INCH-POUND
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SUPERSEDING
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PERFORMANCE SPECIFICATION

CAPACITOR, FIXED, GLASS DIELECTRIC, GENERAL SPECIFICATION FOR

Inactive for new design after November 15, 2016

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for, glass dielectric, fixed capacitors able to operate satisfactorily in military systems.

1.2 Classification. Capacitors covered by this specification are classified by the style, as specified (see 3.1).

1.2.1 Part or Identifying Number (PIN). Capacitors covered by this specification are identified by a PIN as shown in the following example:

M23269	/01	-	1001
Performance specification number	Specification slash sheet number		Non-significant dash number (see 3.1)

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-23269/1 - Capacitor, Fixed, Glass Dielectric, (Axial Wire-Lead Terminals), , Style CYR10.
MIL-PRF-23269/2 - Capacitor, Fixed, Glass Dielectric, (Axial Wire-Lead Terminals),-, Style CYR15.
MIL-PRF-23269/10 - Capacitor, Fixed, Glass Dielectric, (Radial or Wire-Lead Terminals), Styles CYR51, CYR52, and CYR53.

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, ATTN: VAT, Post Office Box 3990, Columbus, OH 43218-3990 or e-mailed to capacitorfilter@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil/.

AMSC N/A

FSC 5910

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202	-	Electronic and Electrical Component Parts.
MIL-STD-202-101	-	Salt Atmosphere (Corrosion).
MIL-STD-202-105	-	Barometric Pressure (Reduced).
MIL-STD-202-106	-	Moisture Resistance.
MIL-STD-202-107	-	Thermal Shock.
MIL-STD-202-108	-	Life (At Elevated Ambient Temperature).
MIL-STD-202-204	-	Vibration, High Frequency.
MIL-STD-202-208	-	Solderability.
MIL-STD-202-210	-	Resistance to Soldering Heat.
MIL-STD-202-211	-	Terminal Strength.
MIL-STD-202-213	-	Shock (Specified Pulse).
MIL-STD-202-215	-	Resistance to Solvents.
MIL-STD-202-302	-	Insulation Resistance.
MIL-STD-202-305	-	Capacitance.
MIL-STD-202-306	-	Quality Factor (Q).
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests.
MIL-STD-1276	-	Leads for Electronic Component Parts.
MIL-STD-1285	-	Marking of Electrical and Electronic Parts

(Copies of these documents are available on line at http://quicksearch.dla.mil/.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

ISO 10012	-	Measurement Management Systems – Requirements for Measurement Processes and Measuring Equipment – First Edition.

(Copies of this document may be ordered online at http://www.iso.org or from the International Organization for Standardization American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036).

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL)

NCSL Z540.3	-	Requirements for the Calibration of Measuring and Test Equipment.

(Copies of this document may be ordered online at http://www.ncsli.org or from National Conference of Standards Laboratories (NCSL), 5766 Central Avenue, Suite 150, Boulder, Colorado 80301)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.2 and 6.3), a sample shall be subjected to first article inspection in accordance with 4.4.

3.4 Materials. The material shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the capacitors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4.1 Solder. Solder for electrical connections shall be selected to meet the requirements of this specification. In no case shall the solder start to melt at a temperature of less than 200°C.

3.4.2 Soldering flux. The use of materials that leave potentially corrosive residues should be avoided. Where such materials must be used to ensure the satisfactory performance of a process, all potentially corrosive residues must be neutralized and removed to prevent deterioration of the capacitor from the occurrence of related corrosion in application.

3.5 Interface and physical dimension requirements. Capacitors shall meet the interface and physical dimensions specified (see 3.1).

3.5.1 Terminals.

3.5.1.1 Lead terminals. Lead terminals shall be C, D, N, or W in accordance with MIL-STD-1276. Final finish is the option of the manufacturer.

3.5.2 Solder dip (retinning leads). Only the manufacturer (or their authorized category B distributor) may solder dip/retin the leads of the product supplied to this specification provided the solder dip process has been approved by the acquiring activity as follows:

a. As a corrective action if the lot fails the group A solderability test.

b. After the group A screening test. Following any solder dip or retinning process, the seal, insulation resistance, capacitance, and dissipation factor measurements shall be performed on 100 percent of the lot. The defective allowable (PDA) shall be the same as the group A, subgroup 1. Following these tests, the manufacturer shall submit the lot to the group A solderability test.

3.5.2.1 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of capacitor components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.5).

3.5.3 Case. Each capacitor shall be enclosed in a suitable case which will protect the capacitor element against the entry of contaminants.

