

ELECTROLYTIC CAPACITORS ALUMINUM TYPE REQUIREMENTS AND PROCEDURES

1. GENERAL

1.01 This section covers aluminum-type electrolytic capacitors. It does not apply to tantalum-type electrolytic capacitors because none of the restrictions of this section are necessary with the tantalum type. The aluminum type are distinguished by the fact that they are stamped or labeled "Electrolytic Condenser," "Electrolytic Capacitor," or "Elect. Cap." Tantalum type are not so designated.

1.02 This section is reissued to incorporate material from the addendum in its proper location.

1.03 There are three general classes, namely, polarized, nonpolarized, and motor starting capacitors.

(a) The polarity of polarized electrolytic capacitors is identified by stamping the positive and negative terminals with POS and NEG or a + and - symbol by painting the positive terminal red and/or the negative terminal black or white, or by designating the terminals by numbers or symbols which can be interpreted by referring to information on the capacitor case or in the circuit schematic. An exception to this is on older KS-8531 capacitors on which the 5 and 7 terminals are + but not so designated. Any capacitor with polarity markings must be connected + to positive of the power and - to negative of the power as shown on the circuits.

(1) Caution: When making connections to a polarized electrolytic capacitor or to any circuit containing a polarized electrolytic capacitor, extreme care should be used to see that the connections are correctly made with respect to the polarity of the capacitor. Reversal of polarity or application of ringing or ac will not only damage the capacitor but also may cause injury to personnel or damage to equipment if the capacitor should explode. The positive and negative terminals of the capacitor may be determined as described in (a). In every case, however, the proper manner of connection should be determined before power is connected to the capacitor or circuit containing the capacitor.

(b) Nonpolarized capacitors either have no polarity marking or are designated "Nonpolarized" or "N.P." on the container. They are also for dc service but are intended for circuits where the dc polarity reverses.

(c) Motor starting types are used on ac circuits where they are subjected to brief intervals of ac voltage during the motor starting periods. Motor starting capacitors have no polarity markings and there is usually an ac voltage rating stamped on the container.

1.04 Because of the drying out of the electrolyte in an electrolytic capacitor, there is a slow rate decrease of capacity and increase in series effective resistance with time, which is maintained until near the end of the useful life of the capacitor when these two characteristics begin to change rapidly with a consequent rapid increase of the impedance of the capacitor. The limit of the effectiveness of a capacitor is based on the impedance which can be tolerated for the particular circuit in which it is used. When the impedance of the capacitor exceeds the tolerable impedance for the circuit, it is necessary that it be replaced. See 2.03.

1.05 Caution: Capacitors may retain their charge for some time after being disconnected from power. The terminals and the metal container of the capacitor may be above ground potential. Therefore, care should be exercised when replacing capacitors or working near them to avoid electrical shock or short circuits.

2. REQUIREMENTS

2.01 Film

(a) When not connected to power, the film which is the dielectric, tends to deteriorate progressively. If polarized capacitors are connected to d-c power of proper voltage for sufficient time, the film can usually be restored, provided the deterioration has not progressed too far.

(b) Polarized electrolytic capacitors that have been disconnected from power for more than 30 months shall be checked before being placed in service (see 3.01 (1) and (2)) to see that film can be reformed and then held for 2 hours at 80 to 100 per cent of capacitor voltage rating to reform the film.

(c) A somewhat simpler reforming process is acceptable for polarized electrolytic capacitors in the hands of the telephone company, provided it is put into effect before the expiration of the 30-month interval, say within 24 to 30 months. This reforming shall consist of 1/2 hour or more of application of d-c voltage which should be 80 to 100 per cent of capacitor voltage rating unless the maximum voltage applied to the capacitor in normal service for the particular application is known, in which case such maximum voltage is satisfactory.

(d) Reforming of film of polarized electrolytic capacitors with more than one section may be per the above for each section. The reforming of all sections may be carried on simultaneously.

(e) Reforming of film per above may also be applied to nonpolarized electrolytic capacitors, except that they shall have the above forming voltage applied with the voltage poled first in one direction for the specified time and then poled in the reverse direction for the same length of time.

(f) In the case of motor starting capacitors, the above reforming of film is not recommended.

2.02 Fuse Blowing: Precautions shall be taken to avoid blowing associated fuses by the capacitor charging current when the capacitors are connected or reconnected to power.

2.03 Capacitor Replacement

(a) Polarized and nonpolarized electrolytic capacitors should be replaced, when the impedance of the capacitor exceeds the tolerable impedance for the circuit. See (b) to (e) below.

(b) When test requirements are specified on circuits or other job information, the capacitors shall be replaced when they fail to meet such requirements. Unless otherwise specified they should be replaced regardless of test results, after 10 years of life for capacitors dated prior to 1946 or 15 years for capacitors of later date.

