

Recommendations

Perform only a visual examination of the packaging and the powder. Change the shelf life extension period to the full stated shelf life.

NSN: 6850007535000
Name: Cleaning Compound, high pressure
Description: Thick, dark, amber liquid with a mild odor
Intended Use: Intended for use in high pressure steam cleaning machines of the continuous tubular coil vapor-generating type, for cleaning of painted and unpainted aircraft surfaces and to neutralize acid in specialized paint stripping operations
Military Specification: MIL-C-22542
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-STD-793 Appendix M

Summary

Shelf Life: Challenge - Lengthen to thirty six months.
Extension Criteria: Challenge - Add tests measuring corrosion and pH.

Background

This item has several different formulas (several different MSDS sheets) all having one NSN and military performance specification making it difficult to predict shelf life.

One of these cleaners is a concentrated liquid alkali (containing potassium hydroxide) cleaner. It has high alkalinity to neutralize acidic materials generated in some paint stripping operations as well as surfactants to remove oil and dirt. This cleaner loses some activity if it is allowed to absorb carbon dioxide from the air, but the surfactants remain unaffected.

A second type of cleaning compound covered by this NSN contains silicate, fatty acid soap, polyether, EDTA, and sulfonates. This material should be stable indefinitely under room temperature (65-85°F) storage conditions, so 36 months should be a reasonable conservative shelf life.

Discussion of Shelf Life

The shelf life is difficult to predict because there are a number of different formulations all meeting one Military Specification. Most of these, nevertheless, contain inorganics and detergent type organics and should therefore be stable. The shelf life can be lengthened to 3 years for unopened containers stored at above freezing temperatures and could probably be increased further (to 4 years) if storage were at room temperature.

Discussion of Extension Criteria

The (visual) tests outlined specifically in FED-STD-793 Appendix M are not suitable by themselves for determining if the item should be extended. The tests do not investigate the issue in enough depth. In addition to those visual tests, the following two tests found in MIL-C-22542 are recommended: Corrosion (Para 4.5.5), Alkalinity/pH (Para 4.5.4). If at any point during the revised 9 year total shelf life the material no longer meets specification, it could still probably be used, but at a higher concentration. The cleaning performance test of MIL-C-22542 (Para 4.5.11) would also be an excellent indication of any degradation of cleaner properties but this test requires very specialized equipment and thus appears to be very expensive. It would only be practical if a large quantity of the cleaner were involved.

Recommendations

Lengthen the shelf life to 36 months and add the two recommended tests to those stated in FED-STD-793 Appendix M. In addition, consider changing the Military Specification so that fewer formulations are possible, perhaps better tailored to more specific applications, and add a requirement for a 36 month SLT.

NSN: 6850010457931
Name: Cleaning Compound
Description: Amber liquid with a solvent odor.
Intended Use: Intended for cleaning painted and unpainted aircraft surfaces
Military Specification: MIL-C-43616
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: MIL-A-46143

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Extend the shelf life extension period to thirty six months.

Background

This is a solvent and surfactant system in which the solvent dissolves the grease and the surfactants maintain the emulsion and remove dirt. Choosing the correct packaging is very important to the shelf life of this item. Lined metal drums are the best choice for several reasons. Corrosion of an unlined metal drum could occur before the cleaning compound itself degrades. With plastic packaging alone, plasticizers could leach out of the container and contaminate the cleaning compound, or solvents could diffuse out of the container.

The mechanisms by which the product degrades are less significant. The solution could separate but must simply be shaken up to restore it to its original condition. Over time, both the surfactant and the solvent lose working strength but this is not necessarily a cause for disposal because the same effect can be achieved by using a little more than is required of fresh cleaning compound. Storage temperature also plays a role in the degradation of this compound. It should be stored at room temperature because high temperatures can increase the rate of degradation.

Discussion of Shelf Life

The designated shelf life of 36 months is a reasonable time for examining the product packaging although the total shelf life could be much more if packaging is uncompromised and the storage temperature is maintained at room temperature.

Discussion of Extension Criteria

The extension procedure for this compound is appropriate, including the limit to nine years total. The exception is the extension period of half the stated shelf life. The shelf life extension period should be the full stated shelf life of 36 months. This is supported by the DOD Quality Status List (November 1991 through March 1992) which states that 31 of 33 lots tested were extended for the full 36 months.

Recommendations

Change the shelf life extension period to the full stated shelf life.

FSC	Category
7930	Cleaning/Polishing Compounds

FSC: 7930
Name: Cleaning/Polishing Compounds - General Overview

Background

The primary mechanism of degradation for the cleaning compounds we evaluated for SLT is hydrolysis, whereas for polishes, it is agglomeration of particles. Hydrolysis appears to cause negligible changes to the performance of the product, however, and agglomeration of particles tends to be reversible, since the particles can usually be resuspended by shaking.

Discussion of Shelf Life

The shelf life of the cleaning compounds were challenged with recommendations made to lengthen the current shelf life because although the performance may be slightly reduced, it is not rendered useless. In order to supplement the performance it would suffice to simply use a little more of the product.

Discussion of Extension Criteria

It should be determined whether or not all of these items apply to FED-STD 793 Appendix R because only the plastic polish was specifically listed. It was assumed that the Military Specifications contained the correct extension criteria, with the exception of the plastic polish, NSN 7930009353794 which was specifically listed in FED-STD-793 Appendix R. The limitations on the number of extension periods were challenged most often. If the tests are passed, there is no reason to dispose of the product.

NSN: 7930002829699
Name: Detergent, General Purpose
Description: Liquid nonionic detergent with a mild characteristic odor
Intended Use: Intended for use in preparing cleaning solutions which are effective in, and rinsable with, either fresh or sea water
Military Specification: MIL-D-16791
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: MIL-D-16791

Summary

Shelf Life: Challenge - Lengthen to 4 years.
Extension Criteria: Challenge - Perform tests for emulsifying ability, chemical stability, color and odor; extend shelf life extension period to the full stated shelf life and do not limit the number of extensions.

Background

This detergent is very sensitive to hydrolysis, and to a lesser degree, oxidation and should therefore be stored under nitrogen. An undesirable color and odor are said to be produced if the material is allowed to hydrolyze or to oxidize. Hydrolysis of the ether groups generates alcohol or ethylene glycol.

Discussion of Shelf Life

If the packaging is properly sealed, no hydrolysis or oxidation should occur. Given the assumption that the undesirable color and odor do not affect the performance of the detergent, and the odor is not harmful or toxic, the shelf life should be extended to 48 months. It should be noted, however, that containers opened for testing will lose the nitrogen layer and will degrade more quickly than unopened containers. These should either be used right away or discarded.

Discussion of Extension Criteria

It should be determined whether or not FED-STD-793 Appendix R applies to this item since it is not specifically listed. It is unnecessary to perform all the tests outlined in the Military Specification. The most important examinations include the emulsifying ability, color, and odor. In addition, there should be no limitation on the number of extensions. The extension period should be extended to the full stated shelf life of 48 months instead of half the stated shelf life.

Recommendations

Lengthen shelf life to 48 months and determine whether or not FED-STD-793 Appendix R applies to this item. In addition, perform the following three tests to determine shelf life extension; emulsifying ability, color, and odor. Extend the shelf life extension period to the full stated shelf life and do not limit the number of extensions. Store in non-oxidizable metal containers.

NSN: 7930005599481
Name: Cleaning Compound, Toilet Bowl, Bisulfate
Description: Granular or globular technical grade sodium bisulfate
Intended Use: Intended for use in cleaning toilet bowls
Military Specification: A-A-460
Shelf Life Code: M = 24 months
Shelf Life Extension Procedure: Non-Extendable

Summary

Shelf Life: Challenge - Lengthen to 5 years, Type II shelf life.
Extension Criteria: Challenge - Utilize visual inspection and acid equivalent tests; do not limit the number of extension periods.

Background

Sodium bisulfate ionizes in water to form an acid that cleans by dissolving mineral deposits in the toilet bowl. If this material is in a properly sealed container it should not degrade. However, if not properly sealed, humidity can cause caking. For this reason, the packaging is important to shelf life.

Discussion of Shelf Life

The shelf life should be lengthened to 60 months. If caking does occur it does not affect the performance of the cleaner; it simply needs to be broken apart.

Discussion of Extension Criteria

This material should be changed from Type I non-extendable to Type II. There is no apparent reason to classify it as Type I. In addition, the only necessary tests are visual inspection of the packaging, and the acid equivalent test described in the Military Specifications. A simple pH test could replace the acid equivalent test. The moisture and insoluble matter content tests are irrelevant. The shelf life extension procedure is also inappropriate because there is no reason to put a limit on the number of extensions if it passes these tests.

Recommendations

Lengthen shelf life to 60 months and change the classification from Type I non-extendable to Type II extendable. Perform only a visual inspection of the packaging and an acid equivalent test and do not place a limitation on the number of times the shelf life can be extended.

NSN: 7930007535178
Name: Polish, Automobile
Description: Liquid or paste, with or without silicone, giving off a slight solvent odor
Intended Use: Intended for cleaning and protecting automobile finishes
Military Specification: CID-AA-15
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: CID-AA-15

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Use fineness of dispersion and performance tests; do not limit the number of extensions.

Background

The mechanism of degradation for this automobile polish is the agglomeration of particles. Over time the emulsion breaks down and the liquid becomes thinner allowing the abrasive to agglomerate. If this occurs, the powder, which was meant as an abrasive cleaner, could scratch the surface instead of polishing it. However, the agglomeration of these particles is reversible if the polish is shaken up often enough.

Discussion of Shelf Life

The current shelf life of 24 months is appropriate to ensure that the polish is tested often enough to preclude its use after serious degradation.

Discussion of Extension Criteria

It should be determined whether or not FED-STD-793 Appendix R applies to this item since it is not specifically listed. If all the tests indicated by the Military Specifications must be performed it would likely be less expensive to simply discard than to retest. The only critical tests are a fineness of dispersion test and a visual, performance test to determine the gloss, as explained in the Military Specification. It is very important to remember to shake the polish up well before performing these tests. Furthermore, there should be no limit to the number of times the shelf life of this polish can be extended if it passes these tests.

Two options exist for sampling and testing this commodity for determining shelf life extension. If the stock consists of a small number of containers, after a sample has been taken (from a well shaken container) and tested and found to be acceptable for shelf life extension, all the remaining containers should also be well shaken to redisperse any solids that have settled out.

