ELECTRICAL AND MECHANICAL
ENGINEERING REGULATIONS
(By Command of the Defence Council)

TELECOMMUNICATIONS
A 503

RE-FORMING AND LEAKAGE TESTING OF POLARIZED ELECTROLYTIC CAPACITORS

Note: This Page 1, Issue 3, supersedes Pages 1 to 4, Issue 2, dated 1 Jan 63.

1. The information contained in the Issue 2 of this regulation has been revised and enlarged and is now contained in Gen E 650

2. Tels A 503, Pages 1-4, Issue 2, dated 1 Jan 63 is therefore cancelled and all copies are to be destroyed.

3. When action detailed in para 2 has been completed:-

   (a) Delete all reference from the Tels A 001, Issue 9.

   (b) Destroy this regulation.

EME8b(A)/2170

END

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RE-FORMING AND LEAKAGE TESTING OF POLARIZED ELECTROLYTIC CAPACITORS.

Note: These Pages 1 - 4 Issue 2, supersede Issue 1, Page 1 dated 30 May 1945. The regulation has been rewritten to take into account new types of capacitors and new test equipment.

INTRODUCTION

1. An electrolytic capacitor, when not in use, undergoes gradual chemical changes in its dielectric, particularly in a warm climate. With tantalum electrolytics the effect of this chemical activity is not usually significant. With the aluminium type, the anodic film may deform to such a degree that when the working voltage is next applied, after a period of storage, an unduly heavy leakage current will flow which may cause internal heating and failure. To avoid this, re-forming should be carried out by one of the methods described.

2. Tantalum electrode capacitors do not require re-forming and these remarks are therefore applicable only to aluminium electrode capacitors of the etched, sprayed or plain foil type. If there is any doubt then the re-forming procedure should be applied. All electrolytic capacitors, whether they require re-forming first or not, should pass the leakage test defined in para 14.

REFORMING

3. The re-forming process involves polarizing the capacitor via a suitable series resistor which limits the initial current and allows the voltage across the capacitor itself to build up gradually. If the capacitor is in good condition the initial drop of current will be rapid and the complete re-forming process may take only a few minutes. A slow initial drop of current indicates that the capacitor is in poor condition and should be rejected. Where replacements are in short supply the re-forming process may be continued as described in para 7 (applicable to all four methods), and in most cases the results will be satisfactory.

When to re-form

4. All electrolytic capacitors drawn from stores should be checked and re-formed if necessary before being installed in equipment. The procedure should also be carried out before placing into service an equipment which has been out of use for a period exceeding four months.

CHOICE OF METHOD

5. The first three methods will all achieve satisfactory results and the choice may depend on the equipment available. Where bulk treatment of stores is necessary

a bus-bar version of method 1 could be made, capable of re-forming a number of similar capacitors at once, each via a separate resistor. Method 2 is intended only for checking small quantities of capacitors immediately before use on for capacitors already incorporated in equipment. Where a complete check of capacity and power factor is required in addition to re-forming and leakage testing, method 3 is preferable. Method 4 should only be used as a last resort.

Method 1 - The basic method

6. Apply to each capacitor a smoothed d.c. potential equal to its rated maximum peak voltage through a milliammeter and a series resistance of approximately 1.5K ohms (a suitable carbon filament lamp may be used.) Ensure that the polarity of the supply is in accordance with the terminal marking on the capacitor. Continue until the leakage current approaches a steady value within the limits quoted in para 14.

7. The time required to complete this process increases with capacitance and voltage but should not normally exceed 10 min. If the initial drop of current is slow and the capacitor shows little sign of re-forming within this time it should be rejected. Where the supply position makes it necessary to persevere with an old capacitor the process may be continued for an hour or more as necessary. If at any time the current starts to rise this indicates that the capacitor is overheating. The applied voltage should therefore be reduced or the series resistance increased, until the current falls again. After a while the voltage or resistance may be slowly restored to its original value, i.e. either the voltage or the additional resistance must be variable. If the leagage current cannot be brought within the required limits the capacitor must be rejected.