3.5.4 Connections. Electrical connections shall not depend upon the terminals being clamped between a metallic member and an insulating material other than the glass material.

3.6 Seal.

3.6.1 Test I (for transparent cases). When capacitors are tested as specified in 4.6.2.1, there shall be no evidence of dye extending into the active element.

3.6.2 Test II (for opaque cases). When capacitors are tested as specified in 4.6.2.2, the insulation resistance shall be not less than the value specified (see 3.1).

3.7 High voltage stabilization. When capacitors are tested as specified in 4.6.3, there shall be no evidence of damage, arcing, or breakdown.

3.8 Insulation resistance. When measured as specified in 4.6.4, the insulation resistance shall be not less than the value specified (see 3.1).

3.9 Capacitance. When measured as specified in 4.6.5, the capacitance shall be within the applicable tolerance of the nominal value specified (see 3.1).

3.10 Dissipation factor. When measured as specified in 4.6.6, the dissipation factor shall not exceed the value specified (see 3.1).

3.11 Thermal shock. When tested as specified in 4.6.7, there shall be no short-circuiting and capacitors shall meet the following requirements:

a.	Insulation resistance:	Shall be not less than 100,000 megohms.
b.	Capacitance:	Shall change not more than 0.5 percent of the nominal value or 0.5 pF, whichever is greater, from the initial value obtained when measured as specified in 4.6.5.
c.	Dissipation factor:	Shall not exceed the value specified.
d.	Visual examination:	There shall be no evidence of corrosion or mechanical damage.

3.12 Quality factor (Q). Unless otherwise specified (see 3.1) the Q shall be not less than the value shown on figure 1 when measured as specified in 4.6.8.

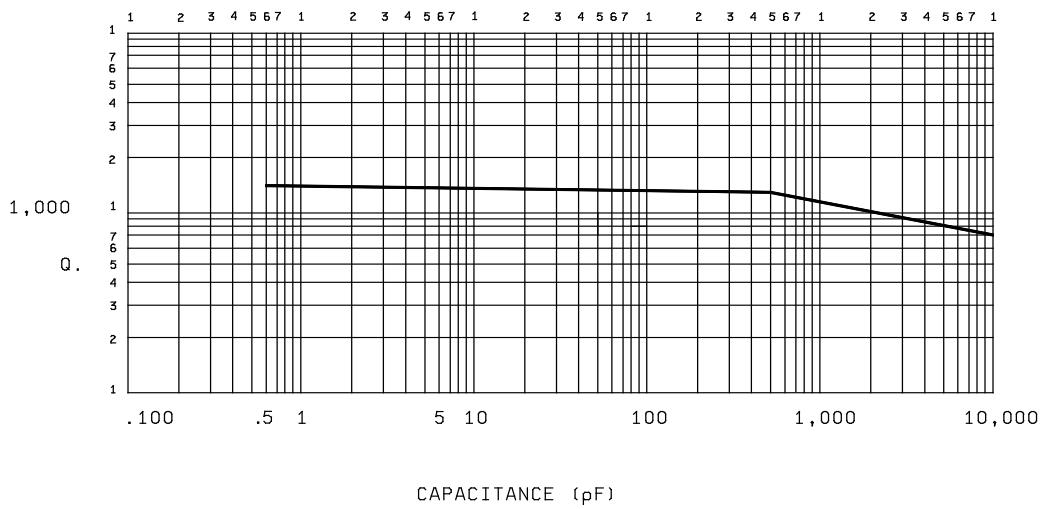

FIGURE 1. Quality factor (Q) at 1 MHz.

3.13 Shock, specified pulse. When capacitors are tested as specified in 4.6.9, there shall be no intermittent contacts of 0.5 millisecond (ms) or greater duration, open-circuiting or short-circuiting, or evidence of arcing or mechanical damage.

3.14 Vibration, high frequency. When capacitors are tested as specified in 4.6.10, there shall be no intermittent contacts of 0.5 ms or greater duration, open-circuiting or short-circuiting, or evidence of mechanical damage.

3.15 Solderability. When capacitors are tested as specified in 4.6.11, the dipped portion of the terminals shall conform to the solid-wire termination criteria of MIL-STD-202-208.

3.16 Terminal strength. When capacitors are tested as specified in 4.6.12, there shall be no loosening or rupturing of the terminals, and no damage to the terminals or seal.

3.17 Barometric pressure. When capacitors are tested as specified in 4.6.13, there shall be no evidence of damage, arcing, or breakdown.

3.18 Temperature coefficient and capacitance drift. When measured as specified in 4.6.14, the temperature coefficient and capacitance drift shall be as specified (see 3.1).

