INCH-POUND

MIL-C-11272E
3 March 2008
SUPERSEDING
MIL-C-11272D
w/AMENDMENT 1
22 August 2003

MILITARY SPECIFICATION

CAPACITORS, FIXED, GLASS DIELECTRIC GENERAL SPECIFICATION FOR

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

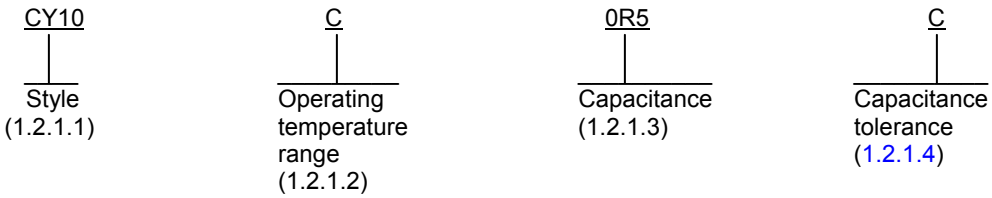
INACTIVE FOR NEW DESIGN
AFTER 24 AUG 79, USE MIL-PRF-23269

1. SCOPE

1.1 Scope. This specification covers the general requirements for glass-dielectric, fixed capacitors enclosed in glass, epoxy or porcelain cases, suitably protected against high humidity.

1.2 Classification.

* 1.2.1 Part or Identifying Number (PIN). The PIN is in the following form, and as specified (see 3.1and 6.8):



1.2.1.1 Style. The style is identified by the two-letter symbol "CY" followed by a two-digit number; the letters identify glass and porcelain dielectric, fixed capacitors, and the number identifies the shape and dimensions of the capacitor.

1.2.1.2 Operating temperature range. The operating temperature range is identified by a single letter in accordance with table I.

TABLE I. Operating temperature range.

Symbol	Operating temperature range, °C
C	-55 to +125

1.2.1.3 Capacitance. The nominal capacitance value, expressed in picofarads (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 are required, the letter "R" is used to indicate the decimal point and the succeeding digits of the group represent significant figures. Example: 1R5 indicates 1.5 pF.

* Comments, suggestions, or questions on this document should be addressed to: Defense Supply Center, Columbus, DSCC-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 http://assist.daps.dla.mil.

1.2.1.4 Capacitance tolerance. The capacitance tolerance is identified by a single letter in accordance with table II.

TABLE II. Capacitance tolerance.

Symbol	Capacitance tolerance (±)
B	0.10 pF
C	0.25 pF
D	0.50 pF
F	1%
G	2%
J	5%
K	10%
M	20%

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-C-11272/1 - Capacitors, Fixed, Glass Dielectric, Style CY10
MIL-C-11272/2 - Capacitors, Fixed, Glass Dielectric, Style CY15
MIL-C-11272/13 - Capacitors, Fixed, Glass Dielectric, Style CY06
MIL-C-11272/14 - Capacitors, Fixed, Glass Dielectric, Style CY07
MIL-C-11272/15 - Capacitors, Fixed, Glass Dielectric, Style CY08
MIL-PRF-23269 - Capacitors, Fixed, Glass Dielectric, Established Reliability, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202 - Test Method Standard for Electronic and Electrical Component Parts.
MIL-STD-1276 - Leads for Electronic Component Parts.

* (Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NCSL Z540.1 - Calibration Laboratories and Measuring and Test Equipment - General Requirements (Replaces MIL-STD-45662.)

(Copies of this document may be ordered online at www.ncsli.org or from NCSL International, 1800 30th Street, Suite 305, Boulder, CO 80701-1026)

THE INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS INC. (IPC)

J-STD-004	-	Requirements for Soldering Fluxes.
J-STD-006	-	Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications.

(Copies of these documents can be ordered online at www.ipc.org or from the Institute for Interconnecting and Packaging Electronic Circuits (IPC, INC.), 2215 Sanders Road, Suite 200 South, Northbrook, IL 60062.)

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

ISO-10012-1	-	Quality Assurance Requirements for Measuring Equipment - Part I: Metrological Confirmation System for Measuring Equipment.

