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NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report on
Test of Modified Type CD-48432 Capacitors

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

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Date of Test: 14 February 1935 to 22 March 1935.
Submitted by: J. J. MacGregor, Assistant Radio Engineer.
Reviewed by: M. H. Schrenk, Associate Radio Engineer,
Chief of Section.
A. Hoyt Taylor, Physicist, Superintendent,
Radio Division.
Approved by: H. R. Greenlee, Captain, USN, Director.
Distribution:
BuEng. (5)

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4 APR 1975

NAVY DEPARTMENT
BUREAU OF NAVAL MEDICINE

Report on
Test of Modified Type 12-2425, 2426, 2427

BASED ON REPORTS FROM
NAVY MEDICAL CENTER
WASHINGTON, D.C.

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Table - 2	Table - 2	14 February 1975 to 23 March 1975	U.S. Department, various field stations	U.S. Department, various field stations
Table - 3	Table - 3	14 February 1975 to 23 March 1975	U.S. Department, various field stations	U.S. Department, various field stations
Table - 4	Table - 4	14 February 1975 to 23 March 1975	U.S. Department, various field stations	U.S. Department, various field stations
Table - 5	Table - 5	14 February 1975 to 23 March 1975	U.S. Department, various field stations	U.S. Department, various field stations
Table - 6	Table - 6	14 February 1975 to 23 March 1975	U.S. Department, various field stations	U.S. Department, various field stations
Table - 7	Table - 7	14 February 1975 to 23 March 1975	U.S. Department, various field stations	U.S. Department, various field stations

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AUTHORIZATION

1. This problem was authorized by Bureau of Engineering letter, reference (a). Other additional references pertinent to the problem are listed as references (b) and (c).

Reference: (a) BuEng. ltr. NOs-32109 (12-28-W8) of 3 January 1935.
(b) Specifications RE 13A 472A.
(c) Hygrade Sylvania Corp. Instruction Book on Model GO Equipment.

OBJECT OF TEST

2. The object of this test was to determine whether or not the modified type CD-48432 capacitors complied with Par. 1-1 and 2-29 of the specifications, reference (b), and to determine their suitability for use in the plate supply filter of Model GO equipment as Symbol C-2 of diagram C-250, D-6, page 15 of reference (c).

ABSTRACT OF TEST

3. One of the difficulties encountered in production models of the GO equipment was due to failure of the plate supply filter capacitors. Several modified models of this capacitor were submitted for test. They were compared with one of the former type, taken from a production Model GO equipment, for physical dimensions and the method of construction of the terminals. This was accomplished by cutting into and exposing a cross section of one terminal. The capacitors were placed in a chamber adapted for temperature and humidity control. Various values of voltage were applied across the terminals over long periods of time, at the conclusion of which the voltage was increased in an attempt to determine the breakdown voltage. Insulation resistance measurements were made before and after each test. Tests were conducted with Model GO equipment using a cathode ray oscillograph to determine the peak voltage developed across the filter capacitor.

Conclusions

(a) The type CD-48432 capacitors meet the requirements of the specifications, reference (b), and are considered suitable for use in the plate supply filter of the Model GO equipment.

(b) No change had been made in the physical dimensions and the electrical characteristics have been greatly improved.

(c) A transient causing a peak of 2900 volts is developed in the plate supply filter of the Model GO equipment when keying on full power.

(d) The maximum peak voltage developed across the plate supply filter of the Model GO equipment is 3600 volts when operating on full power. This peak voltage occurs when closing the power switch.

(e) Although the defects noted in this type of capacitor have been corrected, it could be further improved by retaining the original construction of the terminal but using a better grade of material.

Recommendations

(a) Since these capacitors meet the requirements of the specifications, reference (b), it is recommended that they be considered suitable for use in the plate supply filter of Model GO equipment or other Naval aircraft equipment requiring similar capacitors.

(b) It is recommended that in future equipment it be specified that capacitors have ample rating to withstand the maximum peak voltage developed in the circuits in which they are to be employed.

(c) To further improve the capacitor, it is recommended that the type of construction of the former terminal be retained, using a material of greater mechanical strength and insulating properties.

DESCRIPTION OF MATERIAL UNDER TEST

4. Six capacitors manufactured by the Cornell-Dubilier Corporation of New York City were used in making the test. They were of the type CD-48432 and rated as .5 mfd. and 2500 volts d.c., one of these capacitors having been made for the Navy Department (Bureau of Engineering) under contract No. 32109, in 1934. The other five are modified models to be used as replacements for the former. The modification consists of a type of terminal assembly intended to decrease the possibility of a breakdown between the terminal and the case.