If a large number of containers are involved or it is not practical to shake all the containers to redisperse the solids at the time of the test, a different container (with the same expiration date) should be opened, sampled and tested after each two year shelf life period and the rest of that container's contents either used immediately or discarded after the test. The same container of polish should **not** be used for subsequent sampling and testing for shelf life extension since the other containers in that lot of polish will not have the same shelf life history (periodic shaking to disperse the solids).

Recommendations

Do not limit the number of extensions. Perform only a fineness of dispersion test (ASTM D 1210-79) and a performance test and determine whether or not FED-STD-793, Appendix R applies to this item.

NSN: 7930009353794
Name: Polish, Plastic
Description: White lotion with a slight odor
Intended Use: Intended for use in the cleaning and polishing of plastic materials in the removal of light scratches, and produce an anti-static film that will prevent the electrostatic attraction of dust, lint, ash, etc, to the acrylic plastic
Military Specification: P-P-560
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-STD-793, Appendix R

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Utilize a fineness of dispersion and performance test; do not limit the number of extensions.

Background

The mechanism of degradation for this polish is very similar to that of automobile polish. The emulsion tends to break down over time causing the solution to become thinner and the abrasive material to agglomerate and settle out. It is possible that the agglomerated abrasive could scratch the material being cleaned, but this product contains a calcium carbonate abrasive cleaner which is very mild and, therefore, is unlikely to scratch.

Discussion of Shelf Life

The shelf life should remain at 24 months to ensure that the polish is tested often enough to preclude its use after serious degradation.

Discussion of Extension Criteria

In lieu of performing all of the tests in the Military Specification only two tests are necessary. The fineness of dispersion test and a visual performance test, as explained in paragraph 3.12 of P-P560, would display the agglomeration of particles, polishing ability and the abrasiveness. These two tests should be added to 793 Appendix R. In addition, no limit should be placed on the number of shelf life extensions if these criteria are met.

Two options exist for sampling and testing this commodity for determining shelf life extension. If the stock consists of a small number of containers, after a sample has been taken (from a well shaken container) and tested and found to be acceptable for shelf life extension, all the remaining containers should also be well shaken to redisperse any solids that have been settled out.

If a large number of containers are involved or it is not practical to shake all the containers to redisperse the solids at the time of the test, a different container (with the same expiration date) should be opened, sampled and tested after each two year shelf life period and the rest of that container's contents either used immediately or discarded after the test. The same container of polish should not be used for subsequent sampling and testing for shelf life extension since the other containers in that lot of polish will not have the same shelf life history (periodic shaking to disperse the solids).

Recommendations

Add a fineness of dispersion test (ASTM D1210-79) and a performance test to FED-STD-793 Appendix R and do not limit the number of shelf life extensions.

FSC	Category
8010	Paints and Related Products

NSN: 8010001605789
Name: Thinner, Paint Products
Description: Colorless, solvent based liquid
Intended Use: Paint thinner
Military Specification: A-A-857B, TT-T-266
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-2
POC Rich Laymen Ashland Chemical (614) 889-3083

Summary

Shelf Life: Challenge - Lengthen to 60 months.
Extension Criteria: Challenge - Utilize a color test and a test to look for evaporation residue.

Background

Paint thinner is a colorless, solvent-based, flammable liquid. Exposure to temperatures above 80°F will accelerate the formation of long chain hydrocarbon polymers. These polymers are a gummy, varnish-like material which turns the paint thinner from water white (clear) to a yellowish color. The formation of polymers is irreversible, and will occur over time naturally. Storage at temperatures below 80°F will provide a shelf life of 60 months. Freezing will not damage the material.

Discussion of Shelf Life

The formation of polymers is a continuous process which can be slowed by storing the product at temperatures below 80°F. Freezing will not degrade the product. If stored below 80°F we recommend that the shelf life be lengthened to 60 months.

The manufacturer's recommended shelf life of 24 to 60 months, depending upon storage conditions, is the same for both government and commercial customers.

Discussion of Extension Criteria

Chemical breakdown (polymerization) evidenced by color change and increased viscosity will render the product useless. Existing shelf life extension criteria only looks at package integrity and product contaminants such as rust and sediment. Extension criteria should evaluate the color of the product and evaporation residue as a direct method of determining the extent of polymerization and subsequently the integrity of the product.

Recommendations

Store material at temperatures below 80°F and lengthen the shelf life from 36 months to 60 months. Revise FED-STD-793 Appendix S-2 to include a color change inspection and evaporation residue test.

NSN: 8010001658557
Name: Primer Coating
Description: Yellow, zinc chromate, oil based paint with a petroleum distillate odor
Intended Use: Corrosion inhibiting primer for use on metal surfaces
Military Specification: FED-SPEC-TT-F-645B
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-2

POC Mark Steve Coronado Paint Co (904)428-6461

Summary

Shelf Life: Challenge - Lengthen to 48 months.
Extension Criteria: Concur.

Background

The primer coating is a zinc chromate based alkyd resin paint supplied in 5 gallon metal cans. The product will thicken and dry slower as it ages. Generally, after four years, the paint has thickened to an extent that makes it difficult to apply.

Discussion of Shelf Life

The paint will dry slower with age and a dry surface skin may form due to exposure to air present within the can. The formation of a skin (which is easily removed) does not indicate product degradation. At a high storage temperature, the paint may thicken almost to a gel making application of the product impossible. Components of the paint may coagulate and settle to the bottom of the can with age. The paint should be stored at a relatively constant temperature in the range of 50°F to 95°F to slow the thickening process. The shelf life should be lengthened from 24 to 48 months.

The manufacturer's recommended shelf life of 24 to 60 months based on storage conditions is the same for both government and commercial customers.

Discussion of Extension Criteria

The procedures outlined in FED-STD-793, Appendix S-2 are appropriate.

Recommendations

Store the paint should at a relatively constant temperature in the range of 50°F to 95°F. Lengthen the shelf life from 24 to 48 months.

NSN: 8010001817568
Name: Remover, Paint
Description: Thick opaque yellow brown liquid with a phenolic odor
Intended Use: Removal of paint, epoxy, polysulfide, and polyurethane coatings
Military Specification: MIL-R-81294D
Shelf Life Code: 4 = 12 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-1

POC John Jones Turco Products Inc (714)890-3600

Summary

Shelf Life: Challenge - Change to nondeteriorative.
Extension Criteria: Challenge - Change to "Not Applicable."

Background

This product is packaged in 1 gallon resealable metal cans. The primary solvent in this paint remover is methylene chloride in which paint, epoxy, polysulfide, and polyurethane coatings are dissolved. The only means of product degradation are evaporation of the solvents, particularly the methylene chloride component, or hydrolysis of the methylene chloride by moisture.

Discussion of Shelf Life

The product is extremely stable and will not normally degrade by any chemical interaction unless moisture is introduced into the product. Evaporation of the methylene chloride component, however, will severely degrade the stripping ability of the product. Evaporation can be minimized by keeping the cover tightly sealed until the product is to be used, and by storing at temperatures below 95°F. Freezing will not degrade the product.

The manufacturer has an arbitrarily recommended shelf life of 12 months but has no justification for this value. They admitted that the product has an indefinite shelf life if the methylene chloride has not evaporated.

Discussion of Extension Criteria

The current shelf life interval requires that the product be opened every 12 months to verify that there has not been any separation of components, sediment formation, chemical reaction, or component degradation. This annual effort will actually shorten the product's shelf life by allowing the methylene chloride and other solvents to evaporate. This yearly check also increases the probability that solvent will evaporate throughout the coming year due to an improperly replaced cover.

With this in mind, we recommend that the shelf life be changed from 12 months to non-deteriorative and that product integrity be tested at the time of use by application to the painted surface that is to be cleaned. Quite simply, if the product removes paint, it is still chemically sound.

Recommendations

Change shelf life from 12 months to non-deteriorative. Store the product below 95°F to reduce the possibility of solvent evaporation. Freezing will not degrade the product. Do not open the product until time of use. Modify FED-STD-793, Appendix S-1, to include an inspection of the exterior of the container/packaging only.

NSN: 8010001818276
Name: Polyurethane Coating
Description: Black, 2 component, oil free, aliphatic isocyanate coating
Intended Use: Exterior protective coating for metal surfaces
Military Specification: MIL-C-83286B
Shelf Life Code: 4 = 12 months
Shelf Life Extension Procedure: MIL-C-83286B

POC Norm Gaul Dept Chem. Coat. (714) 474-0400

Summary

Shelf Life: Challenge - Lengthen to 60 months.
Extension Criteria: Challenge

Background

The material consists of two components, each separately packaged in one quart metal cans. Part A (base) consists of pigmented polyester resin, Part B (catalyst) consists of clear aliphatic isocyanate. Part B will change chemically if it comes into contact with moisture.

Discussion of Shelf Life

The polyester base material does not degrade, but the catalyst will react with moisture and turn cloudy, eventually hardening to a solid. The manufacturer runs a moisture content test on every batch and has determined that a 5 year shelf life is appropriate if the containers are not opened. We agree with the 60 month shelf life and further recommend that the product be stored at temperatures between 40°F and 85°F.

The manufacturer's recommended shelf life of 60 months is the same for both government and commercial customers.

Discussion of Extension Criteria

The introduction of moisture into the catalyst is the mechanism by which the material will degrade. Performing all the tests in the Military Specification is unnecessary. The procedure outlined in NAVAIR 01-1A-75 Work Package 012 should be used in lieu of MIL-C-83286B for shelf life extension as well as at time of use.

Recommendations

Lengthen shelf life from 12 months to 60 months. Store product between 40°F and 85°F.

NSN: 8010002911069
Name: Paint, Rubber, Type 1
Description: White, chlorinated, aliphatic, rubber based paint
Intended Use: Interior or exterior application on concrete and masonry surfaces
Military Specification: FED-SPEC-TT-P-95C
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-2
POC Charles Friedman Baker Sealants/Wait Co. (201) 333-6986

Summary

Shelf Life: Challenge - Reduce to 12 months if supported by DOD QSL extension history for other lots of this material.
Extension Criteria: Concur.

Background

This ready mixed paint contains a chlorinated rubber compound with high flexural properties and is primarily applied over concrete and masonry materials. It is also intended for application where high moisture resistance, mild acid and alkali resistance, and abrasion resistance are desired.

