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DEPARTMENT OF DEFENSE HANDBOOK FOR

STORAGE SHELF LIFE AND
REFORMING PROCEDURES FOR
ALUMINUM ELECTROLYTIC FIXED CAPACITORS

THIS DOCUMENT IS FOR GUIDANCE ONLY.
DO NOT CITE THIS DOCUMENT AS A REQUIREMENT.

AMSC N/A

FSC 5910

FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This document provides guidance for storage shelf life and reforming procedures for aluminum electrolytic fixed capacitors.

3. This Military Handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

4. Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, ATTN: VAT, Post Office Box 3990, Columbus, OH 43218-3990 or e-mailed to capacitorfilter@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil

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1. SCOPE

1.1 Scope. This handbook provides guidance in determining and prolonging the serviceability of aluminum electrolytic fixed capacitors during storage. This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

1.2 Purpose. The purpose of this document is to furnish guidance for the inspection, storage, reformation, and issue of aluminum electrolytic fixed capacitors, Federal Supply Class (FSC) 5910.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-62	-	Capacitors, Fixed, Electrolytic (DC, Aluminum, Dry Electrolyte, Polarized), General Specification For
MIL-PRF-39018	-	Capacitors, Fixed, Electrolytic (Aluminum Oxide), Established Reliability and Non-Established Reliability, General Specification For

(Copies of these documents are available online at http://quicksearch.dla.mil/.)

3. DEFINITIONS

This section is not applicable.

4. GENERAL REQUIREMENTS

4.1 Type of storage. Aluminum electrolytic fixed capacitors should be stored in warehouse space under one of the following conditions:

a. Condition A:

(1) MIL-C-62 and non-military grade: Temperature +35°C or less, 60 ±15 percent relative humidity, and air pressure of 725 ±75 millimeters of mercury.

(2) MIL-PRF-39018: Temperature +40°C or less, 50 ±20 percent relative humidity, and air pressure of 725 ±75 millimeters of mercury.

b. Condition B: Temperature, relative humidity, or air pressure other than that specified above within specified storage limits.

4.2 Storage and issue acceptability.

4.2.1 MIL-C-62 and non-military grade aluminum electrolytic fixed capacitors should be acceptable for storage and issue within a 6-year certified period computed from date of manufacture if stored as recommended in 4.1, condition A (1), or within a 4-year period computed from date of manufacture if stored as recommended in 4.1, condition B, or within 3 years from date of last inspection (see 4.3).

4.2.2 MIL-PRF-39018 aluminum electrolytic fixed capacitors should be acceptable for storage and issue within a 10-year certified period computed from date of manufacture if stored as recommended in 4.1, condition A (2), or within 4 years from date of last inspection (see 4.3).

4.3 Inspection frequency.

4.3.1 MIL-C-62 and non-military grade: At the end of 6 years, or 4 years from the date of manufacture, depending upon storage conditions (see 4.2) or 3 years from the last inspection period, capacitors should be inspected (see 4.6) to determine if the dc leakage requirements of the applicable acquisition document can be met.

4.3.2 MIL-PRF-39018: At the end of 10 years or 5 years from the date of manufacture, depending upon storage conditions (see 4.2) or 5 years from the last inspection period, capacitors should be inspected (see 4.6) to determine if the dc leakage requirements of the applicable acquisition document can be met.

4.4 Inspection sampling. At the end of the specified period (see 4.3), it is recommended that a sample as shown in table I be selected. If the number of defectives exceeds zero, it is recommended that all capacitors be tested; those units not meeting the requirements of the applicable acquisition document dc leakage should be reformed and redated, if acceptable. All units exhibiting out-of-tolerance dc leakage characteristics after reforming should be discarded.

TABLE I. Sampling plan.

Lot size	Number of samples
1 - 5	100%
6 - 50	5
51 - 90	7
91 - 150	11
151 - 280	13
281 - 500	16
501 - 1,200	19
1,201 - 3,200	23
3,201 - 10,000	29
10,001 - 35,000	35
35,001 - and over	40

4.5 Disposal period. MIL-C-62 and non-military grade aluminum electrolytic fixed capacitors more than 12 years old should be disposed of. MIL-PRF-39018 aluminum electrolytic fixed capacitors more than 15 years old should be disposed of.

4.6 Inspection method. The method of inspection should be visual and technical (see 5.2 and 5.1).

5. DETAILED GUIDENCE

5.1 DC leakage limits. The dc leakage limits should be in accordance with the applicable acquisition document. If limits are not available for non-military grade capacitors, use applicable MIL-C-62 limits. The following electrical tests are applicable:

a. Electrical failure - DC leakage.

b. Electrical failure - Out of tolerance.

5.2 Visual requirement. Aluminum capacitors should be examined for the following defects:

a. Damaged material.

b. Excessive corrosion.

c. Marking.

d. Packaging.

5.3 Reforming. Groups of electrolytic capacitors should be reformed in accordance with figure 1.

5.3.1 Capacitor reforming groups. The tungsten filament lamp in series with the capacitor bank will serve as a limiting resistor, which allows the voltage across the capacitors to rise as the leakage current decreases. The lamp size should be chosen so that the load current will not exceed an average of 5 milliamperes (mA) per capacitor. Otherwise, internal heating may cause permanent damage to the capacitors under test. The reforming current for each capacitor or section should be limited to a maximum of 5 mA so the total current for each bank is equal to the number of capacitors or sections being reformed, multiplied by 0.005 amperes.

Example: Determine what size lamp should be placed in series with a bank of 50 capacitors with similar voltage ratings.