METHOD OF TEST

5. For identification purposes the modified capacitors were numbered from one to five. They were measured to determine their compliance with the rating as stamped on the name plates. One of the terminals of No. 5 was disassembled to determine the method of construction. The physical dimensions were noted and compared with those of the former model.

6. Insulation resistance measurements were taken with a 1000 volt megger before and after each series of tests.

7. A chamber which was adapted for temperature and humidity control was used. A 100 watt lamp with a thermostat control adjusted to 50°C maintained the desired temperature. For humidity control two 125 watt immersion heaters were inserted in a large beaker of water which also contained several wicks so arranged as to distribute moisture uniformly about the chamber. A precision hygrometer was used to record the humidity. A high voltage test rectifier with a range of 450 - 50,000 volts was used to supply the potential for the tests. This rectifier is equipped with an induction voltage regulator so that any desired voltage within the range may be obtained.

8. The case of the capacitor as installed in the Model GO equipment is at a ground potential. For this reason one terminal of each capacitor was connected to the case so that the potential when applied would be effective from terminal to case as well as across the terminals.

9. The capacitors were placed in the chamber, the temperature and humidity brought to the desired values and a potential applied to the terminals. A number of tests were conducted. Each test was made at an increased voltage and over a period of several days. At the conclusion of these tests the voltage was gradually increased in an attempt to determine the breakdown voltage.

10. A cathode ray oscillograph was used to make photographic records of the transient voltage developed in the plate supply circuit of the Model GO equipment.

11. The following instruments were used in conducting the tests:

(a) General Radio capacity bridge, type 650-A, Serial No. 102.

- (b) Evershed 1000 volt megger, Serial No. 140670.
- (c) Weston voltmeter, d.c., Model 45, Serial No. 40640.
- (d) High voltage test rectifier.
- (e) G. Lufft precision hygrometer.
- (f) Standard thermometer.
- (g) Model GO transmitter.
- (h) General Radio Company electron oscillograph and sweep circuit, type 637-A, Serial No. 132.

DATA RECORDED DURING TEST

12. The following data were recorded during the tests:

- (a) Table of capacity measurements.
- (b) Table recording temperature, humidity, voltage and insulation resistance.
- (c) Diagrams showing the construction of the old and new type of terminal.
- (d) Photograph of exposed terminal of modified capacitor.
- (e) Oscillograms of transient voltage of Model GO equipment.

These tables and photographs form an appendix to this report.

DISCUSSION OF PROBABLE ERRORS

13. The accuracy of the measuring equipment used during the test, according to the manufacturer's guarantee, is as follows:

- (a) Capacity bridge $\pm 2\%$
- (b) Megger $\pm 10\%$
- (c) Voltmeter $\pm 1/2$ of 1%
- (d) Rectifier $\pm 2\%$
- (e) Hygrometer $\pm 10\%$

RESULTS OF TEST

14. An investigation of the old terminal revealed that the reason for the failure of the old terminal was that the shoulder of the inner insulating pillar, which is located just below the can cover, had cracked in several places. This was due to strain in tightening the machine screw which secures both inner and outer pillars in place and acts as a terminal of the capacitor. The can of the capacitor is at ground potential as used in the Model GO equipment. These cracks resulted in a greatly reduced path from the terminal to ground and it was between these points that the breakdown occurred. The capacity element in itself was not injured. This was determined by removing the can from ground and applying a potential across the terminals. In this condition the capacitor performed satisfactorily. The construction of the new terminal is such that there is less possibility of failure such as occurred in the old one. However, the construction of the old terminal is much superior if the material used is replaced

with another of greater mechanical strength and insulation properties. The method of construction of the old and the modified terminals is illustrated by the drawings on Plate 1 and the photograph, Plate 2, of the appendix.

15. The capacitors were all within 3 per cent of the nominal value as shown in Table 2. They were submitted to various potentials up to and including 8500 volts for a total of 106 hours without failure, as shown in Table 2. The potential was increased in an attempt to determine the breakdown voltage and at approximately 9200 volts four of the capacitors arced across the terminals; the fifth, capacitor No. 5, having had the insulation pillar removed from one terminal, thereby increasing the air gap, withstood a potential of 11,000 volts. There was no evidence of injury to any of the capacitors on completion of the tests.