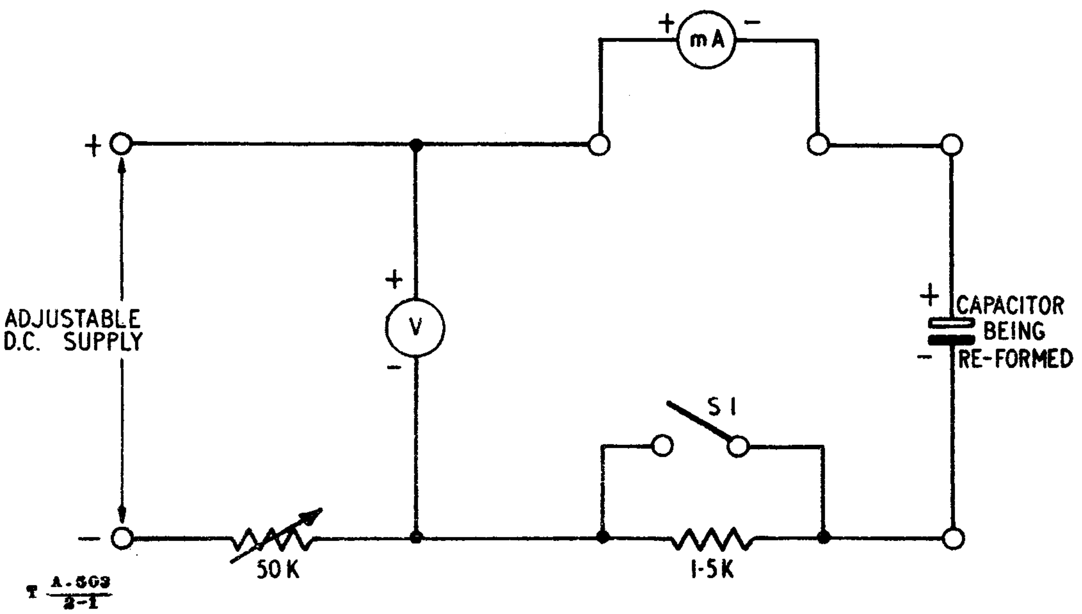

Fig 1 - Simple re-forming circuit

8. A suitable circuit is shown in Fig 1. The milliammeter should be an Avometer or similar instrument set initially to its highest d.c. current range. The switch S1 is included to facilitate measurement of the leakage current as detailed in para 14 and it should be left open throughout the re-forming process.

Method 2 - Re-forming Unit, Electrolytic Capacitor, No 1

9. This unit operates from 200/250V or 100/125V, 50 or 60c/s a.c. mains. It is designed to re-form capacitors of up to 5000μF and from 6 to 500V d.c. working. Its use is fully described in Tels W 611. See also para 13 below regarding measurement of leakage current.

Method 3 - Brdiges, Capacitance, Electrolytic, No 2

10. This unit operates from 200/250V a.c. mains only and can be used to reform capacitors of up to 2,200μF capacitance and up to 600V d.c. working. It will also carry out the leakage test detailed in para 14. Its use is described in Tels W 601.

Method 4 - Reforming in situ

11. Any of the above methods can be used for re-forming capacitors built into an equipment provided all wiring to the capacitor terminals is first disconnected. If none of the above apparatus can be obtained or improvised, the following method can be employed although the results may not be completely satisfactory.

12. Connect a 1.5K ohms resistor or suitable lamp in series with each electrolytic capacitor. Switch on the equipment in the normal way thus allowing the h.t. voltage to re-form all the capacitors.

MEASUREMENT OF LEAKAGE CURRENT

13. The leakage current of an electrolytic capacitor varies with capacitance, applied voltage and temperature and the acceptable limits in any given case must therefore be calculated. The following test can be carried out either with the circuit shown in Fig 1 or on Bridges, capacitance, electrolytic No 2. It cannot be carried out on the re-forming unit referred to in para. 9 since this does not provide for fine adjustment of the polarizing voltage. This unit can, however, measure leakage current at the rated working voltage of the capacitor and if the current thus indicated is still within the limits quoted then the capacitor is acceptable. Capacitors outside these limits should not necessarily be rejected unless tested as below.

14. Apply the full rated working voltage directly across the capacitor terminals. After 3 minutes reduce this by 10% and check that the leakage current does not exceed the limits given in Table 1.

Type of capacitor	Temperature conditions	Max permissible leakage current
Aluminium electrode capacitors, style CE.	(i) Up to 25°C	(i) 100μA or (0.15 x CV) μA whichever is the greater. Where C = capacitance in μF V = applied volts.
	(ii) For each 2°C increase above 25°C up to 55°C.	(ii) Add 5μF or (.01 x CV) μA whichever is the greater.

Type of capacitor	Temperature conditions	Max permissible leakage current
Tantalum electrode capacitors style CET II (Foil type)	(i) Up to 25°C (ii) At 85°C	(i) 1µF and above (.02 x CV) µA less than 1µF (.04 x CV) µA (ii) 1µF and above (0.4 x CV) µA less than 1µF (0.8 x CV) µA
Tantalum electrode capacitors style CET 12 (Pellet type)	(i) Up to 25°C (ii) at 125°C	(i) Not greater than 5µA (ii) Not greater than 150µA

Table 1 - Maximum permissible leakage current

EME8b/2170

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