Discussion of Shelf Life

The chlorinated rubber used in the paint degrades with time allowing hydrogen chloride to attack the metal can. If opened, moisture can enter the product, accelerating the degradation process. The material will thicken naturally with time and after about one year will probably be too thick to apply effectively. Storage conditions should be below 80°F to slow the degradation process. Freezing will not degrade the product.

The manufacturer's recommended shelf life of 12 months is the same for both government and commercial customers.

Discussion of Extension Criteria

The procedures outlined in FED-STD-793, Appendix S-2 are appropriate.

Recommendations

Store material below 80°F. Review any available shelf life extension history data and decrease shelf life from 24 months to 12 months only if the shelf life extension history given by the DOD QSL supports this.

NSN: 8010004108460
Name: Epoxy Coating Kit
Description: Two part, polyamide based epoxy, Type 1
Intended Use: Ext. finish coat on steel, aluminum, or fiberglass, for chem. resistance
Military Specification: MIL-P-24441A
Shelf Life Code: 6 or 4 = 24 or 12 months (two codes are listed)
Shelf Life Extension Procedure: FED-STD-793, Appendix S-1

POC Louis Holzknecht Devoe Coating Co. (502)589-9340

Summary

Shelf Life: Challenge - Lengthen to 48 months.
Extension Criteria: Concur.

Background

The product is a two part (base and catalyst) polyamide-based epoxy paint currently packaged in a 10 gallon kit. The methods of degradation are: settling of the pigments which may occur after 48 months; and oxidation of the polyamide components which may occur if the product is opened repeatedly.

Discussion of Shelf Life

The product will last many years if it is stored at temperatures between 50°F and 85°F and is not opened to the air, which may initiate oxidation of the polyamide components. Pigments within the product may begin to settle and after 4 years of storage the application results may be variable. A representative of the product should be evaluated per FED-STD-793 Appendix S-1.

The manufacturer claims that the recommended shelf life of 12 months is in response to the requirements of MIL-P-24441A, however, we could not locate this reference within the specification. Commercial customers have a recommended shelf life of 48 months.

Three shelf life codes (see Figure 2-1) were noted for this product; 0, 4, and 6. The shelf life code of 0 was indicated on the Ship's Hazardous Material List (SHML) taken from the HMIS CD/ROM disk. This was assumed to be an error.

Discussion of Extension Criteria

Settling of pigments is the primary concern when looking at product integrity and should be fully evaluated at the time of use. Except for containers used to perform shelf life extension tests, the product should not be opened prior to time of use since oxidation of the polyamide components may be initiated . A minimum number of representative containers should be used for this purpose and should then be discarded. The procedures outlined in FED-STD-793, Appendix S-1 are appropriate for shelf life extension evaluation.

Recommendations

Store product at temperatures between 50°F and 85°F. Lengthen shelf life to 48 months. Do not open product until time of use except for those containers used to perform shelf life extension tests which should then be used immediately or should be discarded. Shake pigment containing component well before opening and examine for pigment dispersion

NSN: 8010004198541
Name: Paint, Latex
Description: Water based, pigmented paint
Intended Use: Exterior paint for concrete, masonry and wood
Military Specification: FED-SPEC-TT-P-19D
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-2

POC Mark Strene Coronado Paint Co (904) 428-6461

Summary

Shelf Life: Challenge - Lengthen to 48 months.
Extension Criteria: Concur.

Background

The product is purchased in 5 gallon metal cans. Latex paint is an acrylic emulsion, water-based product intended for exterior use. The paint will typically degrade through the following mechanisms: corrosion of can; bacterial growth; thickening due to freezing; and formation of long polymer chains.

Discussion of Shelf Life

The water based paint may corrode the metal can it is stored in even if the can is coated with epoxy or phenolic. Bacteria may exist under anaerobic conditions, which will produce a sulfur smell, lower the paint's viscosity, and encourage settling of pigments. Freezing of the product will destroy the paint by causing it to thicken heavily. Exposure to temperatures above 95°F will encourage the formation of long, stringy, polymer chains that will make application very difficult.

The manufacturer's recommended shelf life of 24 to 60 months, based on storage conditions, is the same for both government and commercial customers.

Discussion of Extension Criteria

The storage temperatures will have a dominant effect on product quality. Improper storage temperatures can have numerous effects such as viscosity changes and pigment settling. Current shelf life extension tests as outlined in FED-STD-793, Appendix S-2 are appropriate and comprehensive.

Recommendations

Lengthen shelf life from 24 months to 48 months and maintain storage temperatures between 50°F and 95°F to limit excessive viscosity changes.

NSN: 8010004376757
Name: Epoxy Primer Coat Kit
Description: Two part, polyamide based epoxy
Intended Use: Exterior finish coat on steel, aluminum, or fiberglass, for chemical resistance
Military Specification: MIL-P-24441A
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-1

POC Louis Holzknecht Devoe Paint Co (502) 589-9340

Summary

Shelf Life: Challenge - Lengthen to 48 months.
Extension Criteria: Concur.

Background

The product is a two part (base and catalyst) polyamide based epoxy paint typically purchased as a 10 gallon kit. The methods of degradation are: settling of the pigments which may occur after 48 months; and oxidation of the polyamide components which may occur if the product is opened repeatedly.

Discussion of Shelf Life

In response to MIL-P-24441A the manufacturer has a label shelf life of 12 months but states that the product will last many years if it is stored at temperatures between 50°F and 85°F and is not opened to air, which may initiate oxidation of the polyamide components. Pigments within the product will begin to settle and after 4 years of storage the application results may be variable. The product should be evaluated per FED-STD-793 Appendix S-1 at the time of use, if past the original 48 month shelf life.

The manufacturer claims that their recommended shelf life of 12 months is in response to the requirements of MIL-P-24441A, however, we were unable to find this reference in the specification. Commercial customers have a recommended shelf life of 48 months.

Discussion of Extension Criteria

Settling of pigments are the primary concern when looking at product quality and should be fully evaluated at time of use. The product should not be opened prior to time of use since oxidation of the polyamide components may be initiated. A representative number of containers should be opened for performing shelf life extension procedures. These materials should be used immediately or should be discarded.

Recommendations

Store product at temperatures between 50°F and 85°F. Do not open product until time of use except for performing shelf life extension tests, and then use immediately or discard. Lengthen shelf life from 24 months to 48 months. Shake pigment containing component well before opening and examine for pigment dispersion upon opening.

NSN: 8010008152692
Name: Paint, Heat Resisting
Description: Aluminum based, heat resistant paint
Intended Use: (1) For heated steel surfaces up to 120°F. (2) For military equipment where operating temperatures preclude the use of conventional paints. (3) For application to engraved, stamped, or stenciled lettering or numerals on metallic gun or weapon components for identification or functioning purposes when those components are exposed to temperatures up to 1200°F.
Military Specification: FED-SPEC-TT-P-28G
Shelf Life Code: 4 = 12 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-2

POC Carl Kennaday Sentry Paint (215) 522-1900

Summary

Shelf Life: Challenge - Lengthen to 24 months.
Extension Criteria: Concur.

Background

The paint, which is purchased in 1 gallon metal cans, consists of an aluminum pigment, a nonvolatile silicone vehicle, and several volatile vehicles. It is formulated to withstand temperatures up to 1200°F if properly applied. Typical methods of degradation include oxidation of the resin and settling of the pigments.

Discussion of Shelf Life

The primary mode of degradation is oxidation of the resin component due to the small amount of air present in the sealed can. Twenty four months is a reasonable shelf life if the product is stored between 50°F and 85°F to limit pigment settling, and is left tightly sealed until time of use to reduce the level of oxidation.

The manufacturer's recommended shelf life of 12 months is a minimum value for both government and commercial customers. If the product is stored between 50°F and 85°F to limit pigment settling, and is tightly sealed until time of use to reduce the level of oxidation, then the shelf life could possibly be extended up to 48 to 60 months. However, under uncontrolled storage conditions, the paint sometimes shows some degradation of properties after 24 months.

We therefore recommend that the shelf life value be lengthened from 12 months to 24 months.

Discussion of Extension Criteria

Degradation occurs through oxidation of the resin and settling of the aluminum pigment. Measurable degradation should not occur if the product is not opened prior to use.

Recommendations

Store the paint at temperatures between 50°F and 85°F, and lengthen the shelf life from 12 months to 24 months.

NSN: 8010008791103
Name: Paint, Anti-fouling
Description: Cuprous oxide, vinyl based paint with a ketone smell
Intended Use: Prevent bio-fouling from attaching to ship underwater hulls
Military Specification: MIL-P-15931F
Shelf Life Code: 4 = 12 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-2

POC Louis H.

Summary

Shelf Life: Concur.
Extension Criteria: Concur.

Background

The product is a Type II, Class 1 (contains Tricresyl phosphate) black, anti-fouling paint with a ketone smell. The anti-fouling component is cuprous oxide which makes up 70% of the paint. The copper acts as a respiratory inhibitor on invertebrates and prevents the uptake of oxygen. Therefore, the paint is an effective inhibitor of barnacle and other marine life growth on ships' hulls.

Discussion of Shelf Life

The high density of the copper anti-fouling compounds make settling of the paint components the limiting factor in the product's shelf life. The settling action can be slowed by storing the product between 50°F and 85°F, but the maximum usable shelf life is 12 months.

The manufacturer's recommended shelf life of 12 months is the same for both government and commercial customers.

Discussion of Extension Criteria

Settling of the components is the dominant shelf life limiting factor. Procedures outlined in FED-STD-793 Appendix S-2 properly address this issue and should continue to be used.

Recommendations

Store the paint at temperatures between 50°F and 85°F and do not open the product until time of use. Retain the current 12 month shelf life.

NSN: 8010009172256
Name: Enamel, Alkyd
Description: Semigloss enamel made from a copolymer of long-oil alkyd and silicone resins
Intended Use: High quality finish coat on smooth, primed, exterior metal
Military Specification: FED-SPEC-TT-E-490E
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: FED-STD-793, Appendix S-2
POC Mark Stone

Summary

Shelf Life: Challenge - Lengthen to 60 months.
Extension Criteria: Concur.

Background

The material is a copolymerized silicone alkyd enamel purchased in 5 gallon metal cans. The pigment comes in a choice of 24 colors and is primarily a titanium dioxide base with secondary pigments. The vehicle is a silicone modified long-oil air drying soya alkyd. The typical cause of degradation is exposure to elevated temperature which promotes degradation of the polymers with a change in viscosity and settling of the pigment.

