

# Performance Characteristics for GE Aluminum Electrolytic Capacitors

## OPERATING AND STORAGE TEMPERATURE

The permissible operating and storage temperature range for each product series is specified in Table-PC1.

SERIES	OPERATING		STORAGE	
	*TEMPERATURE		*TEMPERATURE	
23A	-40	+85	-55	+95
23B	-40	+85	-55	+95
23C	-40	+95	-55	+105
23D	-40	+85	-55	+95
23F	-55	+105	-55	+105
23H	-40	+85	-55	+95
23J	-40	+105	-55	+105
23M	-40	+85	-55	+95

\*All Temperatures expressed  
in Degrees C.

**Table-PC1**

## SHELF LIFE PERFORMANCE TEST

The capacitors shall be placed in a circulating air oven maintained at  $85 \pm 2^\circ \text{C}$  for a period of  $100 \pm 4$  hours with no voltage applied. After completion of this phase, the units shall be allowed to cool for a period of at least 4 hours in an ambient temperature of  $25^\circ \text{C}$ .

Once cooled, capacitance and E.S.R. shall be measured as follows, and shall meet the initial specifications: Capacitance measurements shall be made using the bridge method at a frequency of 120 Hz. at  $25^\circ \text{C}$ , using an RMS test signal of either 100 milliamps or 1 volt. The capacitor(s) shall meet the tolerance specified for the device(s) being tested.

E.S.R. measurements shall be made using a 4-terminal bridge using a test signal of 100 milliamps RMS or 1 volt RMS at a frequency of 120 Hz. The test shall be performed after the capacitor has been stabilized at a temperature of  $25^\circ \pm 2^\circ \text{C}$  for a minimum of 2 hours. The capacitor(s) shall meet the initial E.S.R. specified for the device(s) being tested.

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## DC WORKING VOLTAGE

The DC Working voltage is the maximum operating voltage for continuous duty at the maximum rated ambient temperature specified for the capacitor.

## SURGE VOLTAGE

The DC Surge voltage is the maximum voltage to which the capacitor can be subjected to under any conditions. Surge Voltage capability can be tested using the following procedure: Connect the capacitor in series with a current limiting resistor\* and apply the DC Surge voltage for a period of 30 seconds at an ambient temperature of  $25^{\circ} \pm 2^{\circ}\text{C}$ , then discharge the capacitor through the resistor. This procedure shall be repeated at 10 minute intervals for a period of 24 hours. The leakage current should be measured 4 hours after completion of the test and must not exceed the initially specified leakage current for the device. There should be no distortion of the capacitor case, and there should be no leaking electrolyte from the seal or vent hole.

**Note:** for capacitors up to  $2500\mu\text{F}$  the value of the current limiting should be 1000 Ohms; For capacitors greater than  $2500\mu\text{F}$  the value of the current limiting resistor should be 100 Ohms.

## DC LEAKAGE CURRENT

DC Leakage current tests shall be performed after the capacitor(s) are preconditioned as follows: Capacitor(s) shall be preconditioned by applying rated voltage for 30 minutes. Leakage current measurements shall be made within 48 after preconditioning.

Measurements should be made at  $25^{\circ} \pm 2^{\circ}\text{C}$ , with the reading of the Leakage current taken by measuring the voltage drop across a 1000 Ohm resistor connected in series with each capacitor being tested. Rated working voltage should be applied from a steady source of DC power, such as a laboratory quality, regulated DC power supply. Readings should be taken within  $5 \pm 0.5$  minutes after the capacitor being tested reaches rated working voltage. The DC leakage current shall not exceed that which is specified for the device, or when this value is not readily available, the value determined by the following equation:

$$I_{dcl}(\text{max}) = \chi \sqrt{C V} \quad (I_{dcl}(\text{max}) = \text{maximum leakage current in microAmps})$$

**Where:**  $\chi$  is determined from Table-AP8 on page 76  
 $C$  is the value of capacitance in microfarads  
 $V$  is the rated DC working voltage specified for the capacitor

**\* NOTE: In no case shall the DC Leakage current exceed 5000 microAmps**

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## LOW TEMPERATURE PERFORMANCE

The following general guidelines may be used when estimating capacitance and E.S.R. values for reduced temperature performance; (All test parameters are the same as those used for "SHELF LIFE PERFORMANCE" shown on page 81; except that reduced temperature measurement values should be used)

\* **NOTE:** For specific performance values at reduced temperature, contact GE engineering.

