

NATIONAL AIRCRAFT STANDARDS COMMITTEE

AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, INC., 610 SHOREHAM BUILDING, WASHINGTON 5, D. C.

SPECIFICATION

CAPACITORS, FIXED, ROLLED FOIL, MINIATURE

1. SCOPE AND CLASSIFICATION

- 1.1 Scope - This specification covers fixed, hermetically sealed capacitors of the rolled foil type with wire lead terminals for operation in ambient temperatures up to 125°C. The sizes shall be as shown in the attached drawings.
- 1.2 Classification - Capacitors shall be furnished in the following characteristic and grade.
- 1.2.1 Characteristic - Capacitors covered by this specification shall be of one characteristic capable of operation at ambient temperature from -55°C to 125°C. Maximum change in capacitance with temperature referred to 25°C shall be 10 percent at -55°C and ±5 percent at 125°C.
- 1.2.2 Grade - All capacitors shall be of one grade capable of meeting the humidity and moisture resistance requirements specified herein.
- 1.3 Type Designation - The type designation shall be in the following form:
- | ACF | 10 | N | 1 | F | 102 | J |
|-----------|------|--------------|---------|---------|-------------|-----------|
| Component | Case | Construction | Circuit | Voltage | Capacitance | Tolerance |
- 1.3.1 Component Designation - Fixed capacitors of the rolled foil variety are identified by the symbol ACF.
- 1.3.2 Case Designation - The case designation is a two digit symbol which appears on the attached detailed figures and identifies a particular family of case sizes and shapes.
- 1.3.3 Construction - The construction shall consist of either extended foil or tab and is identified by a single letter "N" for extended foil and "T" for inserted tab construction.
- 1.3.4 Circuit - The number of terminals and circuit diagrams are identified by a single digit as indicated in Table I.

TABLE I

Digit	Number of Terminals	Circuit	Notes
1	2	1 ○ — — ○ 2	Both ends insulated.
2	1	1 ○ — —	One end grounded. No lead on grounded end.
3	2	1 ○ — — ● —○ 2 	One end grounded with two leads.

- 1.3.5 Voltage - The direct working voltage rating over the specified temperature range is identified by a single letter as indicated in Table II.

TABLE II

Voltage Designation Letter	Direct Working Voltage Rating
C	100
E	200
F	400
G	600
O	1000

- 1.3.6 Capacitance - The nominal capacitance value in micromicrofarads is identified by a three digit number. The first two digits represent the significant figures of the capacitance value and the last digit specifies the number of zeros to follow.
- 1.3.7 Capacitance Tolerance - The capacitance tolerance in percent is identified by a letter as indicated in Table III.

TABLE III Capacitance Tolerance

Tolerance Designation Letter	Tolerance
J	± 5%
K	± 10%
M	± 20%

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2. **APPLICABLE SPECIFICATIONS.** The following specifications of the latest issue form a part of this specification.
- ARMY - NAVY AERONAUTICAL STANDARD DRAWINGS; AND 10398 - Metals, Definition of Dissimilar.
- QQ-M-151a Metals; General Specification for Inspection of.
- ASTM-D92-46 Standard Method of Test for Flash and Fire Points by means of Open Cup.
3. **GENERAL REQUIREMENTS**
- 3.1 **Materials** - The materials used in the units covered by this specification shall be as noted herein. A suitable material shall be used when a definite material is not specified. (Acceptance or approval of a constituent material shall not be construed as a guarantee of the acceptance of the finished product.)
- 3.1.1 **Use of Ferrous Material** - The use of ferrous materials for current carrying parts may be permitted subject to conditions stated on order or drawing. NOTE: Non-ferrous materials may be specified by purchaser. Cases shall be of a material or properly plated to be compatible with both aluminum and steel in accordance with the definition for dissimilar metals as defined by AN Aeronautical Standard drawing AND 10398.
- 3.1.2 **Wire Leads** - Wire leads shall be hot solder dipped or electro-solder plated.
- 3.1.3 **Enclosure** - Each capacitor shall be enclosed in a hermetically sealed case which shall protect the capacitor element from moisture and mechanical damage under all applicable test conditions included in this specification.
- 3.1.4 **Impregnating and Filling Compounds** - Compounds used in the impregnation and filling of capacitors shall be chemically inactive with respect to the capacitor element and enclosure. The compound, either in the state of original application or as a result of having aged, shall have no adverse effect on the performance of the capacitor.
- 3.1.4.1 The flash point of the impregnating compound shall be greater than 145°C., to be checked in accordance with ASTM Specification D92-46 or other suitable means.
- 3.2 **Marking** - Where space permits, each capacitor shall be legibly marked with the capacitor manufacturer's name or symbol, the type designation, the capacitance in microfarads, and the rated direct working voltage. Capacitors which do not provide sufficient space for this information may be marked with the capacitor manufacturer's name or symbol and the type designation. In practice there shall be no space between the groups of letters and figures which comprise the type designation. If the lack of space necessitates, the designation may be set in two lines. The marking should remain legible through the qualification tests.
4. **METHODS AND SAMPLING, INSPECTION AND TESTS**
- 4.1 **Classification of Tests** - The methods of sampling, inspection, and tests conducted upon fixed rolled foil capacitors shall be classified as follows:
- 4.1.1 **Qualification (type or brand approval) Tests** - (Test to be performed at a facility mutually agreed upon by manufacturer and user.)
- 4.1.2 **Inspection Tests** - (At place of manufacturer)
- 4.2 **Standard Test Conditions** - Unless otherwise specified herein, all measurements shall be made at a room temperature of 30°C ± 10°C at a barometric pressure between 28 and 32 inches of mercury and at a relative humidity of less than 80 %.
- 4.3 **Test Equipment and Inspection Facilities for Inspection and Acceptance Tests** - The capacitor manufacturer shall furnish and maintain all necessary facilities and equipment for making all tests. The test equipment shall be adequate in quantity to enable the inspector to keep up with production. The test equipment shall be of sufficient accuracy and quality to permit performance of the required test. Wherever practical, inspection of capacitors shall be at point of manufacture.
- 4.4 **Qualification (type or brand approval) Tests** - Qualification (type or brand approval) tests shall be made on a sample quantity to insure that the basic design produces capacitors meeting all the requirements of this specification.
- 4.4.1 **Number of Samples** - 48 samples of the smallest case size and highest voltage rating are to be submitted for tests. In addition, 12 samples of the highest capacity value of each case size shall be submitted to tests specified in Table IV.