16. One of the capacitors was installed as a replacement in a Model GO transmitter and after operation for several hours on full power showed no indication of failure.

17. An analysis of the photographic record of the cathode ray oscillograph shown in Plate 3 gives the following results. In the key up position the deflection produced by the plate voltage is $11/64$ " which corresponds to 2500 volts. With the key down the total deflection is $9/64$ " which corresponds to 2050 volts as measured by the voltmeter. Thus deflection of $1/64$ " is equal to a potential of approximately 225 volts. When the key is either open or closed, a transient appears which causes a peak deflection of $13/64$ " which indicates that the peak value of these keying transients is 2950 volts. When the plate switch is opened or closed a transient appears across the filter condenser which produces a deflection of $16/64$ " or 3600 volts. From this analysis it will be seen that the filter condenser must withstand transients having a peak value of 3600 volts.

18. The result of the test shows that the capacitors comply with the specifications, reference (b), and are considered satisfactory for use in the plate supply filter of the Model GO equipment.

CONCLUSIONS

19. The type CD-48432 capacitors meet the requirements of the specifications, reference (b), and are considered suitable for use in the plate supply filter of the Model GO equipment.

20. No change had been made in the physical dimensions and the electrical characteristics have been greatly improved.

21. A transient causing a peak of 2900 volts is developed in the plate supply filter of the Model GO equipment when keying on full power.

22. The maximum peak voltage developed across the plate supply filter of the Model GO equipment is 3600 volts when operating on full

power. This peak voltage occurs when closing the power switch.

23. Although the defects noted in this type of capacitor have been corrected, it could be further improved by retaining the original construction of the terminal but using a better grade of material.

TABLE 1

TEST RESULTS OF CAPACITORS

Serial No.	Initial Value	Final Value
101	1.00	1.00
102	1.00	1.00
103	1.00	1.00
104	1.00	1.00
105	1.00	1.00

TABLE 2

TEST RESULTS OF CAPACITORS

Serial No.	Initial Value	Final Value	Initial Value	Final Value	Serial No.	Initial Value	Final Value
101	1.00	1.00	1.00	1.00	101	1.00	1.00
102	1.00	1.00	1.00	1.00	102	1.00	1.00
103	1.00	1.00	1.00	1.00	103	1.00	1.00
104	1.00	1.00	1.00	1.00	104	1.00	1.00

TABLE 1

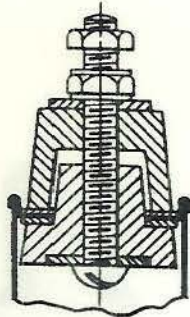
CAPACITY MEASUREMENTS

<u>Capacitor</u>	<u>Rated Capacity</u>	<u>Measured Capacity</u>
No. 1	.5 mfd.	.490 mfd.
No. 2	.5 mfd.	.485 mfd.
No. 3	.5 mfd.	.490 mfd.
No. 4	.5 mfd.	.490 mfd.
No. 5	.5 mfd.	.485 mfd.

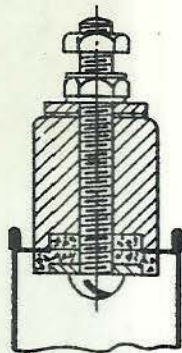
TABLE 2

TIME RECORD OF VOLTAGE TESTS

<u>Hours</u>	<u>Volts</u>	<u>Temperature</u>	<u>Humidity</u>	<u>Insulation Resistance</u>	
				<u>Before Test</u>	<u>After Test</u>
35	3000	50°C	85%	2000+	2000+
63	5000	50°C	85%	2000+	2000+
8	6750	50°C	85%	2000+	2000+
5 Min.	8500	50°C	85%	2000+	2000+



OLD TERMINAL



NEW TERMINAL

8781

PLATE I

PLATE 2



1379

PLATE 1

PLATE 2

FIG. 1-KEY DOWN

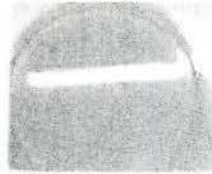


FIG. 2-KEY UP

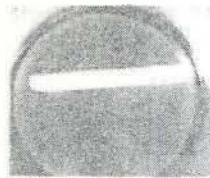


FIG. 3-PLATE SWITCH ON