Temperature	% of Nominal Capacitance	% of Nominal E.S.R.
-10° C	85%	200%
-25° C	70%	300%
-40° C	50%	600%

## THERMAL SHOCK

All GE Electrolytic capacitors should be resistant to thermal shock based on the following test guidelines:

Capacitors shall be subject to the following thermal cycle conditions:

4 Hours @ 105° C (then)	} <b>Four complete cycles constitutes one complete test cycle</b>
4 Hours @ 25° C (then)	
4 Hours @ -55° C (then)	
4 Hours @ 25° C	

The above cycle should be performed four (4) times in a circulating air environment. Following the final temperature cycle, the capacitor(s) being tested should be placed in a water bath maintained at 90 - 95° C for 5 minutes. A failure shall be defined as any unit exhibiting a **continuous** chain of bubbles from the gasket or vent area during immersion. ( a few non-sustained bubbles of trapped air should not be considered as a failure of the performance test)

## LIFE TEST

GE Electrolytic capacitors are capable of the published life, shown in **Table-PC2** on page 84 of this catalog, based on the following test conditions:

Rated DC voltage and Ripple current shall be applied to the capacitors, such that the sum of the AC and DC portions of voltage do not exceed the rated working voltage. The tests shall be performed at the rated temperature and for the Proof Life hours as shown in Table-PC2.

After completion of the Life Test, the capacitor(s) shall be allowed to cool to 25° ± 2° C for a period of at least 4 hours during which time the rated DC working voltage of the capacitor(s) shall be continuously applied. The following results shall be met:

Capacitance shall not have changed more than ± 15% from initial pre-test value.

E.S.R. shall not have increased to more than 200% of the initial pre-test value.

DC Leakage current shall meet the specified requirements as shown under "DC Leakage Current" on page 80 of this catalog.

**Acceptable life criteria shall be defined as not more than 1 failure be permitted in 24 capacitors being tested.**

# Performance Characteristics for GE Aluminum Electrolytic Capacitors

## LIFE TEST (CONT'D)

SERIES	RATED * TEMPERATURE	PROOF LIFE HOURS
23A	85	1000
23B	85	3000
23C	95	1000
23D	85	1000
23F	105	1000
23H	85	2000
23J	105	2000
23M	85	2000

Table-PC2

## VIBRATION TEST

GE Electrolytic capacitors shall be capable of being subjected to sinusoidal vibration over a frequency range of 10 to 55 Hz. and return, traversed within a period of one minute for a test duration of two (2) hours each in three (3) mutually perpendicular directions. A maximum displacement of 0.06 inches or a maximum acceleration of 10 G's will be allowed, whichever is less.

Capacitors shall be securely mounted to the test fixture by the body of the device, using an approved clamp. During the last hour of the test, the capacitor shall be connected to a capacitance bridge, and shall be observed continuously for a period of five (5) minutes. During this time, the capacitor shall be capable of providing a continuous capacitance and E.S.R. reading and there shall be no evidence or indication of any intermittent electrical connection within the capacitor.

# Safety Guidelines for GE Aluminum Electrolytic Capacitors

**WARNING !**

**DANGER !**

## SAFETY

Improper application of aluminum electrolytic capacitors is extremely hazardous.

The high watt-second capability of electrolytic capacitors requires extreme caution in testing and application. Users should provide for proper protection in design considerations. This should include protection against leaking or exploding capacitors.

**EXTREME CAUTION SHOULD BE TAKEN AT ALL TIMES WHEN WORKING WITH ENERGIZED CAPACITORS. ALL SERVICING SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY !**

**SEE ADDITIONAL SAFETY RELATED INFORMATION ON PAGES 78 & 79 OF THIS CATALOG.**

(Capacitor Mounting Applications; Electrolyte Fluids; Safety