Discussion of Shelf Life

The paint may form a surface skin if exposed to temperatures above 95°F. This skin is easily removed and will not effect the shelf life or working properties of the remaining paint. As with all oil base paints, the drying time will increase with age.

The manufacturers recommended shelf life of 24 to 60 months based on storage conditions is the same for both government and commercial customers.

Discussion of Extension Criteria

Paint viscosity and evidence of settling are the primary points of interest when determining paint condition as related to shelf life extension. The procedures outlined in FED-STD-793, Appendix S-2 adequately cover these conditions.

Recommendations

Store the paint between 50°F and 95°F. Lengthen the shelf life from 24 months to 60 months.

FSC	Category
8030	Sealing Compounds

FSC: 8030
Name: Sealing Compounds - General Overview

Background

Federal Supply Code 8030 is comprised of both sealing compounds and corrosion protective coatings. The sealants investigated are 2 component systems that are polysulfide based. The corrosion resistant coatings contain chromium-based inhibitors. The main mechanism of degradation for all 5 items is oxidation.

Discussion of Shelf Life

In general, the shelf life designated for each of these items is appropriate.

Discussion of Extension Criteria

There is quite a bit of confusion concerning the extension procedures for these items. There are three different existing extension procedures possible. First, Federal Standard 793 Appendix T lists a procedure for FSC 8030 but entitles it only "Sealants." These tests seem inadequate to cover all the NSNs. Second, some of the Military Specifications state detailed shelf life extension procedures. Third, all of the tests outlined in the Military Specification for procurement could be followed, but this seems unnecessary and repetitive. It was assumed that the extension criteria in the Military Specification is followed unless it is specifically listed in FED-STD-793.

NSN: 8030000087207
Name: Sealing Compound
Description: Accelerated, room temperature curing synthetic rubber compounds
Intended Use: Used in the sealing and coating of metal components on weapons and aircraft systems for protection against corrosion
Military Specification: MIL-S-81733
Shelf Life Code: 2 = 6 months
Shelf Life Extension Procedure: MIL-S-81733

Summary

Shelf Life: Concur.
Extension Criteria: Concur.

Background

This polysulfide sealant is a two component system. Calcium dichromate, which is stable, acts as both the corrosion inhibitor and the catalyst for curing. Polysulfides, on the other hand, are fairly reactive. Exposure to air will cause oxidation of the reactive groups on the ends of the polysulfide. A skin may form on the surface of the sealant in the can which may easily be peeled off and discarded without affecting the properties of the remaining material in the can. The viscosity will increase due to oxidation, making it more difficult to work into crevices during application. Furthermore, the application time and cure time will increase. The supplier states that minor changes in the application properties (i.e., viscosity tack time, cure rate) will not affect the performance of the cured material. This rationale does not appear to be accepted by the U.S. Government. For a similar polysulfide sealant (NSN 8030007535006), it is stated in the Military Specification that both application and cured performance requirements must be met for Government purchases. The Arthur D. Little experts agree with what appears to be the current Government policy, (which requires the sealant to meet both application and cured performance specification) for the following reasons: First, if the viscosity has increased, this can lead to improper application; secondly, if the polysulfide partially polymerizes before use, its ability to adhere to a surface may be diminished; finally, it is possible that the polysulfide will not be as moisture resistant if it has partially oxidized before use.

Discussion of Shelf Life

Six months is a reasonable length of time for the shelf life due to the fact that polysulfides are so reactive.

Discussion of Extension Criteria

It should be determined whether FED-STD-793 Appendix T or paragraph 3.3.3 "Long-term Storage" of MIL-S-81733 should be followed. MIL-S-81733 stipulates that the following four requirements be met for an extension to be granted: flow, application time, tack free time, and hardness. On the other hand, FED-STD-793 Appendix T stipulates only viscosity and dry time. The extension criteria in the Military Specification appears to be more stringent than FED-STD-793.

The Arthur D. Little experts believe that performing the four tests indicated in paragraph 3.3.3 of MIL-S-81733 would give a better measure of shelf life.

Recommendations

Use the four tests in paragraph 3.3.3 of MIL-S-81733 as the basis for shelf life extension.

NSN: 8030001658577
Name: Coating Compound
Description: Liquid, pretreatment wash primer with a solvent odor
Intended Use: Intended as a treatment prior to the application of the coating system in order to increase adhesion
Military Specification: DOD-P-15328
Shelf Life Code: 4 = 12 months
Shelf Life Extension Procedure: DOD-P-15328

Summary

Shelf Life: Concur.
Extension Criteria: Concur.

Background

This is a two component wash primer system in which resin is mixed with the acid at the time of use. The pigment/corrosion preventative, zinc chromate, reacts with a metal surface to provide a corrosion protective layer. Several possible degradation mechanisms exists. First, the pigment could settle out, decreasing the performance of the corrosion protective layer. However, it is unlikely to cause major problems because it can simply be mixed again, unless the particles are greatly agglomerated. Second, the zinc chromate and the resin form a complex that causes an increase in viscosity and a decrease in adhesion properties. The storage temperature should remain below 100° F because heat can accelerate these reactions.

Discussion of Shelf Life

Twelve months was found to be an appropriate shelf life.

Discussion of Extension Criteria

The tests outlined by the Military Specifications are more reasonable than the Federal Standard 793 Appendix T. The recommended tests are fineness of dispersion (ASTM D 1210), viscosity, drying time (Method 4061 Fed-Std-141), and a performance test such as the knife test (Method 6304 FED-STD-141).

Recommendations

Determine which document contains the correct shelf life extension procedure.
We recommend performing the four above-mentioned tests in addition to those listed in Fed-Std 793 Appendix T.

NSN: 8030007535006
Name: Sealing Compound
Description: Temperature resistant, two component synthetic rubber compound (Type II - MnO_2 curing agent)
Intended Use: Intended for sealing areas of Integral fuel tanks and fuel cell cavities
Military Specification: MIL-S-8802
Shelf Life Code: 3 = 9 months
Shelf Life Extension Procedure: MIL-S-8802

Summary

Shelf Life: Concur.
Extension Criteria: Concur.

Background

This sealant is also a two-component system that has a polysulfide base. Manganese dioxide is used as the curing agent. As previously stated, polysulfides are somewhat unstable and exposure to air can cause oxidation of the reactive groups on the ends of the polysulfide. Although application properties will be affected, performance of the sealant should not be greatly diminished within this time period. The most significant change will be an increase in cure time.

The above NSN and Military Specification covers classes A, B, and C sealing materials with different applications and curing times. According to a study by Engel[1], the shelf life of Class A CS-3204 sealants is affected by packaging and storage conditions. Enclosing the plastic injection kit in a mylar-lined aluminum foil bag will aid in extending the shelf life because it will prevent solvents from diffusing out of the packaging and causing an increase in viscosity. In addition, storing class A sealants at cooler temperatures increases the shelf life. Class B and C sealants were unaffected by packaging and storage condition changes, according to Engel.

Discussion of Shelf Life

The shelf life of 9 months is reasonable due to the reactivity of polysulfides.

Discussion of Extension Criteria

It should be determined whether the extension criteria in MIL-S-8802 or Federal Standard 793 are to be followed. "Long-term Storage" and "Shelf Live Surveillance and Updating" procedures are outlined in paragraphs 3.4.21 and 4.1.3 respectively, of the Military Specification. These requirements appear to be sufficient in judging shelf life. Federal Standard 793 requires only viscosity and cure time to be evaluated, whereas the specification requires application time, tack-free time, cure time, viscosity, and peel strength. Furthermore, section 4.1.3 of the Military Specification states that the shelf life can be extended if all tests are passed for a period of three months, up to three times. This does not coincide with the procedures outlined in FED-STD-793 which states that the shelf life is extended for half the original shelf life.

---

1 Engel, Samuel L., "A Shelf Life Study of Chem Seal Polysulfide Sealants Packaged in Plastic Injection Kits," 17th National SAMPE Technical Conference, October 22-24, 1988.

Recommendations

Require in the Military Specification that the Class A CS-3204 sealant plastic injection kit be enclosed in a mylar-lined aluminum foil bag. Determine whether MIL-S-8802 or FED-STD-793 contains the correct extension criteria. Follow FED-STD-793 for the length of the shelf life extension period.

NSN: 8030008238039
Name: Corrosion Resistant Coating
Description: Premixed liquid, concentrated liquid, or powder with an acid odor
Intended Use: Intended for use in the formation of compounds to prevent corrosion and increase adhesion of paint finish systems to aluminum
Military Specification: MIL-C-81706
Shelf Life Code: 4 = 12 months
Shelf Life Extension Procedure: MIL-C-81706

Summary

Shelf Life: Challenge - Lengthen shelf life of the powder form to 36 months.
Extension Criteria: Challenge - Verify which document should be followed, modify the extension tests to include a corrosion preventive test and an adhesion test.

Background

This product is meant to react with aluminum or an aluminum alloy to create a corrosion preventative layer that will increase the adhesion of paint finish systems. It is available in 3 different forms: concentrated liquid, powder, and liquid (ready for use). The pigment reacts with the metal to create a chemical conversion coating. The mechanisms of degradation are somewhat different depending on the form of the product. With the liquid form, evaporation or agglomeration could cause the pigment to settle out of solution. This situation, however, can normally be reversed by simply mixing it. The powder version should last even longer than the liquid version unless the packaging has been compromised. In this case, heat and humidity causes moisture to enter creating a concentrated chromic acid solution. This is a strong oxidizer that could react to change the chemical composition. Packaging is important in this case because plastic can begin to crack in this highly oxidizing environment. If cracking occurs, moisture can then pass through the cracks.

Discussion of Shelf Life

A 12 month shelf life for the liquid form is reasonable. The powder form, which is much more stable, should have the shelf life lengthened thirty six months.

Discussion of Extension Criteria

Although FED-STD-793 Appendix T lists test procedures for FSC 8030, these are not sufficient indicators for this NSN. On the other hand, performing all of the tests in the Military Specification is unnecessary. It should be determined whether only the tests stated in paragraph 3.10 "Storage Stability," of MIL-C-81706 are performed. A corrosion preventive test and an adhesion test such as those outlined in paragraphs 4.5.1-4.5.3 of MIL-C-81706 are the most important and should be included in the extension procedure. Although salt spray tests (Method 6061 FED-STD-141) meet industry standards, electro-chemical tests, or different accelerated aging tests are more accurate indicators of corrosion prevention.

