

CAPACITORS, ELECTROLYTIC

ALUMINUM FOIL TYPE

1. GENERAL

1.1 Scope

1.11 This section covers aluminum foil electrolytic capacitors. These capacitors are marked "Electrolytic Capacitor" or "Elect. Cap."

1.12 Capacitors made from tantalum are not covered and none of the restrictions herein apply. Tantalum capacitors are quite a bit smaller than the aluminum foil type for the same capacity rating and are not marked with the designations in Paragraph 1.11.

1.2 Types of Capacitors

1.21 There are two types of these electrolytic capacitors in general use, polarized or polar and non-polarized or nonpolar.

1.22 Polar or polarized electrolytic capacitors have their terminals identified in one of these ways: + and - signs, painting the positive terminal red, marking terminals "POS" and "NEG", or numbering the terminals and listing a terminal code on the container.

1.23 The nonpolarized type either have no polarity marking or are identified by marking "Nonpolarized", "Non-Pol", or "N.P." on the container.

1.3 Construction

1.31 Aluminum foil electrolytic capacitors are constructed from high purity aluminum foil. A type of aluminum oxide coating is formed on one piece of foil which is then used for the anode or positive plate. Paper impregnated with an electrolyte paste is placed against the aluminum oxide coating and this electrolyte is the cathode or negative connection. There are several ways to make electrical contact with the electrolyte. Sometimes a second foil plate, without any oxide, is used, sometimes the case is used, and sometimes a piece of cloth sprayed with metallic particles is used. Whatever the method used, the assembly is rolled up and inserted into the case. The case may sometimes be insulated from the assembly by material such as varnished cambric or muslin. For other types the assembly may have potting compound poured around it. The can is then sealed to prevent drying out of the electrolyte.

1.32 Aluminum oxide offers very high resistance to passage of current (acts as a good dielectric) as long as the

anode (positive plate) is positive with respect to the negative plate. If the polarity is reversed the film offers very little resistance and acts as a short circuit. This overheats the capacitor and ruins the film, making the capacitor worthless. The capacitor may even explode from excessive heating unless some kind of venting system was provided in the case.

1.33 Nonpolarized electrolytic capacitors are often used in filter circuits. Two aluminum oxide anodes are used with cathode. The anodes are brought out to the terminals. The nonpolar capacitor is really two capacitors in series and will have twice the volume of a polarized capacitor of the same capacity and voltage rating.

1.34 Motor starting capacitors are a special type. For further information on these see Section 120 in this Handbook.

1.4 Voltage Rating

1.41 Aluminum oxide will stand a voltage of about 25 million per 0.1 inch thickness before breaking down. The oxide dielectric film is controlled for thickness according to the voltage rating desired for the capacitor. This voltage is stamped on the case of the capacitor and should not be exceeded or the film may break down and ruin the capacitor.

1.5 Film Deterioration

1.51 When not connected to voltage the aluminum oxide film deteriorates. The film can usually be reformed by connecting the capacitor to dc voltages of the proper polarity and value. See Paragraph 4.

1.6 Precautions

1.61 When making connections to a polarized capacitor or to circuits containing polarized capacitors, use extreme care to see that voltage of the proper polarity is connected to the capacitor. Reversal of polarity or application of ringing or ac voltages will not only damage a polarized capacitor but will cause it to overheat and possibly explode.

1.62 Capacitors may retain their charge for some time after being disconnected from circuit voltage. Terminals and the metal case may be above ground potential. Exercise care when working near the terminals of the capacitors. If necessary to make any connections to the terminals or remove any connections be sure power is disconnected and then short the terminals to the case of the capacitor with an insulated lead before proceeding.

1.63 When replacing a polarized capacitor be sure the new capacitor is connected into the circuit properly.

2. REPLACEMENT

2.1 Due to High Impedance

2.11 There is a slow decrease in capacity and increase in impedance with time due to the electrolyte drying out. Near the end of the useful life of the capacitor the impedance increases rapidly.

2.12 Any of these capacitors should be replaced when its impedance exceeds the tolerable limit for a circuit, or, when the capacitor fails to meet test requirements.

2.2 Due to Age

2.21 These capacitors (KS Type only) are designed to have a useful life of 15 years. Date of manufacture is marked on the container, generally in this order: month-day-year. Any of these capacitors should be automatically replaced 15 years from date of manufacture.

2.3 Due to Other Reasons

2.31 Any of these capacitors should be immediately replaced if the case is punctured.

2.32 Replace any electrolytic capacitor causing noise in a rectifier or other circuit.

2.33 Replace any polarized capacitor that has been connected incorrectly into a circuit and subjected to incorrect polarity.