No of capacitors		Amperes		Amperes
50	x	.005	=	0.250

Since the capacitors are initially uncharged, their resistance may be considered negligible and the entire voltage drop would then appear across the lamp. The wattage of the lamp would then be:

Amperes		Volts		Watts
0.250	x	(rated)	=	---

5.3.2 Capacitor voltage. The power supply output voltage should be so adjusted that the initial total current does not exceed 5 mA per axial leaded capacitor and 10 mA per radial, threaded terminal capacitor. As the leakage current decreases, the power supply output voltage will be adjusted so that the total current does not exceed current specified above. This procedure will be repeated until rated voltage appears across the capacitor bank or until 4 hours have elapsed.

5.3.3 Capacitor reforming time. The leakage current which an electrolytic capacitor will pass increases with temperature rise. Heat is generated in the electrolytic capacitor during the reforming process. Accordingly, leakage current measurements made immediately after reforming will be higher than at ambient temperature. If leakage current measurements taken immediately after reforming are within specified limits, the capacitor should be considered acceptable. The capacitors should be reformed for a maximum period of 1 hour or for a shorter period where the leakage current measurements fall within specified limits. Where the limits are still exceeded after the 1-hour period, the capacitors should be removed from the voltage source, held for approximately 24 hours, and the leakage test performed again.

5.4 Packaging. Packaging should be in accordance with the applicable acquisition document.

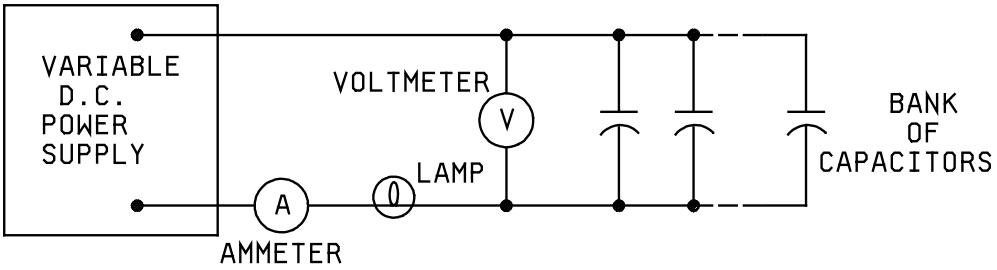

FIGURE 1. Schematic diagram.

6. NOTES

6.1 Intended use. This handbook provides guidance for storage shelf life and reforming procedures for aluminum electrolytic fixed capacitors.

6.2 Surge voltage. The components of an electronic dc voltage supply will provide a measure of protection to the extent of absorbing a portion of the line surge. Electrolytic capacitors are expected to withstand surge voltage of the magnitudes indicated below.

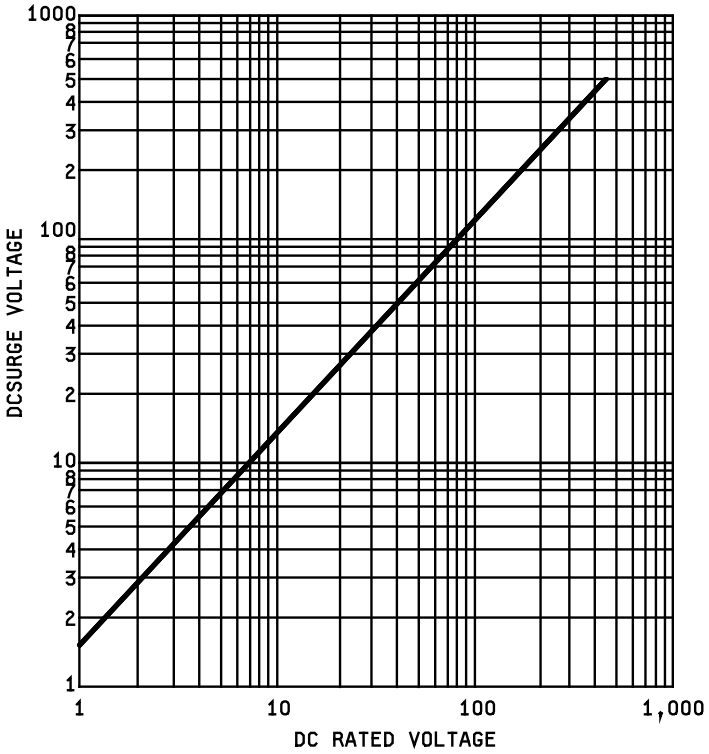

FIGURE 2. Surge voltage.

NOTE: Surge voltages shown are conservative and are given for general field service guidance. Detail specification sheets may permit higher values in some instances. Refer to individual specification sheets for details where necessary.

TABLE II. Rated voltage, surge voltage, percent surge allowed.

Capacitors rated voltage at equipment ambient temperature	DC surge voltage	Percent surge allowed
5	7	40
6	8	33
7	10	43
7.5	10	33
10	15	50
15	20	33
16	20	25
20	25	25
25	30	20
30	40	33
40	50	25
50	60	20
60	75	25
75	90	20
100	125	25
150	175	16.6
200	225	12.5
225	250	11.1
250	275	10
275	300	9.1
300	325	8.3
350	375	7.1
400	450	12.5
450	500	11.1

6.3 Line voltage variations. It is recommended that a constant voltage transformer or regulator be inserted in the equipment power line where line surges are found to be greater than those outlined above.

6.4 Shelf life. This handbook covers items where shelf life is a consideration. The shelf life codes are contained in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, Shelf life Management Manual, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points (ICPs), and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: https://www.shelflife.hq.dla.mil/policy_DoD4140_27.aspx .

6.5 Subject term (key word) listing.

Shelf life
Type of storage
Capacitor reforming time

6.6 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 85
DLA - CC

Preparing activity:
DLA - CC

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NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.