(Copies of this document may be ordered online at http://webstore.ansi.org/ or from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036-0350)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications, specification sheets, or MS 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 requirements of this specification and the specification sheets, the latter shall govern. (see 6.2)

3.2 Qualification. Capacitors furnished under this specification shall be a product which has been tested and has passed the qualification tests specified in 4.4, and has been listed on or approved for listing on the applicable qualified products list (see 6.3).

3.3 Material. 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.

* 3.3.1 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 6.6).

3.3.2 Solder. Solder for electrical connections shall be in accordance with J-STD-006. In no case shall the solder start to melt at a temperature of less than 200°C.

3.3.3 Soldering flux. Soldering flux shall be in accordance with J-STD-004.

3.4 Design and construction. Capacitors shall be of the design, construction, and physical dimensions specified (see 3.1).

3.4.1 Capacitor element. The capacitor element shall consist of alternate layers of glass dielectric and electrode.

3.4.2 Case. Each capacitor shall be enclosed in a glass, porcelain, or epoxy case that will protect the capacitor element from the effects of prolonged exposure to high humidity under all the test conditions specified herein.

3.4.3 Connections. Electrical connections shall not depend upon the terminals being clamped between a metallic member and an insulating material other than the glass material. Such connections shall be securely made, mechanically and electrically, with the capacitor element by soldering, welding, or mechanical means, in such a manner that the normal movements of the terminal leads will not result in strain, wear, or damage to the capacitor element, case, or coating.

3.5 Dielectric withstanding voltage. Capacitors shall withstand the direct current (dc) potential specified in 4.6.2 without damage, arcing, or breakdown.

3.6 Barometric pressure. Capacitors shall withstand the dc potential specified in 4.6.3 without damage, arcing, or breakdown.

3.7 Insulation resistance. When measured as specified in 4.6.4, the insulation resistance shall exceed 100,000 megohms.

3.8 Capacitance. When measured as specified in 4.6.5, the capacitance shall be within the tolerance shown in the type designation (see 3.1).

3.9 Dissipation factor. When measured as specified in 4.6.6, the dissipation factor shall be not more than 0.001.

3.10 Quality factor (Q). When measured as specified in 4.6.7, the Q shall be not less than the value shown on figure 1, unless otherwise specified (see 3.1).

3.11 Shock (specified pulse). When capacitors are tested as specified in 4.6.8, there shall be no intermittent contacts, open- or short-circuiting, nor evidence of arcing or mechanical damage.

3.12 Vibration, high frequency. When capacitors are tested as specified in 4.6.9, there shall be no intermittent contacts, open- or short-circuiting, nor evidence of mechanical damage.

3.13 Thermal shock and immersion. When tested as specified in 4.6.10, capacitors shall meet the following requirements:

a. Visual examination - There shall be no evidence of corrosion or mechanical damage that will affect life or serviceability.

b. Dielectric withstanding voltage - There shall be no evidence of damage, arcing, or breakdown.

c. Insulation resistance - Not less than 100,000 megohms.

d. Capacitance - 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.

e. Dissipation factor - Not to exceed 0.001.