3. INSTALLING EQUIPMENT

3.1 Dry cells or storage batteries, a 110 volt lamp of any wattage, a short-circuiting switch, and a Volt-Ohmmeter (ITE-4034 or ITE-4442) will be required, depending on the film forming requirements, Paragraph 4.

4. REFORMING FILM

4.1 If the polarized capacitor has been disconnected from power less than 30 months, reform the film in one of the following ways:

4.11 Connect the capacitor into the operating circuit for which it was designed observing the polarity of the voltage.

4.12 Connect the capacitor across the dc output of a rectifier, observing the polarity of the voltage as well as making certain the output voltage does not exceed the rated voltage of the capacitor. Reform film for at least 1/2 hour. (See Paragraph 5 on charging currents.

4.13 Connect sufficient dry cells in series, or use dc voltage from storage batteries, to equal approximately

the rated dc voltage of the capacitor. Connect the cells to the capacitor through a 1000 ohm resistor, observing the proper polarity. Reform film for a least 1/2 hour.

4.14 Film forming voltages may be considered as the rated dc voltage marked on the capacitor. Some capacitors may not have this rated voltage on the container, in which case refer to Table 1 for the voltage to be used.

4.2 If a polarized capacitor has been disconnected from power for more than 30 months test the capacitor as in Paragraph 4.22 and reform the film as in Paragraph 4.23 if the test was satisfactory.

4.21 Circuit: Use a battery voltage equal to approximately 100% of working voltage stamped on the capacitor. See Table 1 for capacitor that may not be marked with working voltages. Connect the battery to the capacitor through a resistance in series with a milliammeter (ITE-4034 or 4442) with a shorting switch closed around the resistance and milliammeter. The milliammeter can be any range from 0-50 to 0-150 milliamperes. The resistance in ohms should be approximately battery voltage divided by ampere range of the meter (milliamperes divided by 1000). Example: 200 volt battery, 150 millampere meter range. Resistance required is $200 \times 1000 / 150 = 1300$ ohms. Use a 1300 ohm 18BK or 1340 ohm 18GN resistor.

TABLE 1 FILM FORMING VOLTAGES

Capacitor KS No.	DC 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 DC 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 film forming with dry cells or storage batteries.

4.22 Test: With meter and resistance shorted out by the switch, apply battery voltage to capacitor terminals for about 5 seconds, observing the correct battery polarity. Open the switch and note if the current read on the milliammeter is decreasing. If it is not decreasing there is too much leakage current and the capacitor film probably cannot be restored by reforming. Remove the test voltage from the capacitor immediately and replace the capacitor. If current is decreasing the capacitor is satisfactory and film can be restored.

4.23 Reforming: Reform film by connecting dc voltage of proper polarity and value to the capacitor for two hours.

4.24 Sections: If a polarized capacitor has more than one section form each section separately as in Paragraphs 4.12 or 4.13 or 4.2, depending on the time the capacitor has been uncharged. When a polarized capacitor with more than one section is connected into its normal operating circuit, the sections do not have to be reformed separately.

4.3 If a nonpolarized capacitor has been disconnected from power for more than 30 months test the capacitor as in Paragraph 4.22 with the circuit of Paragraph 4.21, but make two tests, first with one polarity connected to the terminals and then the reverse polarity. Reform film as in Paragraph 4.23 for two hours

No arrows are shown due to extensive changes.

with one polarity of battery connected to the capacitor and then reverse the polarity and reform film for another two hours.

5. CHARGING CURRENTS

5.1 Initial charging current of a capacitor added to load currents may be sufficient to cause a fuse to blow. This is most likely to occur with a large capacitor and a small fuse, for example, a KS-8056 capacitor and a 2 ampere fuse in station equipment.

5.2 Filter capacitors in rectifiers will be charged by the battery as soon as the output fuse is inserted. The initial charge current may be sufficient to blow this fuse or burn the fuse clips. The rectifier should be used to charge these filter capacitors before the battery is connected to the output of the rectifier.

5.3 A 110 volt lamp, any wattage, used to connect one line of the power source to the capacitor will prevent fuses blowing. After charging the capacitor through the lamp remove the lamp and make direct connection to the reforming voltage while the capacitor is still charged.

5.4 If a lamp is not available the capacitor can sometimes be charged by tapping the connections together several times before making the final connection. This method will not be successful if the condition in Paragraph 5.1 exists and the lamp should be used as in Paragraph 5.3.

Engineer of Installation

Reason for Reissue:

- (1) To add information on marking of capacitors, Paragraph 1.2.
- (2) To add Precautions, Paragraph 1.6.
- (3) To add information construction of these capacitors.

Replaces Section 10 dated 7-17-52.