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4. METHODS AND SAMPLING, INSPECTION AND TESTS (Cont)

4.4.2 Outline of Tests -

4.4.2.1 Qualification Tests - Tests shall be conducted in the order in which they are listed in Table IV.

TABLE IV

Test	Test Group I - All Samples (60)	Number of Failures Permitted
Visual Inspection (4.4.3)		0
Insulation Resistance (4.4.4)		0
Capacitance (4.4.5)		0
Dissipation Factor (4.4.6)		0
Voltage Breakdown (4.4.7)		0
<u>Test Group II - 25% of Samples (15)</u>		
Vibration (4.4.8)		0
Salt Spray (4.4.9)		0
Temperature and Immersion Cycling (4.4.10)		1*
<u>Test Group III - 25% of Samples (15)</u>		
Moisture Resistance (4.4.11)		1*
<u>Test Group IV - 50% of Samples (30)</u>		
Capacitance Change (4.4.12)		0
Low Temperature (4.4.13)		0
Life (4.4.14)		1

Note 1* ONLY ONE FAILURE WILL BE ALLOWED IN GROUPS II AND III COMBINED

- 4.4.2.2 Failure - If the number of failures exceeds that allowed, a second set of samples shall be tested (such samples shall be accompanied by a description of the changes incorporated in the new sample to overcome the failure of the preceding ones.)
- 4.4.3 Visual Inspection - Capacitors shall be inspected to verify that their dimensions are within the limits as shown on the applicable figure and that the marking, workmanship and seal are satisfactory.
- 4.4.4 Insulation Resistance - Insulation resistance shall be measured by megohm bridge, megger, or other approved method at a potential of 100 volts with an elctrification time of one (1) minute. Measurements are taken at temperatures of 25°C and 125°C.
- 4.4.4.1 Terminal to Terminal - Insulation resistance shall be measured between terminals at the high test temperature and at 25°C. The insulation resistance expressed in megohms - microfarads shall not be less than 4,000 at 25°C except that no capacitor need exceed 10,000 megohms. All units shall have an insulation resistance of not less than 10 megohm - microfarads at 125°C except that no capacitor need exceed 100 megohms.
- 4.4.4.2 Terminals to Case - Where the case is not a terminal, the measurement of insulation resistance shall be made between each terminal and the case. This insulation resistance shall be greater than 5,000 megohms at 25°C and 100 megohms at 125°C.
- 4.4.5 Capacitance - Capacitance shall be measured by a suitable method providing an accuracy to within 2%. Measurements shall be made at 1000 cycles per second.
- 4.4.6 Dissipation Factor - Dissipation factor shall be measured at room ambient at a voltage not greater than 20% of the rated direct voltage. Measurements shall be made at 1000 cycles per second and the dissipation factor shall not exceed 1%.
- 4.4.7 Voltage Breakdown -
- 4.4.7.1 Terminal to Terminal - Each capacitor shall withstand for a period of 1 minute, without breakdown or flashover a voltage application between terminals equal to 2X the rated direct voltage. The capacitors shall be charged and discharged through a resistance sufficient to limit the current to an initial minimum of 5 milliamperes and a maximum of 1 ampere. For production tests 2X rated direct voltage for 15 seconds or 2.5 times rated direct voltage for not less than 1 second.