3.19 Salt atmosphere. When capacitors are tested as specified in 4.6.15, there shall be no harmful corrosion or mechanical damage, and the marking shall remain legible.

NOTE: Harmful corrosion shall be construed as being any type of corrosion which in any way interferes with the mechanical or electrical performance of the capacitor.)

3.20 Fungus. The manufacturer shall certify that all external materials are fungus resistant or shall perform the test specified in 4.6.16. When tested as specified in 4.6.16, there shall be no evidence of fungus growth on the external surface of the capacitor.

3.21 Resistance to solvents. When capacitors are tested as specified in 4.6.17, there shall be no evidence of mechanical damage, and the marking shall remain legible.

a. Insulation resistance: Shall be not less than the initial requirement.

b. Capacitance: Shall change not more than 0.5 percent of nominal value or 0.5 pF, whichever is greater, from the initial value obtained when measured as specified in 4.6.5.

c. Dissipation factor: Shall not exceed the initial requirement.

d. Visual examination: There shall be no evidence of mechanical damage.

3.22 Resistance to soldering heat. When tested as specified in 4.6.18, capacitors shall meet the following requirements:

a. Insulation resistance: Shall be not less than the initial requirement.

b. Capacitance: Shall change not more than 0.5 percent of nominal value or 0.5 pF, whichever is greater, from the initial value obtained when measured as specified in 4.6.5.

c. Dissipation factor: Shall not exceed the initial requirement.

d. Visual examination: There shall be no evidence of mechanical damage

3.23 Moisture resistance. When tested as specified in 4.6.19, capacitors shall meet the following requirements:

a. Visual examination: No mechanical damage. Marking shall remain legible.

b. Insulation resistance: Unless otherwise specified (see 3.1), not less than 10 percent of the initial 25°C requirement.

c. Capacitance: Unless otherwise specified (see 3.1), change not to exceed ±10 percent from initial measured value.

3.24 Life. When tested as specified in 4.6.20, capacitors shall meet the following requirements, as applicable.

3.24.1 1,000 hour (first article inspection) (see 4.6.20.1).

a.	Insulation resistance:	Shall be not less than the initial requirement.
b.	Capacitance:	Shall change not more than the percent specified (see 3.1) of nominal value or 0.5 pF, whichever is greater, from the initial value obtained when measured as specified in 4.6.5.
c.	Dissipation factor:	Shall not exceed the value specified (see 3.1).
d.	Visual examination:	There shall be no evidence of mechanical damage.

3.25 Marking. Capacitors shall be permanently marked with the Part or Identifying Number (PIN), date code, lot symbol, and manufacturer's source code in accordance with MIL-STD-1285 (see 3.1). Paper labels shall not be used. Each capacitor shall be legibly marked using smear-resistance ink which will withstand the environmental conditions specified herein. Marking shall remain legible after all tests. Manufacturing records shall include these same date codes and lot symbols. The date code, lot symbol, source code, capacitance, capacitance tolerance, and rated voltage shall be marked on the unit package. The nominal capacitance value, expressed in pF, is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow. When fractional values of a pF or values of less than 10 pF are required, the letter "R" shall be used to indicate the decimal point and the succeeding digits or the group shall represent significant figures. Example: 1R5 indicates 1.5 pF.

3.25.1 Substitutability of capacitance tolerance and rated voltages. Parts marked to tighter capacitance tolerance or higher rated voltage, with acquiring agency approval, are substitutable for parts marked to looser capacitance tolerance or lower rated voltage, provided all other values, such as case size, characteristic, and leads are the same. The substitutable parts shall not be remarked unless specified in the contract or order (see 6.2).
In the event the capacitance tolerance or voltage rating is remarked, the lot date codes on the parts shall not be changed and the workmanship criteria shall be met.

3.25.2 Full marking. Unless otherwise specified (see 3.1), capacitors shall be marked with the, PIN (see 1.2.1), date code and lot number, manufacturer's name (not trademark) or the Commercial and Government Entity (CAGE) code, voltage, capacitance, and capacitance tolerance. There shall be no space between the symbols which comprise the PIN. The date code and lot number shall consist of the year, week, and lot code. For example: The third week of 1984 would be 8403.

3.26 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.27 Workmanship. Capacitors shall be processed in such a manner as to be uniform in quality and shall be free from pits, corrosion, cracks, rough edges, and other defects which will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.4).

b. Conformance inspection (see 4.5).

4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI/NCSL Z540.3, ISO 10012-1 or approved equivalent.

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the “GENERAL REQUIREMENTS” of MIL-STD-202.