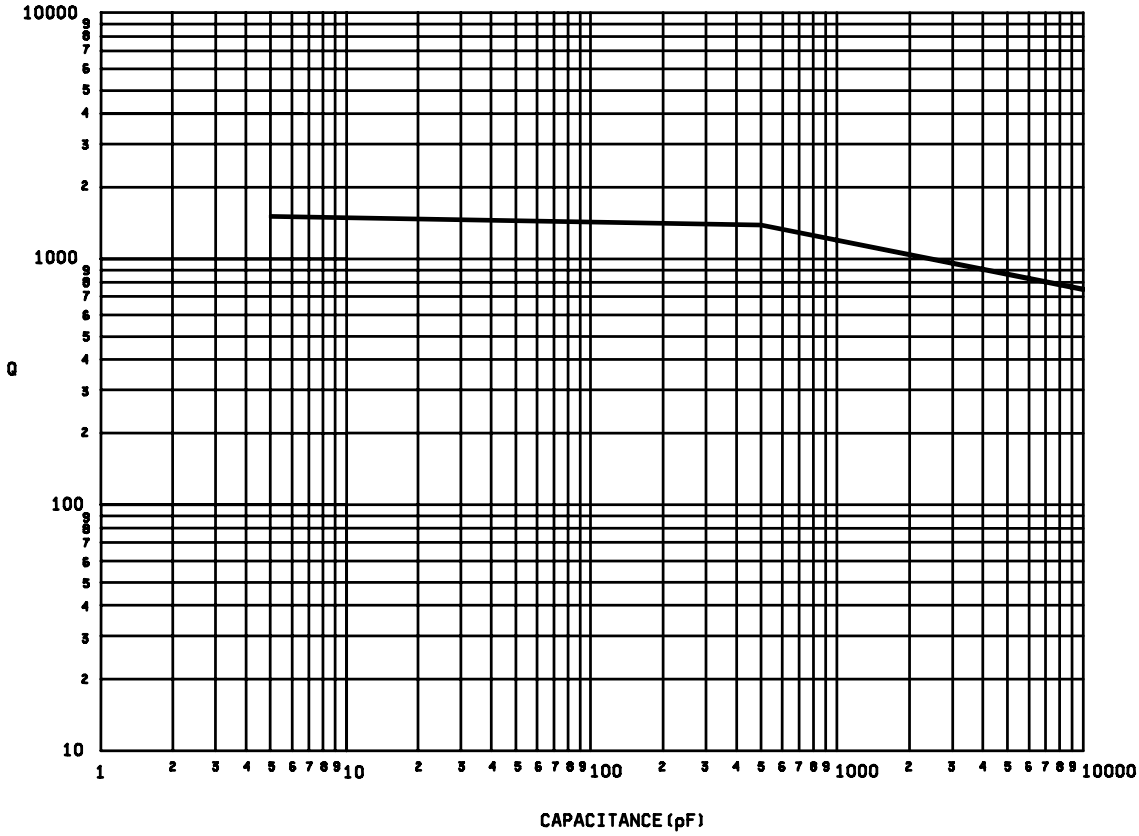


FIGURE 1. Quality factor (Q) at 1 megahertz (MHz).

3.14 Moisture resistance. When tested as specified in 4.6.11, capacitors shall meet the following requirements:

a. Visual examination - There shall be no evidence of corrosion or mechanical damage that will affect life or serviceability.

b. At 90 to 95 percent relative humidity:

(1) Insulation resistance - 1,000 megohms, minimum.

c. At 50 ±5 percent relative humidity:

(1) Dielectric withstanding voltage - There shall be no evidence of damage, arcing, or breakdown.

(2) Insulation resistance - Not less than 100,000 megohms.

(3) Capacitance - 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.

(4) Dissipation factor - Not to exceed 0.001.

3.15 Life. When tested as specified in 4.6.12.1, capacitors shall meet the following requirements, as applicable:

a. Visual examination - there shall be no evidence of corrosion or mechanical damage that will affect life or serviceability.

b. At 25°C:

* (1) Insulation resistance - Not less than 100,000 megohms.

* (2) Capacitance - 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.

(3) Dissipation factor - Shall not exceed the value specified (see 3.1).

* c. At 125°C

(1) Insulation resistance – Not less than 10,000 megohms.

(2) Capacitance - 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.

(3) Dissipation factor – Shall not exceed the value specified (see 3.1).

3.15.1 Performance check. When tested as specified in 4.6.12.2.1, capacitors shall meet the following requirements:

a. Visual examination - There shall be no evidence of corrosion or mechanical damage that will affect life or serviceability.

* b. Insulation resistance - Not less than 100,000 megohms.

* c. Capacitance - Change not more than 0.5 percent of the nominal value or 0.5 pF, which ever is greater, from the initial value obtained when measured as specified in 4.6.5.

d. Dissipation factor - Shall not exceed the value specified (see 3.1).

3.15.2 Continuation test. When tested as specified in 4.6.12.2.2, capacitors shall meet the requirements specified in 3.15.

3.16 Solderability. When capacitors are tested as specified in 4.6.13, the dipped surface of the leads shall be at least 95 percent covered with a new, smooth, solder coating. The remaining 5 percent of the lead surface shall show only small pinholes or rough spots; these shall not be concentrated in one area. Bare base metal and areas where the solder dip failed to cover the original coating are indications of poor solderability, and shall be cause for failure. In case of dispute, the percent of coverage with pinholes or rough spots shall be determined by actual measurement of these areas, as compared to the total area.