Recommendations

Consider purchasing only the powdered form of this product. Lengthen shelf life for the powder form to 36 months. Review extension tests and determine which document contains the correct procedure. Revise FED-STD-793 or MIL-C-81706 to include a corrosion prevention test and an adhesion test. Consider replacing the salt spray test with an electro-chemical test or other accelerated aging tests.

NSN: 8030009381947
Name: Corrosion Resistant Compound
Description: Ultra thin film, water displacing liquid or aerosol with organic odor
Intended Use: Intended for use on any metal surface for initial protection during shipment and storage and for in-service treatment. Intended for indoor protection and short term protection outdoors where surfaces can be recoated when required
Military Specification: MIL-C-81309
Shelf Life Code: 4 = 12 months
Shelf Life Extension Procedure: MIL-C-81309

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Perform the three recommended tests and do not limit the number of extensions for the liquid version.

Background

The mechanism of degradation for this item depends on whether it is in the aerosol or liquid form. The liquid form tends to be more stable because over time, the propellant in the aerosol can diffuse through the valve. In spite of the fact that the performance has not been altered, disposal would be required because it would not be possible to dispense it. Pigments would also be likely to settle out of the aerosol form because it is only 20% solids which is quite low. If this happens, not only could the pigment clog the valve, but the corrosion protective coating ability would also be diminished. With the liquid version, if the compound is solvent based, two modes for degradation exist. First, moisture could cause oxidation. Second, solvents could evaporate causing the wax to separate out of solution. Generally, if the packaging is uncompromised, neither of these scenarios will occur. This material will be adversely affected if allowed to freeze.

Discussion of Shelf Life

The liquid form of this coating is likely to be more stable for longer periods of time than the aerosol form. However, 12 months is still an appropriate time for retesting.

Discussion of Extension Criteria

Performing all of the tests outlined by MIL-C-81309 may be unnecessary. The most important extension tests include a corrosion test (para 4.10.2), presence of abrasives test (para 4.10.5), and minimum dielectric breakdown test (para 4.10.10). Regardless, there should be no limit to the number of extensions granted for the liquid version.

Recommendations

Purchase only the liquid form. Determine whether FED-STD-793 or MIL-C-81309 is followed for extension criteria. If MIL-C-81309 is followed, reduce the extension criteria to include only a corrosion test, a presence of abrasive test, and a minimum dielectric breakdown test. Eliminate limitations on the number of extension periods.

FSC	Category
8040	Adhesives

NSN: 8040002254548
Name: Adhesive
Description: Solid, white paste with acetic acid odor
Intended Use: For use with sensitive metals and equipment
Military Specification: MIL-A-46146B
Shelf Life Code: 4 = 12 months

Summary

Shelf Life: Not Applicable.
Extension Criteria: Not Applicable.

Background

This adhesive is no longer utilized by the Navy. It has been replaced by an adhesive which does not contain acetic acid. Therefore, this adhesive is not evaluated since the disposal data on which this study is based is no longer relevant. Since the replacement adhesive does not have any appreciable shelf life history as of yet, it is not analyzed.

Discussion of Shelf Life

Not Applicable.

Discussion of Extension Criteria

Not Applicable.

Recommendations

Not Applicable.

NSN: 8040005824597
Name: Adhesive Paste
Description: Black paste with asphalt odor
Intended Use: Intended resilient coverings to steel decks
Military Specification: MIL-A-21016F
Shelf Life Code: 4 = 12 months
Shelf Life Extension Procedure: FED-STD-793, Appendix U

Summary

Shelf Life: Challenge - Lengthen to 18 months.
Extension Criteria: Concur.

Background

The adhesive paste is a waterbase latex mixed with emulsified asphalt. The emulsion breaks down over time usually due to one or more of the following: freezing, high temperature, or exposure to acid. The breakdown of the emulsion is irreversible, and occurs over time. Generally, after five cycles of freezing and thawing, the adhesive is completely unusable. Some degree of breakdown can be tolerated in the interim.

Discussion of Shelf Life

If some degree of breakdown can be tolerated, the manufacturer of this product indicated that the shelf life could be reasonably lengthened to eighteen months. The breakdown process can also be slowed if the item is stored properly, that is, if it is not allowed to freeze, nor exposed to high temperatures. The shelf life of this item is the same for commercial customers as it is for the government.

Discussion of Extension Criteria

Dry time and viscosity are the relevant criteria for extension. These factors are indicators of the amount of breakdown the emulsion has experienced. The shelf life extension procedures outlined by the Navy are satisfactory.

Recommendations

Lengthen shelf life from 12 months to 18 months.

FSC	Category
9150	Oils, Greases, Lubricants

FSC: 9150
Name: Lubricants, Oils, Greases-General Overview

Background

In general, lubricants, oils, and greases are very stable compounds. The packaging and storage conditions are the most important factors determining shelf life. Plastic containers are more likely to permit diffusion of oxygen than metal drums. In addition, some plastics can begin to crack with age. A constant, moderate storage temperature is essential because excessive heating and cooling can pull moisture into the drum. Heat also accelerates the mechanisms of degradation that are described as follows. Esterified oils breakdown more quickly when heated. The presence of surfactants can cause the emulsion to breakdown. Lubricants containing chlorine can form HCl which would increase the acidity. Oxidation of a product that contains sulfur results in the generation of sulfur dioxide and an increase in the acidity. Lastly, the fatty oil additive in some lubricants could separate from the basic oil. Nevertheless, as previously indicated, these lubricants and oils are formulated to be stable under extreme conditions of heat and pressure and, therefore, degradation in storage is usually extremely slow.

Discussion of Shelf Life

For the most part, the Navy shelf life designations are overly cautious when considering the stability of these materials. A better approach would be to revise the extension criteria.

Discussion of Extension Criteria

There are two possible approaches to revising the shelf life extension criteria. First, the actual tests could be changed to be more efficient and specific to the product. While the extensive testing listed in some of the Military Specifications is appropriate for initial procurement of the oils, greases, or lubricants (such as chemical analysis, ash content and engine tests) they are not meaningful in assessing degradation of the product. Second, the amount of time the shelf life is extended after each retest could be revised. Assuming the material meets all the requirements of the Military Specification, the extension time should be the same as the stated shelf life instead of half the stated time period. This is supported by the DOD Quality Status List (November 1991 through March 1992). Four of the five items reviewed in FSC 9150 were consistently extended by the original shelf life. In addition, as long as the product meets the specifications, there should be no limit on the total shelf life.

NSN: 9150000044535
Name: Cutting Fluid
Description: Blended cutting fluids, containing sulfur and chlorine additives, with or without fatty oils, in a mineral oil base
Intended Use: Intended for use as received. See page 6 of MIL-C-46149.
Military Specification: MIL-C-46149
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: MIL-C-46149

Summary

Shelf Life: Challenge - Lengthen to 60 months.
Extension Criteria: Challenge - Modify extension tests to include only the recommended 3 tests.

Background

This cutting fluid is generally, very stable even when heated. Degradation could occur through the separation of the fatty oil additives from the hydrocarbon base oil. If this occurs, the lubricating properties of the oil are compromised. In addition, decomposition is caused by either hydrolysis or oxidation. Because this fluid contains sulfur and chlorine additives, hydrochloric acid and sulfuric acid could be generated causing an increase in acidity. However, decomposition of sulfur and chlorine compounds seems very unlikely in unopened containers. Polyethylene containers would allow moisture and oxygen to diffuse more readily, so glass or metal packaging is more suitable.

Discussion of Shelf Life

Assuming this material is stored in unopened metal containers, decomposition seems unlikely so the shelf life should be lengthened to 60 months.

Discussion of Extension Criteria

Some of the tests outlined in the Military Specification appear to be superfluous for extension criteria. The most important tests for extension criteria are the viscosity,and sedimentation/phase separation. Sulfur and chlorine content may change slightly due to oxidation or hydrolysis, but this slight change may be more easily detected by a change (lower) in pH. Regardless, if the product passes all the tests outlined in the Military Specification, the extension period should be the full stated shelf life. This is supported by the fact that all 30 lots tested on the DOD Quality Status List (November 1991 through March 1992) were extended.

Recommendations

Ensure the fluid is packaged in metal containers and lengthen shelf life to 60 months. Modify the current extension procedure to include only viscosity and sedimentation/phase separation tests. Add a pH test to detect oxidation or hydrolysis of the sulfur or chlorine additives. Extend the allowable extension time to the full 60 months.

NSN: 9150001497432
Name: Hydraulic Fluid, Fire Resistant
Description: Synthetic hydrocarbon base hydraulic fluid
Intended Use: For use in the -40°F to 400°F temperature range in aircraft and missile hydraulic systems
Military Specification: MIL-H-83282
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: MIL-H-83282

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Utilize moisture content and viscosity tests, extend the extension period to two years.

Background

This is a synthetic oil in which the triorthocresyl phosphate contributes to fire resistance. Due to its synthetic nature it is more stable than mineral oils, which oxidize somewhat more readily. However, this is required to be a super-clean fluid, which is, therefore, particularly subject to the solid particle contamination requirement of the Military Specification. A compromised seal on the package could allow moisture, dust, and dirt to contaminate the fluid as well as cause oxidation.

Discussion of Shelf Life

It appears as though the only factor in the shelf life degradation of this product is the solid particle contamination requirement. Otherwise, this product should be good for at least 60 months. The Military Specification could be revised to include a less stringent solid particle contamination requirement, although, it is anticipated that this is highly unlikely due to the expensive and high tech machinery in which it is used. Second, if the oil is adversely affected by this contamination and cannot perform its intended purpose, perhaps the oil could then be applied to another, less critical use.

Discussion of Extension Criteria

If all the tests of the Military Specification are acceptable, the extension time should be increased to two years instead of one year. This is supported by the DOD Quality Status List (November 1991 through March 1992) that shows that 147 of 159 lots were extended for 24 months. On the other hand, some of the tests specified appear to be superfluous. Moisture content (para 3.3.7) solid particle contamination (para 3.3.5), and viscosity (ASTM D445) are the recommended extension criteria tests.

Recommendations

Review the solid particle contamination requirement of the Military Specification. Increase the extension time to 24 months or revise the tests performed. Find alternative uses for materials that do not pass the test for solid particle contamination. Revise the extension criteria to include only moisture content, solid particle contamination, and viscosity.