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4. METHODS AND SAMPLING, INSPECTION AND TESTS (Cont)

- 4.4.7.2 Terminal to Case - Each capacitor, no terminal of which is connected to the case, shall withstand, for at least 1 minute without breakdown or flashover a voltage application between all the terminals connected together and the case. The voltage application shall be 2X rated direct voltage.
- 4.4.7.3 Reduced Pressure - Each capacitor shall withstand for at least one minute, without breakdown, flashover, harmful deformation of case, or leakage of impregnant, an application of 125 percent of rated direct voltage at a barometric pressure of 3.4 inches of mercury, applied in turn between each terminal and every other terminal and between the case and each terminal not connected to the case.
- 4.4.8 Vibration -
- 4.4.8.1 Mounting - Capacitors weighing less than 1/2 ounce shall be mounted and soldered to rigidly supported terminals so spaced that the length of each lead from the capacitor shall be approximately 5/8 inch when measured from the edge of the supporting terminal. Capacitors weighing more than 1/2 ounce shall be mounted with brackets, clips, or clamps, and shall not be supported by their leads. All capacitors shall be subjected to a harmonic motion having an amplitude of .03 inch (maximum total excursion of .06 inch), the frequency being varied uniformly between the approximate limits of 10 and 55 cycles per second. The entire range of frequencies from 10 to 55 cycles and return to 10 cycles shall be traversed in approximately 1 minute. This motion shall be applied for a total period of 3 hours.
- 4.4.8.2 The capacitors, mounted as above, shall be subjected to vibration in the range of from 55 to 500 cycles per second with the amplitude varied so as to subject the capacitor to a constant acceleration of 10g units. The range of frequencies from 55 to 500 and back to 55 cycles per second shall be uniformly traversed in approximately 15 minutes. This motion shall be applied perpendicular to the axis of the capacitor for a total period of one hour.
- 4.4.9 Salt Spray - Capacitors shall be subjected to 100 hours of the salt spray (fog) test in accordance with specification Q9-M-151a. Capacitors and brackets shall then be washed in tap water to remove water soluble stains. There shall be no harmful or extensive corrosion, and at least 90 percent of any exposed metallic surfaces of the capacitor or bracket shall be protected by the finish. The marking shall remain legible.
- 4.4.10 Temperature and Immersion Test - Each capacitor shall be exposed to five of the temperature cycles listed below:

Degrees - Centigrade

Start at	25 ± 5
To	- 55
To	25 ± 5
To	125 - 0 / 5
To	25 ± 5

The air within the conditioning chamber shall be circulated. The temperature within the cold chamber shall be in accordance with the chart above. The rate of change of temperature within the conditioning chamber shall be at least 2°C per minute, or the capacitors may be transferred from one chamber to another, in which case they shall be held at the minimum and maximum ambient temperature for at least 15 minutes and at a room temperature for no more than 15 minutes. When in the heat chamber, the capacitors shall be placed on absorbent paper to check the possibility of oil leakage. The temperature cycling shall be followed by 2 cycles of 15 minute immersions in tap water at 65°C and 20°C (149 and 68°F) or lower. The elapsed time between the removal of the capacitors from the immersion tank and the measurements shall not exceed 30 minutes. Surface moisture shall be removed by circulating air at room temperature, wiping with a clean, dry cloth, or both.

The capacitors shall then meet the following requirements:

Insulation Resistance Terminal to Terminal as specified in Paragraph 4.4.4.1
 Insulation Resistance Terminal to Case as specified in Paragraph 4.4.4.2
 Voltage Breakdown as specified in Paragraphs 4.4.7.1 and 4.4.7.2

- 4.4.11 Moisture Resistance - The moisture resistance test shall be performed in accordance with Figure 1 and Paragraph 4.4.11.1 to 4.4.11.4 inclusive.
- 4.4.11.1 Subcycle - During step 7, at least 1 hour but not more than 4 hours after step 7 begins, the capacitors shall be removed from the humidity chamber for performance of steps 7a and 7b, after which the capacitors shall be returned to the humidity chamber and kept there until the next cycle begins. A total of five subcycles shall be performed. Except for the length of the test, the vibration shall be conducted as specified in Paragraph 4.4.8.

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