4.3.1 Accuracy of test voltage measurements. Accuracy of all test voltage measurements shall be ±2.0 percent of the specified voltage.

4.3.2 Referenced measurements. When requirements are based on comparative measurements made before and after conditioning, the reference measurements shall be considered the last measurement made at 25°C ±3°C prior to conditioning. Unless reference measurements have been made within 30 days prior to the beginning of conditioning, they shall be repeated.

4.3.3 Power supply. The power supply used for life testing shall have a regulation of ±2.0 percent or less of the specified test voltage.

4.4. First article inspection. First article inspection shall be performed at a laboratory acceptable to the Government(see 6.3) on sample units which have been produced with equipment and procedures normally used in production.

4.4.1 Sample size. The number of capacitors to be subjected to-the first article-inspection shall be 85 units of each type.

4.4.2 Inspection routine. The sample shall be subjected to the inspection specified in table III, in the order shown. All sample units shall be subjected to the inspection of group I and group II. The sample units shall then be divided as specified in table III for group III to group VI inclusive, and subjected to the inspections for their particular groups; one group shall be subjected to the Life (rated condition).

4.4.3 Failures. Failures in excess of those allowed in table III shall be cause for refusal to grant first article approval.

TABLE III. First article inspection.

Examination or test	Requirement paragraph	Test method paragraph	Number of sample units to be inspected		Number of failures allowed 1/
Group I					
Seal	3.6	4.6.2	85		0
High voltage stabilization	3.7	4.6.3			
Group II					
Visual and mechanical examination (external) 2/ 3/	3.1, 3.4, 3.5, 3.25, and 3.27	4.6.1	85 4/		1
Insulation resistance (at 125°C and 25°C)	3.8	4.6.4			
Capacitance	3.9	4.6.5			
Dissipation factor	3.10	4.6.6			
Group III					
Thermal shock	3.11	4.6.7	12		1
Quality factor (Q)	3.12	4.6.8			
Shock, specified pulse	3.13	4.6.9			
Vibration, high frequency	3.14	4.6.10			
Group IV					
Solderability	3.15	4.6.11	12		1
Terminal strength	3.16	4.6.12			
Barometric pressure	3.17	4.6.13			
Temperature coefficient and capacitance drift	3.18	4.6.14			
Salt atmosphere	3.19	4.6.15			
Group V					
Fungus 5/	3.20	4.6.16	5	10	1
Resistance to solvents	3.21	4.6.17	5		
Resistance to soldering heat	3.22	4.6.18			
Moisture resistance	3.23	4.6.19			
Group VI					
Life (rated condition)	3.24.1	4.6.20.1	50		1

1/ A specimen having one or more defects shall be considered as a single failure.
2/ Nondestructive tests.
3/ Marking defects are based on visual examination only and shall be charged only for illegible, incomplete, or incorrect marking.
4/ One additional sample unit is included in each sample of 85 sample units to permit substitution for the failure allowed in group II.
5/ Certification of fungus resistance may be substituted for testing.

4.5 Conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection.

4.5.1.1 Production lot. A production lot shall consist of all capacitors of the same style, voltage rating, nominal capacitance value, voltage temperature characteristic, and termination finish. Manufacture of all parts in the lot shall have been started, processed, assembled, and tested as a group. Lot identity shall be maintained throughout the manufacturing cycle.

4.5.1.2 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table IV, in the order shown.

4.5.1.2.1 Subgroup 1 tests. The subgroup 1 tests shall be performed on a production lot basis on 100 percent of the product supplied under this specification. Capacitors failing the tests of subgroup 1 shall be removed from the lot. If, during the 100 percent inspection, screening requires more than 5 percent of the capacitors to be discarded, the entire production lot shall be rejected.

TABLE IV. Group A inspection.

Examination or test	Requirement paragraph	Test method paragraph	Sample	Lot criteria
Subgroup 1				
Seal	3.6	4.6.2	100% inspection	
High voltage stabilization	3.7	4.6.3		
Insulation resistance (at 25°C)	3.8	4.6.4		
Capacitance	3.9	4.6.5		
Dissipation factor	3.10	4.6.6		
Thermal shock (styles CYR51, CYR52, and CYR53 only)	3.11	4.6.7		
Subgroup 2 1/				
Visual and mechanical examination				
Materials	3.4	4.6.1	13	0 failures
Physical dimensions	3.1	4.6.1		
Design and construction (other than physical dimensions)	3.5	4.6.1		
Marking 2/	3.25	4.6.1		
Workmanship	3.27	4.6.1		
Subgroup 3 3/				
Solderability	3.15	4.6.11	5	0 failures

1/ The manufacturer may request the deletion of the subgroup 2, visual and mechanical examination, provided an in-line or process control system for assessing and assuring the visual and mechanical requirements are met, can be validated and approved by the acquiring activity. Deletion of this examination does not relieve the manufacturer from meeting these requirements.
2/ Marking defects are based on visual inspection only.
3/ The manufacturer may request the deletion of the subgroup 3 solderability test, provided an in-line or process control system for assessing and assuring the solderability of leads can be validated and approved by the acquiring activity. Deletion of the test does not relieve the manufacturer from meeting this test requirement.