NSN: 9150001818097
Name: Lubricating Oil, Engine
Description: Oily dark red liquid with a bland odor
Intended Use: Intended for use in advanced design high-output shipboard main propulsion and auxiliary diesel engines using fuel conforming to MIL-F-16884
Military Specification: MIL-L-9000H
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: MIL-L-9000H

Summary

Shelf Life: Challenge - Lengthen to 3 years.
Extension Criteria: Challenge - Reduce the number of extension criteria tests listed in MIL-L-9000H and permit extension periods of the full stated shelf life.

Background

This is an engine lubricating oil composed of a blend of mineral oils that tend to oxidize more quickly than synthetic oils. The amount of oxygen introduced into the drum should be negligible unless the temperature rises above 150-200° F. In this case, oxidation can cause the creation of sludge and therefore the lubricating properties could be diminished.

Discussion of Shelf Life

Theoretically, under reasonable storage conditions, this lubricant could have a total shelf life of over ten years. The navy's shelf life of 24 months appears to be overly cautious. Therefore, a reasonable compromise seems to be lengthening the retest date to 36 months. The material should be stored at temperatures below 100° F to slow oxidation.

Discussion of Extension Criteria

The tests outlined in the Military Specification are excessive for shelf life extension. The following tests in Military Specification MIL-L-9000H should provide an adequate indication of product degradation for the extension criteria:

- ASTM D96 - Standard Test Methods for Water and Sediment in Crude Oils;
- ASTM D445 - Standard Test Methods for Kinematic Viscosity; and
- ASTM D892 - Standard Test Methods for Foaming Characteristics.

Tests for visual clarity, phase separation, and pH or acid acceptance should also be added to the extension criteria. Also, boiling point (under vacuum) or gas chromatographic analysis may be good rapid tests for indicating commodity degradation. The extension period should be changed to the full stated shelf life instead of half. This is supported by the DOD Quality Status List (November 1991 through March 1992) that shows that all 53 lots tested were extended.

Recommendations

Lengthen the shelf life to 36 months. Reduce the number of tests required for extension criteria. Permit extension periods of the full stated shelf life.

NSN: 9150009857099
Name: Lubricating Oil
Description: Clear liquid with low odor
Intended Use: Intended for use in aircraft gas turbine engines and gear boxes within the approximate range of -40°F to +400°F
Military Specification: MIL-L-23699D
Shelf Life Code: 7 = 36 months
Shelf Life Extension Procedure: MIL-L-23699D

Summary

Shelf Life: Challenge - Lengthen to 5 years.
Extension Criteria: Challenge - Utilize viscosity, foaming, sediment, acid assay, and shear stability; do not limit number of extensions, extend the extension period to the full stated shelf life.

Background

This lubricant contains phosphate esters which are generally very heat resistant. Nevertheless, an ester-based lubricant is less stable to hydrolysis than a straight hydrocarbon oil. Water can contaminate this material, causing it to breakdown into acid and alcohol. However, if it is packaged in a sealed container, water is not likely to contaminate the oil.

Discussion of Shelf Life

Assuming reasonable storage conditions and properly sealed packaging, the shelf life of this material should be lengthened to 60 months.

Discussion of Extension Criteria

Of the tests designated by the Military Specification, viscosity, foaming, sediment, acid assay, and shear stability are appropriate. In addition, the lubricant might also be analyzed for volatiles and semi-volatiles, to determine if the material is breaking down into acids and alcohols. The extension procedure should also be revised to stipulate the extension period be that of the stated shelf life with no limits on the numbers of extensions periods. This is supported by DOD Quality Status List (November 1991 through March 1992) which shows that all 373 lots tested were extended by the full shelf life term.

Recommendations

Lengthen shelf life to 60 months. Investigate volatile and semi-volatile analyses in addition to the other recommended tests. Permit shelf life extension periods of a full 60 months. Do not limit the number of extension periods.

NSN: 9150010355394
Name: Lubricating Oil, Gear
Description: One of 3 grades, heavy oil, bland odor
Intended Use: Intended for automotive gear units, heavy-duty industrial type enclosed gear units, steering gear units and fluid lubricated universal joints of automotive equipment
Military Specification: MIL-L-2105D
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: MIL-L-2105D

Summary

Shelf Life: Challenge - Lengthen to at least 60 months.
Extension Criteria: Concur.

Background

Oxidation tends to be the primary mode of degradation for this lubricant. Since it is a mineral oil, oxidation occurs at a higher rate than with a synthetic oil. First, oxidation causes a sludge to form and the lubrication properties to be diminished. Second, if the sulfur becomes oxidized, sulfur dioxide is formed. This increases the acidity which not only causes breakdown of the oil but may also attack the metal drum itself. However, there is a zinc stabilizer to buffer any acid accumulation and a metal container does not allow the diffusion of significant amounts of oxygen.

Discussion of Shelf Life

Conflicting opinions concerning the shelf life of this item were found. Although all six interviewees agreed that the product would be good for more than ten years under ideal storage conditions, two vendors believed that two years was a suitable retest date. The others believed that it could be lengthened to five years assuming proper storage conditions. The material should be stored at temperatures below 110° F to prevent oxidation. The DOD Quality Status List (November 1991 through March 1992) shows that all 45 lots tested were extended.

Discussion of Extension Criteria

Overall, the tests outlined in the Military Specification were found to be appropriate. The most relevant tests for extension criteria include: the viscosity, boiling point, flashpoint, moisture, corrosion, total acid number, and the foam test.

Recommendations

Lengthen the shelf life to at least 60 months.

NSN: 9150010805962
Name: Hydraulic Fluid, Non-combustible, Catapults
Description: Fire resistant, water base fluid
Intended Use: Power transmission medium for hydraulic actuated systems in Naval aircraft launching catapults
Military Specification: MIL-H-22072C
Shelf Life Code: 6 = 24 months
Shelf Life Extension Procedure: MIL-H-22072C

Summary

Shelf Life: Concur.
Extension Criteria: Challenge - Include ASTM 2783, clarity, viscosity, and pH.

Background

The potential degradation of this product occurs because a lubrication additive reacts with the iron in the metal drum causing it to precipitate out. Consequently, the lubrication abilities of the product are diminished. Temperatures above 80° F tend to increase this process. Conversely, storing it at cool temperatures slows down this process.

Discussion of Shelf Life

The vendor interviewed only guarantees this product for 12 months but admits that if stored at 80° F, it would be fine for 24 months. Cooler temperatures would increase its shelf life. Nonetheless, a 24 month shelf life is suitable.

Discussion of Extension Criteria

The metals composition test, along with others, seem irrelevant for shelf life extension. Recommended tests include the ASTM D2783 test, clarity, viscosity, pH, evaporation, volatiles, and low temperature precipitation.

Recommendations

Revise the test for extension to include ASTM D 2783, clarity, viscosity, and pH. Consider plastic packaging instead of metal drums.

5.0 Conclusions and Recommendations

Arthur D. Little, Inc., analyzed a total of 55 commodities to determine if their shelf life term is reasonable and accurate and the extension criteria, if applicable, is also reasonable and accurate. The objective of the analysis was to ultimately reduce the volume of hazardous waste disposed of by the Navy due to expired shelf life or failure to meet extension criteria.

The approach to this analysis included a review of pertinent documentation such as DOD 4140.27 M Shelf Life Item Management Manual, Military Specifications, NAVAIR Technical Manual, FED-STD-793 Depot Storage Standards, Material Safety Data (MSD) Sheets, and miscellaneous technical papers dealing with shelf life. In addition, Arthur D. Little personnel who were knowledgeable on the items analyzed were interviewed, as were manufacturers. Shelf life extension history provided in the DOD Quality Status List (QSL) was also reviewed to determine whether patterns existed regarding the extension of shelf life terms. All of this information was utilized to make recommendations on shelf life term, shelf life extension criteria, packaging requirements, and possible substitutions.

Of the 55 commodities analyzed, 30 were challenged on the basis that the shelf life could be lengthened and of the 55 commodities analyzed, 36 were challenged on the basis that the extension criteria be modified. Many of the shelf life terms assigned appear to be overly conservative, resulting in commodities not showing signs of degradation within the specified shelf life term. This is simply due to slow degradation mechanisms, especially if stored properly and if the container is not compromised.

Some of the items analyzed were purchased in bulk but utilized in small quantities. This type of arrangement increases the chances of premature degradation through frequent opening of the storage container and results in excessive disposal. Other commodities had no chemical degradation, but could absorb moisture, which made them hard and crusty. Changing the packaging would not only help deter moisture penetration, but also allow visual and physical inspection without opening the inner container. These types of instances led to several recommendations to evaluate packaging and purchase quantities.

Evaluation of extension criteria was based on the relevancy of the test to detect or determine whether or not the material was acceptable for use. Much of the documentation describing the extension criteria included discrepancies, specifically regarding the length of time the shelf life could be extended. Many of the items' shelf life extension criteria were outlined in the Military Specifications. Some tests were too comprehensive, others were not appropriate. Recommendations made to modify the extension criteria include simpler and more targeted test procedures.

Two specific commodities were reviewed in a somewhat different light. They were both freons that are subject to an upcoming worldwide ban. Consequently, recommendations were made to focus on researching potential substitutes for these items.

The following are recommendations to begin the process of improving the shelf life management system and reducing the amount of hazardous waste to be disposed of.

Recommendations

1. Review the recommendations in the enclosed data sheets regarding shelf life term and extension criteria. Many of the items can have their SLT's lengthened and many of the shelf life extension tests can be simplified.

2. Review the documentation which outlines the procedures to be followed for evaluating shelf life term and extension criteria. Rectify the discrepancies regarding the shelf life extension period and which shelf life extension tests should be followed.

3. Establish a database to analyze the history of shelf life extension for commodities such as the DOD Quality Status List (QSL). Extension history is the most valuable information in determining whether or not the assigned shelf life term is reasonable and accurate.

4. Review packaging requirements for those items purchased in bulk but utilized in small quantities. Also review packaging for solids which require only visual inspection for shelf life extension.

5. Ensure items are stored under conditions which prevent temperature extremes, high humidity, and danger of compromising the containers.

6. Review the replacement alternatives for chloroflourocarbons (NSN 8650000338851 and NSN 68500099830282) that will be banned in 1995 (see Appendix A).

