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MIL-HDBK-1131
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DEPARTMENT OF DEFENSE HANDBOOK FOR

STORAGE SHELF LIFE AND REFORMING PROCEDURES FOR ALUMINUM ELECTROLYTIC FIXED CAPACITORS

THIS HANDBOOK IS FOR GUIDANCE ONLY.
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AMSC N/A **FSC 5910**

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DEPARTMENT OF DEFENSE
WASHINGTON, D. C.

Storage Shelf Life and Reforming Procedures for Aluminum Electrolytic Fixed Capacitors.

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1. 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.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center Columbus, ATTN: DSCC-VAM, 3990 East Broad Street, Columbus, OH 43213-1199 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

CONTENTS

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. REFERENCED DOCUMENTS

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

SPECIFICATIONS

MILITARY

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 specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. DEFINITIONS

3.1 Visual inspection. A visual inspection is an inspection by visual means to observe the item and its packaging to detect deficiencies. Visual inspection normally does not require disassembly or testing of the item.

3.2 Technical inspection. A technical inspection is an inspection by visual or other means such as disassembly, measurement, or performance testing.

4. GENERAL GUIDANCE

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. 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).

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. 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 procurement document can be met.

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 procurement 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 procurement document 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 4.3 and 5.1).

4.7 Defects list. Capacitors should be inspected for the following defects:

a. Damaged material.
b. Mechanical.
c. Excessive corrosion.
d. Electrical failure - DC leakage.
e. Electrical failure - Out of tolerance.
f. Marking (specify).
g. Packaging.

5. DETAILED GUIDANCE

5.1 DC leakage limits. The dc leakage limits should be in accordance with the applicable procurement document. If non-military limits are not available, use applicable MIL-C-62 limits.

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

5.2.1 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 shall be placed in series with a bank of 50 capacitors with similar voltage ratings.

No of capacitors		Amperes		Amperes
50	x	.005	=	0.250

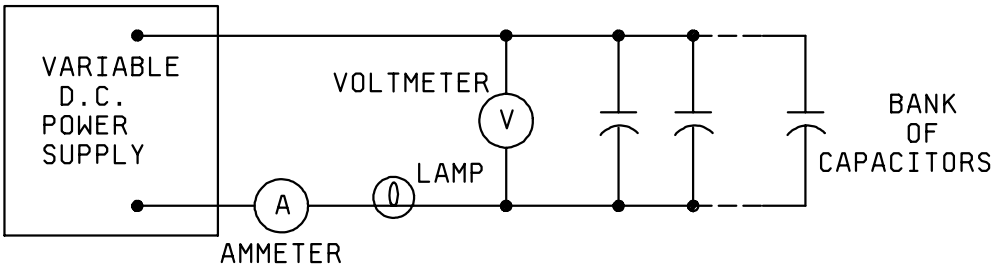
Since the capacitors are initially uncharged, their resistance may be considered negligible and the entire voltage drop would then appear across the lamp. The wattage of the lamp would then be:

Amperes		Volts		Watts
0.250	x	(rated)	=	_____

5.2.2 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 10mA 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.

5.2.3 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.

5.3 Packaging. Packaging, should be in accordance with the applicable procurement document.



6. NOTES

6.1 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.

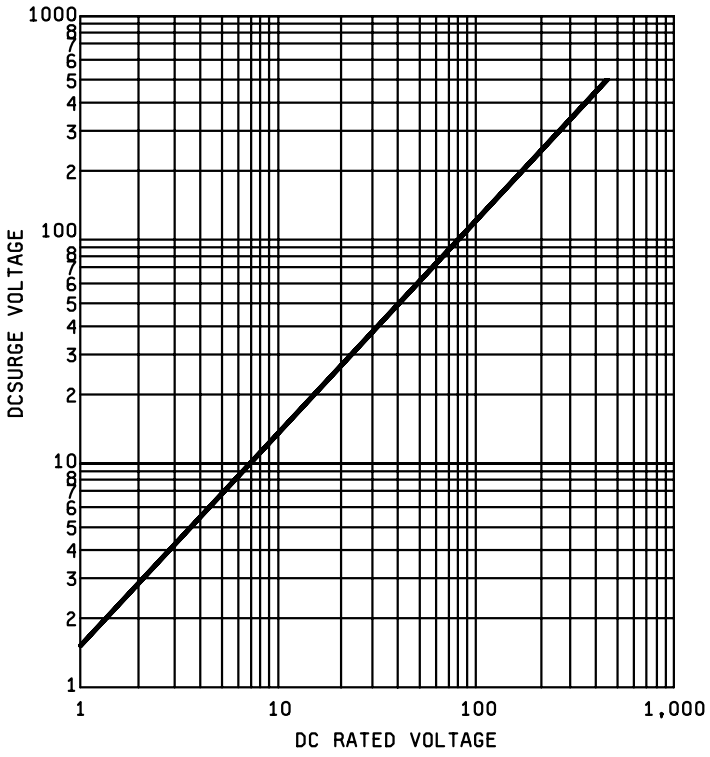


FIGURE 2. Surge voltage.

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.

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

6.2 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.

Custodian:
Army - CR
Navy - EC
DLA - CC
Air Force - 11

Preparing activity:
DLA - CC

(Project 5910-2029)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-HDBK-1131	**2. DOCUMENT DATE (YYYYMMDD)** 19990707

3. DOCUMENT TITLE **STORAGE SHELF LIFE AND REFORMING PROCEDURES FOR ALUMINUM ELECTROLYTIC FIXED CAPACITORS**

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON *(if applicable)*	**7.DATE SUBMITTED** (YYYYMMDD)

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