4.5.1.2.2 Manufacturer's production inspection. If the manufacturer performs tests equal to or more stringent than those specified in subgroup 1, table IV, as the final step of their production process, group A, subgroup 1 inspection may be waived. Authority to waive the subgroup 1 inspections shall be granted by the acquiring activity only. The following criteria must be complied with:

a. Tests conducted by the manufacturer during production shall be clearly identical to or more stringent than that specified for subgroup 1.

b. Manufacturer subjects 100 percent of the product supplied under this specification to their production tests.

c. The parameters measured and the failure criteria shall be the same or more stringent than those specified herein.

d. The lot rejection criteria is the same or more stringent than that specified herein.

e. Once approved, the manufacturer shall not change the test procedures or criteria without prior notification and concurrence by the acquiring activity.

4.5.1.2.3 Rejected lots. Production lots exceeding the 5 percent PDA of group A, subgroup 1 inspection shall be segregated from new lots that have passed inspection. Lots rejected may be offered for acceptance only if the manufacturer 100 percent retests to the requirements of subgroup 1. Resubmitted lots shall be kept separate and shall be clearly identified as resubmitted lots. If, during the 100 percent re-inspection to subgroup 1, the lot exceeds 3 percent defective, the lot shall be rejected and shall not be resubmitted.

4.5.1.2.4 Subgroup 2 tests.

4.5.1.2.5 Subgroup 2 tests. Subgroup 2 tests shall be performed on production lot basis. A sample of 13 parts shall be randomly selected. If one or more defects are found, the lot shall be 100 percent screened for that defect. A new sample shall then be randomly selected. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.5.1.2.6 Subgroup 3 tests (solderability).

4.5.1.2.6.1 Sampling plan. Five samples shall be selected randomly from each production lot and subjected to the solderability test. The manufacturer may use electrical rejects from the subgroup 1 screening tests for all or part of the samples to be used for solderability testing. If there are one or more defects, the lot shall be considered to have failed.

4.5.1.2.6.2 Rejected lots. In the event of one or more defects, the production lot shall be rejected. The manufacturer may rework the lot as follows: Each production lot shall be individually submitted to the solderability test as required in 4.6.11. Production lots that pass the solderability test are available for shipment. Production lots failing the solderability test can be reworked only if submitted to the solder dip procedure based on one of the following options:

a. When the original lead finish first article approve was hot solder dip lead finish 52 in accordance with MIL-STD-1276, the manufacturer shall use the same solder dip process for retinning as is used in the original manufacture of the capacitor. (NOTE: The 200 microinches maximum thickness requirement is not applicable.)

b. When the lead finish originally first article approved was not hot solder dip lead finish 52 of MIL-STD-1276 as prescribed in 4.5.1.2.6.2a, approval for the process to be used for solder dip shall be based on the following procedure:

(1) Thirty samples of any capacitance value for each style and lead finish shall be subjected to the manufacturer's solder dip process. Following the solder dip process, the capacitors shall then be subjected to all group A, subgroup 1 post-electric tests, with no defects allowed.

(2) Ten of the 30 samples shall then be subjected to the solderability test, with no defects allowed.

(3) The remaining 20 samples shall be subjected to the resistance to soldering heat test, followed by the moisture resistance test (or hermetic seal test if the capacitor is hermetically sealed), with no defects allowed.

4.5.1.2.6.3 Disposition of samples. The solderability test is considered a destructive test, and samples submitted to the solderability test shall not be supplied on the contract.

4.6 Methods of inspection.

4.6.1 Visual and mechanical examination. Capacitors shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4, 3.5, 3.25, and 3.27).

4.6.2 Seal (see 3.6). Capacitors shall be tested in accordance with 4.6.2.1 or 4.6.2.2, as specified (see 3.1).

4.6.2.1 Test I (for transparent cases). Capacitors shall be immersed in a fluorescent penetrant for six and one-half minutes and a pressure of 20 pounds per square inch gauge (psig) shall be maintained for 3 minutes. Upon removal from the penetrant, capacitors shall be cleaned, dried, and inspected under ultra-violet light for penetration of the dye.