7. Examine the possibility of reusing, reselling, or recycling items which are no longer suited for use in Navy applications, but which would be adequate to fulfill other applications. One example would be lubricating oil which no longer meets the Military Specification requirement but which could be reblended and potentially used in another application. This could be done within the Navy organization, or with private industry. This is already being done to some extent through a service entitled "Recycle Hazardous Material, GSA Western Distribution Center, Rough and Ready Island," Stockton, California.

8. Update Military Specifications as necessary to allow use of updated and improved formulations of certain commodities.

Implementation of the above mentioned recommendations would likely result in a reduction in hazardous waste disposal and a reduction in the capital expenditures to replace the items disposed of. In addition, the use of specific and simplified tests for extension criteria will enhance and improve the procedure of extending shelf life.

Appendix A

Listing of Product Information Available from Dupont and Allied Signal on Ozone Depleting Chemical Cleaning Agent Alternatives

DU PONT

Here is the information you requested.

Alternatives to
Ozone-Depleting
Chemical Cleaning Agents

Du Pont Customer Service:
1-800-441-9442

Du Pont *FaxBack*®
Instant Response Service

1-800-283-2327
or 302-892-0677

24 hours a day / 7 days a week

To: CLAMONTAGNE

Date: 5-11-92

rom: Du Pont FaxBack

Page 1 of 4

Thank you for using Du Pont FaxBack!

We welcome your feedback and suggestions.

Please take a minute to complete and return the survey on the last page of this fax transmission.

Du Pont FaxBack®

Information on Alternatives To Ozone Depleting Chemical Cleaning Agents

Document Number	Number of Pages	Last Updated	Title	Page 1 of 2
Axarel® Cleaning Agents				
Product Data Sheets				
9031	2	03/26/92	Axarel® 32	
9016	2	03/03/92	Axarel® 38	
9022	4	03/03/92	Axarel® 52	
9015	4	03/26/92	Axarel® 56	
9020	4	03/03/92	Axarel® 6000 & 9000 Series	
Technical Bulletins				
9021	2	03/03/92	Compatibility Testing Guidelines	
9023	2	03/03/92	Test Cleaning Guidelines	
9018	2	03/03/92	Safe Heating Guidelines	
9026	2	03/03/92	Waste Water Considerations	
9017	4	03/26/92	Phase II Benchmark Cleaning Data	
9034	4	03/26/92	Vapor Exposure Potential	
9035	2	03/26/92	Equipment Suppliers	
Material Safety Data Sheets				
9019	6	03/16/92	Axarel® 32	
9014	7	03/16/92	Axarel® 38	
9024	5	03/16/92	Axarel® 52	
9025	5	03/16/92	Axarel® 56	
9032	5	03/16/92	Axarel® 6000	
9012	5	03/16/92	Axarel® 6100	
9033	5	03/16/92	Axarel® 9000	
9011	5	03/16/92	Axarel® 9100	
Solderel® VLR Solder Paste				
Very Low Residue				
9013	4	03/03/92	Solderel® VLR Data Sheet	
9037	2	04/24/92	Solderel® Benefits Bulletin	
9039	9	04/24/92	Solderel® VLR0620 MSDS	
9041	9	04/24/92	Solderel® VLR0621 MSDS	

>>1-800-283-2327 or 302-892-0677/24 Hours a Day/7 Days a Week<<

Information on Alternatives To Ozone Depleting Chemical Cleaning Agents

Document Number	Number of Pages	Last Updated	Title
Case Histories			
9036	1	04/24/92	Archive, Singapore, Axarel® 32
9038	1	04/24/92	Trimble, California, Axarel® 38
9040	1	04/24/92	Orbitel, United Kingdom, Axarel® 38
Technical Papers			
9028	15	03/03/92	Environmental Advantages of the Semi-Aqueous Cleaning Process by Ken Dishart
9029	12	03/03/92	A Membrane System for Semi-Aqueous Defluxing by Carroll Smiley, Herb Fritz and Rich Stewart
Production Cleaning Forum			
9027	8	03/03/92	Winter 1991
9030	6	03/03/92	February 1992
Document Listing			
9001	1	03/16/92	This Listing of FaxBack® Documents

Du Pont FaxBack®

Information on Alternatives To Ozone Depleting
Chemical Cleaning Agents

Would you like mailed to you printed copies of any of the materials recently faxed? Do you need any additional information not provided by FaxBack? Do you have any comments on the FaxBack system? If so, please complete the following:

Name:

Company:

Address:

City: State: Zip:

Phone: Fax:

Cleaning Agent Currently Using:

Purchased from:

Type of Parts being cleaned:

Type of contaminate removed:

Alternative most interested in:

How quickly do you want to convert:

PRINTED COPIES NEEDED

FaxBack Numbers:

ADDITIONAL INFORMATION OR SAMPLES NEEDED
PLEASE HAVE A LOCAL REPRESENTATIVE CALL YES____ NO____

FaxBack FEEDBACK

	Poor				Excellent
Ease of Use	1	2	3	4	5
Convenience	1	2	3	4	5
Timeliness of Response	1	2	3	4	5
Document Quality	1	2	3	4	5
Overall Rating	1	2	3	4	5

COMMENTS OR SUGGESTIONS

Please Fax your reply to 302-773-0123. Thank you!

Allied Signal

Genesolv® 2000 Solvent

Physical Properties

Assay, (minimum wt%)	99.5
Chemical Name	1,1-Dichloro-1-Fluoroethane
Molecular Formula	CCl_2FCH_3
Molecular Weight	116.95
Ozone Depletion Potential	0.11
Threshold Limit Value, (ppm)	500
Normal Boiling Point, (°F)	89.7
(°C)	32.1
Vapor Pressure, (psia)	11.47
Liquid Density: (g/ml)	1.24
(lb/gal)	10.3
Surface Tension, (dynes/cm)	19.3
Latent Heat of Vaporization at NBP, (Btu/lb)	94.07
Liquid Viscosity, (cP)	0.430
Kauri-Butanol Number	56
Solubility in H_2O, (ppm)	1,800
H_20 Solubility, (ppm)	420
Evaporation Rate, (Ether = 1)	1.2
Breakdown Voltage, (KV/0.1 in @ 70°F 1 Atm pr.)	13.4
Dielectric Constant	8.07
Vapor Flammability (a)	
— Lower Limit (vol. %)	7.6
— Upper Limit (vol. %)	17.7
— Flash Point (°F) (b)	None

Physical properties measured at 77°F unless otherwise marked

(a) Wire & match head used as ignition source, which is ASTM E681-79 method.

(b) No flash point via open cup (ASTM D 1310-86), or closed cup (ASTM D 56-87 & ASTM D3828 - 87)

enesolv®2000 Solvent Cleaning Compatibility

The listing below is meant to be a general guide. Since plastics and elastomers can be formulated and manufactured to have a wide range of physical properties, it is recommended that compatibility for the particular grade or product formulation be established prior to production cleaning.

PLASTICS

Compatible

Acetal ("Delrin")
Nylon (Polyamide)
Polyvinyl Chloride (Rigid, Pipe Compound)
High Density Polyethylene
Polytetrafluoroethylene ("Teflon")
Epoxy
Polypropylene
Chlorinated Polyvinyl Chloride
Polyetherimide ("Ultem")
Polyester ("Mylar")
Polyphenylene Sulfide ("Ryton")
Polyvinylidene Fluoride ("Kynar")
Poly (Amide-Imide)
Polyether Ether Ketone ("Arlon")
Polyethylene Terephthalate
Vinylester Composite

Not Compatible

Acrylic
Polystyrene
Polycarbonate ("Lexan")
ABS
Cellulose Acetate
Polyethylene-Terephthalate (Glycol Modified)
Polyvinyl Chloride (Clear Molding Compound)

ELASTOMERS

Little or No Change

Perfluoroelastomer ("Chemraz")
Epichlorohydrin 956

Slight Change

Fluoroelastomer ("Viton" A, B)
Polyurethane
Polysiloxane (Silicone)
Natural Rubber

Moderate Change

Polychloroprene (Neoprene)
Isobutylene-Isoprene (Butyl)
Acrylonitrile-Butadiene (Buna N)
Ethylene-Propylene Terpolymer

The above trademarks were registered by the following companies:
Delrin, Teflon, Mylar, Viton — E.I. duPont de Nemours & Co. (Inc.)
Ultem, Lexan — General Electric Co.
Ryton — Phillips Petroleum Co.
Kynar — Penwalt Corp.
Arlon, Chemraz — Green, Tweed Corp.

Genesolv® 2004 Solvent

Physical Properties

Composition, (wt%): HCFC 141b	95.8
Methanol	3.9
Nitromethane	0.3
Ozone Depletion Potential	0.11
Threshold Limit Value, (ppm)	400
Normal Boiling Point, (°F)	84.9
(°C)	29.4
Vapor Pressure, (psia)	10.2
Liquid Density: (g/ml)	1.22
(lb/gal)	10.1
Surface Tension, (dynes/cm)	18.5
Latent Heat of Vaporization at NBP, (Btu/lb)	111.3
Liquid Viscosity, (cP)	0.450
Kauri-Butanol Number	76
Vapor Flammability (a)	
— Lower Limit (vol. %)	6.0
— Upper Limit (vol. %)	20.3
— Flash Point (°F) (b)	None

Physical properties measured at 68°F unless otherwise marked

(a) Wire & match head used as ignition source, which is ASTM E681-79 method.

(b) No flash point via open cup (ASTM D 1310-86), or closed cup (ASTM D 56-87 & ASTM D3828-87)

enesolv®2004 Solvent Cleaning Compatibility

The listing below is meant to be a general guide. Since plastics and elastomers can be formulated and manufactured to have a wide range of physical properties, it is recommended that compatibility for the particular grade or product formulation be established prior to production cleaning.