Note: Electrolytic capacitors, except a few furnished during part of 1944 and 1945, are dated. Age is figured from the earliest date on the container, and subsequent dates which may have been added on the container or on an attached tag do not apply.

(c) When test requirements are not specified on motor starting capacitors, they should be replaced only when failing to cause the associated motor to start.

(d) When test requirements are not specified on capacitors in rectifier units, the capacitor should be replaced only when causing noise or other trouble in the rectifier unit.

(e) When test requirements are not specified on electrolytic capacitors not covered by (c) or (d), they should be replaced after 10 years of life if dated prior to 1946 and after 15 years if of later date.

3. PROCEDURES

3.001 Tools, Gauges, Materials, and Test Apparatus (Equivalents May Be Substituted)

Dry cells
Lamp, 110-120 volts, any wattage
Resistance, 18 or 19 type, as required
Switch, short-circuiting (obtain locally)
Volt-ohm-milliammeter, KS-14510 or Meter, M9B

3.01 Film (Rq. 2.01)

Testing and Reforming after Being Disconnected from Power for More Than 30 Months

(1) Make up a test circuit locally with a dry cell battery, milliammeter, and resistance in series and with a switch to short out the milliammeter and resistance. The battery voltage should be 80 to 100 per cent of capacitor rating. See Table A for capacitors not stamped with voltage rating. The milliammeter can be of any range from 0-50 to 0-150 milliamperes. The resistance in ohms should be approximately the battery voltage divided by the milliammeter range in amperes (milliamperes range divided by 1000), example, with a 200-volt battery and a 150-milliamperes instrument, the resistance should be 200 divided by 0.150 or 1333 ohms. A 1300-ohm 18BK or a 1340-ohm 18GN resistance would be satisfactory.

(2) With the instrument and resistance shorted by the switch, apply the battery voltage to the capacitor terminals for 5 seconds with + to + and - to -. Open the switch and note whether or not the current as read on the milliammeter is decreasing. If it is not decreasing, it indicates too much leakage current and the film probably cannot be restored. The capacitor should be removed from the circuit

immediately and discarded. If the current is decreasing, reclose the switch and continue to apply the voltage to the capacitor for 2 hours.

TABLE A

Capacitor KS No.	Film Forming D-C Voltage
7160	24-30
7450	160-200
7480	52-65
7481	144-180
7763	64-80
7868	40-50
7869	10-12
7870	360-450 (Note)
7896	24-30
8021	52-65
8025	132-165
8045	72-90
8056	48-60
8188	160-200
8373	20-25
8374	160-200
8418	160-200
8531	200-250
8676	20-25
8677	160-200
8679	160-200

Power Equip. Co No.	Film Forming D-C Voltage
C-36	160-200
C-60	200-250
C-80	12-15

Note: Due to the high voltage rating of the KS-7870 capacitor, every effort should be made to avoid the necessity of film forming by procedure using dry cells. Where this is unavoidable, proper precautions should be taken.

Reforming Where Disconnection From Power Has Not Exceeded 30 Months

(3) The simplest means of supplying voltage for film restoration is to connect the capacitor into an operating circuit of the type for which the capacitor is specified. In the case of a rectifier unit, this would mean connecting the rectifier unit (with all tubes of a tube-type rectifier in) to the a-c service voltage. If in the case of a battery charging

rectifier unit, it is known that the capacitor is directly across the output, connecting the output to battery is satisfactory for forming the film.

(4) Where such normal or operating voltage is not available, dry cells in series with approximately 1000 ohms of resistance are satisfactory. Connect + and - of capacitor to + and -, respectively, of battery. Rated voltage is now being stamped on most electrolytic capacitors. The above table A lists film forming voltages for capacitors on which rating may not be stamped.

3.02 Fuse Blowing (Rq.2.02)

(1) The charging current of a capacitor when added to the load and leakage currents may be sufficient to blow the associated fuse unless precautions are taken when fuse or capacitor is installed. Blowing is more likely to occur with a large capacitor and a small fuse, for example, a KS-8056 capacitor and 2-ampere fuse in station equipment.

(2) A lamp or a 10- to 100-ohm resistance held for a few minutes in series with the capacitor and source of power will allow the capacitor to charge and avoid the chance of the fuse blowing. Permanent connections should be completed immediately after removal of the lamp or resistance while the capacitor is still charged.

(3) Where a lamp or resistance is not available, the capacitor can sometimes be charged without blowing the fuse by tapping the final connections together several times before completing the permanent connection. This allows the capacitor to take on some charge at each tap. This method will not be successful if the total load represents too much of the fuse capacity, and should not be attempted with voltage above 60. In such cases, (2) must be followed.

3.03 Capacitor Replacements (Rq 2.03)

(1) When replacing a polarized electrolytic capacitor, be sure that the new capacitor is connected into the circuit properly. See 1.03(a) and (1), and 1.05.