4.6.2.2 Test II (for opaque cases). Capacitors shall be subjected to a saturated steam atmosphere of 5 psig for a period of 20 minutes to 30 minutes. Insulation resistance shall be measured as specified in 4.6.4 within 5 minutes after removal from steam atmosphere.

4.6.3 High voltage stabilization (see 3.7). Capacitors rated at 300 volts and above shall be subjected to 1,500 volts ±30 volts dc; capacitors rated at less than 300 volts shall be subjected to 400 percent ±2 percent of the dc rated voltage at room temperature for 50 hours +10 hours, -0 hours. During this test, capacitors shall be adequately protected against temporary voltage surges of 10 percent or more of the test voltage. After the test, capacitors shall show no damage, arcing, or breakdown.

4.6.4 Insulation resistance (see 3.8). Capacitors shall be tested in accordance with MIL-STD-202-302. The following details shall apply:

a. Test potential: Shall not exceed the rated voltage (see 3.1).

b. Points of measurement: From terminal to terminal.

4.6.5 Capacitance (see 3.9). Capacitance shall be measured in accordance with MIL-STD-202-305. The following details shall apply:

a. Test frequency: 1 MHz ±50 kHz when the nominal capacitance is 1,000 pF or less, and 1kHz ±50 Hz, when the nominal capacitance is greater than 1,000 pF. At the option of the manufacturer, capacitance measurements may be made at any frequency from 1 kHz to 1 MHz and referred to measurements at 1 MHz and 1 kHz, respectively.

b. Limit of accuracy: Shall be ±0.2 percent of nominal capacitance value or ±0.2 pF, whichever is greater.

4.6.6 Dissipation factor (see 3.10). Dissipation factor shall be measured at a frequency of 1 kHz ±100 Hz. Measurement accuracy shall be within ± 2.0 percent of 0.0005, whichever is greater.

4.6.7 Thermal shock (see 3.11). Capacitors shall be tested in accordance with MIL-STD-202-107. The following details shall apply:

a. Test condition letter: B

b. Measurements before cycling: Capacitance shall be measured as specified in 4.6.5.

c. Measurements and examination after cycling: Insulation resistance, capacitance, and dissipation factor shall be measured as specified in 4.6.4, 4.6.5, and 4.6.6 respectively. Capacitors shall be visually examined for evidence of mechanical damage.

4.6.8 Quality factor (Q) (see 3.12). Capacitors shall be tested in accordance with MIL-STD-202-306. The test frequency shall be 1 MHz ±50 kHz.

4.6.9 Shock, specified pulse (see 3.13). Capacitors shall be tested in accordance with MIL-STD-202-213. The following details shall apply:

a. Mounting: Capacitors shall be rigidly mounted by the body to the test apparatus in such a manner that the mounting method does not damage the capacitors.

b. Test condition letter: I (100 g's).

c. Measurements during shock: During shock, an electrical measurement shall be made to determine intermittent contacts or open-circuiting or short-circuiting. The accuracy of the detecting equipment shall be sufficient to detect any interruption of 0.5 ms or greater duration.

After the test, capacitors shall be examined for evidence of arcing and mechanical damage.

4.6.10 Vibration, high frequency (see 3.14). Capacitors shall be tested in accordance with MIL-STD-202-204. The following details shall apply:

a. Mounting: Capacitors shall be rigidly mounted by the body to the test apparatus in such a manner that the mounting method does not damage the capacitors.

b. Test condition letter: D (20 g's).

c. Measurements during shock: During the last cycle in each direction, an electrical measurement shall be made to determine intermittent contacts or open-circuiting or short-circuiting. The accuracy of the detecting equipment shall be sufficient to detect any interruption of 0.5 ms or greater duration.

After the test, capacitors shall be visually examined for evidence of arcing and mechanical damage.

4.6.11 Solderability (see 3.15). Capacitors shall be tested in accordance with MIL-STD-202-208. The following details shall apply:

a. Number of terminations of each capacitor to be tested: Two.

b. Depth of immersion in flux and solder: Both terminals shall be immersed to within .05 inch of the capacitor body.

4.6.12 Terminals strength (see 3.16). The number of sample units shall be divided into two equal groups; a different group shall be used for each of the following tests:

a. Pull test: Capacitors shall be tested in accordance with MIL-STD-202-211. The following detail and exception apply:

(1) Test condition letter A.

(2) Applied force: Four and one-half pounds.

b. Bend test: A 1-pound weight shall be hung from each terminal in turn at a point .750 inch (19.05 mm) from its point of egress from the capacitor body, and the body shall be rotated about an axis which is perpendicular to the axis of the terminals and parallel to the largest face, through 90 degrees, back through 180 degrees, and then return to its original position (see figure 2).