PLASTICS

Compatible

Acetal ("Delrin")
Nylon (Polyamide)
Polyvinyl Chloride (Rigid, Pipe Compound)
High Density Polyethylene
Polytetrafluoroethylene ("Teflon")
Epoxy
Polypropylene
Chlorinated Polyvinyl Chloride
Polyetherimide ("Ultem")
Polyester ("Mylar")
Polyphenylene Sulfide ("Ryton")
Polyvinylidene Fluoride ("Kynar")
Poly (Amide-Imide)
Polyether Ether Ketone ("Arlon")
Polyethylene Terephthalate
Vinylester Composite

Not Compatible

Acrylic
Polystyrene
Polycarbonate ("Lexan")
ABS
Cellulose Acetate
Polyethylene-Terephthalate (Glycol Modified)
Polyvinyl Chloride (Clear Molding Compound)

ELASTOMERS

Little or No Change

Perfluoroelastomer ("Chemraz")
Epichlorohydrin 956

Slight Change

Fluoroelastomer ("Viton" A, B)
Polyurethane
Polysiloxane (Silicone)
Natural Rubber

Moderate Change

Polychloroprene (Neoprene)
Isobutylene-Isoprene (Butyl)
Acrylonitrile-Butadiene (Buna N)
Ethylene-Propylene Terpolymer

The above trademarks were registered by the following companies:
Delrin, Teflon, Mylar, Viton — E.I. duPont de Nemours & Co. (Inc.)
Ultem, Lexan — General Electric Co.
Ryton — Phillips Petroleum Co.
Kynar — Penwalt Corp.
Arlon, Chemraz — Green, Tweed Corp.

Product Information on Cleaning Compound (NSN 6850001817940) Alternative

ETX-6280 Texaco Long-Life Engine Coolant

Typical Properties:

Appearance.	Clear, Purple
Water Content, wt%, maximum.	4.0
Silicon, Phosphate, Nitrate, Nitrite, and Amines.	None
Density, g/ml @ 20°C, minimum.	1.110
Flash Point, °C.	134
Boiling Point, °C.	172
Freezing Point, 50% by volume, °C.	-34
Ash Content, wt%, maximum.	5.0
Reserve Alkalinity, ml 0.1 N HCl.	5.5
pH, 33%.	8.3

Performance Test Results:

ASTM D-1384 Glassware Corrosion Test

Weight Loss in milligrams per coupon, negative indicates net gain.

	Copper	Solder	Brass	Steel	Iron	Aluminum
ETX-6280	2	-2	2	-1	-3	4
ASTM(max)	10	30	10	10	10	30

ASTM D-4340 Cast Aluminum Heat Rejecting Surface Test

Weight Loss in milligrams per square centimeter per week.

ETX-6280	0.2 mg/cm2/wk
ASTM(max)	1.0 mg/cm2/wk

ASTM D-2570 Simulated Service Test

Weight Loss in milligrams per coupon, negative indicates net gain.

	Copper	Solder	Brass	Steel	Iron	Aluminum
ETX-6280	5	-1	4	1	-2	1
ASTM(max)	20	60	20	20	20	60

Product Description:

ETX-6280 is a newly developed universal engine coolant which incorporates patented organic acid corrosion inhibitor technology. It is a nitrite-, nitrate-, phosphate-, borate-, silicate-, and amine-free formulation which uses mono- and dibasic organic acid salts to provide maximum protection of the seven basic metal alloys found in most heat transfer systems. This coolant provides increased protection of metal surfaces due to the unique synergism between the carboxylic acids used in the formulation. ETX-6280 is an extended life coolant due to the slow depletion rate of the organic acid inhibitors. Since the coolant contains no phosphates or silicates, hard water deposits in the cooling system are almost eliminated. Texaco believes that ETX-6280 represents the next generation of universal engine coolants. This coolant is suitable for a five year, or possibly longer, service life in automotive applications.

DISTRIBUTION LIST

92 CES / DEEE, FAIRCHILD AFB, WA
ADMINSUPU / PWO, BAHRAIN, FPO AE
AF / AFSC/DEEE, WASHINGTON, DC; MO ANG, 231 CEF/DE (SCHMEDAKE), BRIDGETON, MO
AFIT / DET, WRIGHT PATTERSON AFB, OH; DEV, WRIGHT-PATTERSON AFB, OH
ARMY / ENGR CEN, ATSE-DAC-LC, FORT LEONARD WOOD, MO; KWAJALEIN ATOLL, CSSD-KA-DE, APO AP; POJED-O, APO AP; QMSCH, ASTM-CDM (JANCZEWSKI), FORT LEE, VA
ARMY CECOM R&D TECH LIBRARY / ASNC-ELC-I-T, FORT MONMOUTH, NJ
ARMY CERL / LIB, CHAMPAIGN, IL
ARMY CRREL / ISKANDAR, HANOVER, NH
ARMY DEPOT / LETTERKENNY, SDSLE-EN, CHAMBERSBURG, PA; SDSNC-T-MOD-E, NEW CUMBERLAND, PA
ARMY EHA / HSE-RP-HG, ABERDEEN PROVING GROUND, MD; HSHB-EA-S, SMITH, ABERDEEN PROVING GROUND, MD; W630, ABERDEEN PROVING GROUND, MD
ARMY ENGRG DIST / SAMEN-DS/DAVIS, MOBILE, AL
ARMY ENGRG DIV / ED-SY (LOYD), HUNTSVILLE, AL
ARMY EWES / LIB, VICKSBURG, MS
BELVOIR R&DC / COLONEL NEWMAN, FT BELVOIR, VA
CBC / CODE 430, GULFPORT, MS; CODE 84, PORT HUENEME, CA; PWO (CODE 400), GULFPORT, MS
CECOS / CODE C35, PORT HUENEME, CA
COGUARD / SUPERINTENDENT, NEW LONDON, CT
COM GEN FMF / PAC, SCIAD (G5), CAMP HM SMITH, HI
COMDT COGUARD / G-ECV, WASHINGTON, DC
COMSUBDEVGRU ONE / CO, SAN DIEGO, CA
COMSUBPAC / CODE 541, SCE, PEARL HARBOR, HI
DEFENSE DEPOT / FACILITY ENGINEER, OGDEN, UT; STRAND, OGDEN, UT
DFSC-F / ALEXANDRIA, VA
DTRC / CODE 284, RUFOLO, ANNAPOLIS, MD
DTRCEN / CODE 4111, BETHESDA, MD; CODE 42, BETHESDA, MD
ESSM / WHSE 12 (BOWMAN), WILLIAMSBURG, VA
FACILITIES DEPT / FACILITIES OFFICER, FPO AP
FCTC / LANT, CODE 182, VIRGINIA BEACH, VA
MCAF / CODE C144, QUANTICO, VA
MCLB / CODE 506, ALBANY, GA; CODE 520, ALBANY, GA
MCRDAC / M & L DIV, QUANTICO, VA
NAF / PWO, FPO AP; SO, EL CENTRO, CA
NALF / OIC, SAN DIEGO, CA
NAVAIRDEVCEN / CODE 832, WARMINSTER, PA
NAVAIRPROPCEN / CODE PW-3, TRENTON, NJ
NAVAL ED & TRAIN CEN / UTIL DIR, NEWPORT, RI
NAVAVIDEPOT / CODE 904, NORFOLK, VA
NAVAVIONICCEN / PWO, INDIANAPOLIS, IN
NAVAVNDEPOT / CODE 011, NORFOLK, VA; CODE 61000, CHERRY POINT, NC
NAVCAMS / WESTPAC, SCE, FPO AP
NAVCOASTSYSCEN / CODE 423, PANAMA CITY, FL
NAVCOMMSTA / PWO, THURSO, UK, FPO AE
NAVCONSTRACEN / CODE D2A, PORT HUENEME, CA

NAVDIVESALVTRACEN / CO, PANAMA CITY, FL
NAVENVIRHLTHCEN / CODE 42, NORFOLK, VA
NAVFAC / N62, ARGENTINA, NF, FPO AE
NAVFAC CENTERVILLE BEACH / FERNDALE, CA
NAVFACENGCOM / CODE 04A3, ALEXANDRIA, VA; CODE 04A4E, ALEXANDRIA, VA; CODE 04B, ALEXANDRIA, VA; CODE 051A, ALEXANDRIA, VA; CODE 083, ALEXANDRIA, VA; CODE 183 (GEBHART), ALEXANDRIA, VA
NAVFUEL DET / OIC, FPO AP
NAVMEDCLINIC / HEAD, INDUST HYGIENE DIV, PEARL HARBOR, HI
NAVMEDCOM / NWREG, FAC ENGR, PWD, OAKLAND, CA; SWREG, CODE 35, SAN DIEGO, CA
NAVMEDRSCHINSTITUTE / CODE 47, BETHESDA, MD
NAVOCEANO / LIB, NSTL, MS
NAVORDSTA / INDIAN HEAD DET, MCALESTER, OK; PWO, LOUISVILLE, KY
NAVPETOFF / SEC OFFR (CODE 20), ALEXANDRIA, VA
NAVPGSCOL / E. THORNTON, MONTEREY, CA
NAVPWC / TAYLOR, PENSACOLA, FL
NAVSCSCOL / PWO, ATHENS, GA
NAVSEACENPAC / CODE 420, SAN DIEGO, CA
NAVSEASYSCOM / CODE 51412, WASHINGTON, DC
NAVSUPCEN / CODE 700A.1, NORFOLK, VA
NAVSUPPACT / PWO, NAPLES, ITALY, FPO AE
NAVSUPPO / SEC OFFR, LA MADDALENA, ITALY, FPO AE
NAVTECHTRACEN / UPSON, PENSACOLA, FL
NAWC / CODE 40, WHITE SANDS MISSILE RANGE, NM
NCR / 20, CODE R70, GULFPORT, MS
NEESA / CODE 113M, PORT HUENEME, CA
NORDA / CODE 352, NSTL, MS
NPWD / CODE 418, SEATTLE, WA
NRAD / CODE 94, SAN DIEGO, CA
NRL / CODE 2530.1, WASHINGTON, DC; CODE 6123, WASHINGTON, DC
NSC / CODE 02, PEARL HARBOR, HI; CODE 43, OAKLAND, CA; CODE 70, OAKLAND, CA; SCE, CHARLESTON, SC
NSGA / UNIT 35167, APO AP
OAS / MCCONAHY, ARLINGTON, VA
SPCC / CODE 082, MECHANICSBURG, PA
SUBASE / SCE, PEARL HARBOR, HI
SWFPAC / SPB30, SILVERDALE, WA
US DEPT OF HHS / FDA (FISHERY RSCH BR), DAUPHIN ISLAND, AL
US DEPT OF INTERIOR / BLM, ENGRG DIV (730), WASHINGTON, DC
USACOE / CESPD-CO-EQ, SAN FRANCISCO, CA
USAE / CEWES-IM-MI-R, VICKSBURG, MS
USCG / G-ECV-4B, WASHINGTON, DC
USN / CAPT COLIN M JONES, HONOLULU, HI
USNA / SYS ENGRG, ANNAPOLIS, MD