After the test, capacitors shall be visually examined for evidence of loosening or rupturing of the terminals, or damage to the terminals or seal.

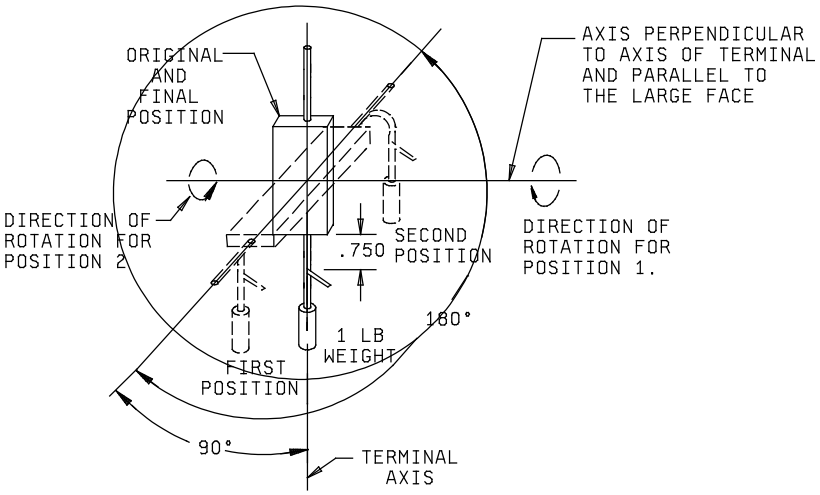

FIGURE 2. Bend test.

4.6.13 Barometric pressure (see 3.17). Capacitors shall be tested in accordance with MIL-STD-202-105. The following details shall apply:

a. Method of mounting: Not applicable.

b. Test condition letter: D (100,000 feet).

c. Tests during subjection to reduced pressure: a minimum of 150 percent - 2 percent of rated voltage shall be applied between the terminals for not less than 1 second nor more than 5 seconds.

After the test, capacitors shall be examined for evidence of damage, arcing, and breakdown.

4.6.14 Temperature coefficient and capacitance drift (see 3.18). Capacitance shall be measured as specified in 4.6.5, except that measurements shall be made in the order and at the temperature shown in the following, at a frequency of 100 kHz ±10 kHz. The reference frequency at which measurements are made shall not drift more than ±50 Hz during the test. An accuracy of ±0.025 percent of nominal capacitance +0.05 pF shall be maintained for measurement of capacitance change.

a. For first article inspection: +25°C, ±2°C; -55°C +0°C, -2°C; -10°C ±2°C; +25°C ±2°C; +65°C ±2°C; +85°C +2°C, -0°C; +125°C +2°C, -0°C; and +25°C ±2°C.

b. For conformance inspection: +25°C, ±2°C; -55°C +0°C, -2°C; +25°C ±2°C; +125°C +2°C, -0°C; and +25°C ±2°C, respectively.

The measurement at each temperature shall be recorded when two successive readings taken at 5-minute intervals at that temperature indicate no change in capacitance. The temperatures at the time of measurement shall be measured at an accuracy of ±1.0 percent of the temperature difference between the nominal test temperature and the nominal reference temperature +0.5 °C.

4.6.14.1 Temperature coefficient. The temperature coefficient shall be computed as follows:

$$TC = \frac{(C_2 - C_1)\,10^6}{(T_2 - T_1)\,C_1}$$

Where:

TC = Temperature coefficient (in parts per million per degree Celsius).
C_1 = Capacitance (in pF at the middle 25°C (reference temperature)).
C_2 = Capacitance (in pF at test temperature).
T_1 = 25°C.
T_2 = Test temperature (in degrees Celsius).

4.6.14.1.1 Continuous curve temperature coefficient. As an alternate to the measurements specified in 4.6.14, a continuous curve of capacitance versus temperature may be produced by subjecting the capacitors to a slowly varying temperature. The temperature shall be varied from +25°C to -55°C to +125°C to +25°C. A temperature-sensing device shall be embedded in a dummy capacitor in a manner to assure accurate internal readings in the sample under test. Temperature shall be varied slowly enough to produce a smooth uniform curve with no loops at -55°C or +125°C. Other test conditions shall be as specified in 4.6.14.

4.6.14.2 Capacitance drift. Capacitance drift shall be computed by dividing the greatest single difference between any two of the three values recorded at +25°C by the intermediate value recorded at +25°C.

4.6.15 Salt atmosphere (see 3.19). Capacitors shall be tested in accordance with MIL-STD-202-101. The following detail and exception shall apply:

a. Applicable salt solution: Five percent.

b. Test condition: B.

c. Examination after test: Capacitors shall be visually examined for evidence of harmful corrosion and mechanical damage.

4.6.16 Fungus (see 3.20). Capacitors shall be tested in accordance with method 508 of MIL-STD-810. Pretest and post-test measurements are not required. After the test, capacitors shall be visually examined for evidence of fungus growth.

4.6.17 Resistance to solvents (see 3.21). Capacitors shall be tested in accordance with MIL-STD-202-215. The following details and exceptions shall apply:

a. Portion of specimen to be brushed: That portion on which marking is present.

b. Number of specimens to be tested: As specified in applicable inspection tables.

c. Permissible extent of damage: As specified in 3.21.

4.6.18 Resistance to soldering heat (see 3.22). Capacitors shall be tested in accordance with MIL-STD-202-210. The following details and exception shall apply:

a. Test condition letter: C.

b. Cooling time prior to measurement after test: 10 minutes ±1 minute.

c. Measurements and examination after test: Insulation resistance, capacitance, and dissipation factor shall be measured at 25°C as specified in 4.6.4, 4.6.5, and 4.6.6, respectively. Capacitors shall then be examined for evidence of mechanical damage.

4.6.19 Moisture resistance (see 3.23). Following resistance to soldering heat, capacitors shall be tested in accordance with MIL-STD-202-106. The following details and exceptions shall apply:

a. Mounting: Capacitors shall be mounted by their terminals in a manner that will keep the capacitor body from touching the test fixture.

b. Initial measurements: Not applicable.

c. Number of cycles: 20 continuous cycles with step 7a applying for the first 10 cycles only. Step 7b is not applicable.

d. Polarization voltage: For the first ten cycles, a dc potential of 90 volts to 100 volts shall be applied across the capacitor terminals. Once each day, a check shall be made to determine whether a capacitor has shorted.

e. Final measurements: After the final cycle and between one hour and four hours after removal from the chamber, insulation resistance shall be measured at room ambient conditions as specified in 4.6.4. Artificial drying shall not be permitted. Between 4 hours and 24 hours after this measurement, capacitors shall be visually examined for evidence of corrosion or mechanical damage; capacitance, and dissipation factor shall then be measured as specified in 4.6.5 and 4.6.6, respectively.

4.6.20 Life (see 3.24).

4.6.20.1 1,000 hour (first article inspection) (see 3.24.1). Capacitors shall be tested in accordance with MIL-STD-202-108. The following details and exceptions shall apply:

a. Distance of temperature measurements from specimens, in inches: Not applicable.

b. Test temperature and tolerance: +125°C +4°C, -0°C.

c. Operating conditions: A minimum of dc rated voltage -2 percent of dc rated voltage shall be applied to the capacitor. The maximum surge current shall be not more than 50 mA. A current-limiting resistor shall be inserted into the circuit.

d. Test condition letter: D (1,000 hours +72 hours, -0 hours).

e. Measurements after exposure: At the conclusion of this test, the insulation resistance, capacitance, and dissipation factor shall be measured as specified in 4.6.4, 4.6.5, and 4.6.6, respectively.

f. Examination after test: Capacitors shall be visually examined for evidence of corrosion or mechanical damage.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. These capacitors are intended for use in any equipment that are primarily designed as a substitute for mica-dielectric capacitors as a step toward conservation of critical mica. They are effective substitutes for mica-dielectric capacitors and can be employed for many applications where mica-dielectric capacitors are used, provided consideration is given to the differences in temperature coefficient and dielectric loss. Capacitors covered by this specification are military unique and are able to operate satisfactorily in military systems under the following demanding environmental conditions: shock, vibration, acceleration, extreme moisture, vacuum, and high operating temperatures.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the specification, the applicable specification sheet, and the complete PIN (see 3.1).

b. Remarking of capacitors (see 3.25.2).

c. Packaging requirements (see 5.1).

d. Lead finish (see 3.5.1.1).

e. Retinning (hot solder dip), if required (see 3.5.2).

6.3 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first production items, or, a standard production item from the contractor's current inventory (see 3.2), and the number of items to be tested as specified in 4.4 The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.4 Subject term (key word) listing.

Quality factor
Dissipation factor

6.5 Tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM B545, Standard Specification for Electrodeposited Coating of Tin.

6.6 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous revisions were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 85
DLA - CC

Review activities:
Navy - AS, MC, OS, SH
Air Force – 19, 99
Other DoD - MDA

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil/.

Preparing activity:
DLA - CC

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