3.17 Terminal strength. When capacitors are tested as specified in 4.6.14, terminals shall not loosen or rupture, and there shall be no permanent damage to the terminals or seal.

3.18 Temperature coefficient and capacitance drift. When measured as specified in 4.6.15, the temperature coefficient and capacitance drift shall be within the limits specified (see 3.1).

* 3.19 Marking. Capacitors shall be marked with the PIN and the manufacturer's name or code symbol. There shall be no space between the symbols that comprise the PIN. If lack of space requires it, the PIN may appear on two lines. In this event, the PIN shall be divided between the operating temperature range and capacitance symbols, as shown in the following example:

CY10C
OR5C

When lack of space prohibits the marking of the PIN on two lines, the PIN may appear on three lines. In this event, the PIN shall be divided after the two-letter symbol "CY" and between the operating temperature range and capacitance symbols, as shown in the following example:

CY
10C
OR5C

Marking shall remain legible after all tests.

* 3.19.1 Alternate marking (all styles). Capacitor packaging containers shall be marked with the PIN, capacitance, capacitance tolerance, voltage, "JAN" brand, and the commercial and Government entity (CAGE) code. Other markings that in any way interfere with, obscure, or confuse those specified herein are prohibited.

When specified in the ordering data (see 6.2), capacitors shall be legibly marked in accordance with table III.

At the option of the manufacturer, capacitors may be laser marked with the manufacturer's trademark or symbol, the three-digit capacitor code and tolerance code as follows:

XXX
OR1
F

Where space does not permit, the manufacturer's trademark or symbol may be omitted.

3.20 Workmanship. Capacitors shall be processed in such a manner as to be uniform in quality and shall be free from pits, corrosion, cracks, chips, and other defects that will affect life or serviceability.

3.20.1 Terminals. Terminals shall be hot-solder-dipped or so coated that soldering can be readily accomplished.

3.20.2 Welding. Surfaces to be welded shall be clean and free from oxides, greases, and other harmful material. Welds shall be of ample size and good fusing, and shall be free from all harmful defects.

4. VERIFICATION

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

a. Qualification 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 supplier. 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 Z540-1.

TABLE III. Alternate marking (all styles).

Character	Significant units	Capacitance (pF) and multiplier					
		Orange (x 0.1)	Black (x 1.0)	Green (x 10)	Blue (x 100)	Violet (x 1000)	Red (x 10,000)
A	10	1.0	10	100	1000	10,000	100,000
B	11	1.1	11	110	1100	11,000	110,000
C	12	1.2	12	120	1200	12,000	120,000
D	13	1.3	13	130	1300	13,000	130,000
E	15	1.5	15	150	1500	15,000	150,000
H	16	1.6	16	160	1600	16,000	160,000
I	18	1.8	18	180	1800	18,000	180,000
J	20	2.0	20	200	2000	20,000	200,000
K	22	2.2	22	220	2200	22,000	220,000
L	24	2.4	24	240	2400	24,000	240,000
N	27	2.7	27	270	2700	27,000	270,000
O	30	3.0	30	300	3000	30,000	300,000
R	33	3.3	33	330	3300	33,000	330,000
S	36	3.6	36	360	3600	36,000	360,000
T	39	3.9	39	390	3900	39,000	390,000
V	43	4.3	43	430	4300	43,000	430,000
W	47	4.6	47	470	4700	47,000	470,000
X	51	5.1	51	510	5100	51,000	510,000
Y	56	5.6	56	560	5600	56,000	560,000
Z	62	6.2	62	620	6200	62,000	620,000
3	68	6.8	68	680	6800	68,000	680,000
4	75	7.5	75	750	7500	75,000	750,000
7	82	8.2	82	820	8200	82,000	820,000
9	91	9.1	91	910	9100	91,000	910,000

4.3 Inspections conditions and methods.

4.3.1 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.

4.3.2 Methods. Unless otherwise specified herein, all visual examinations shall be performed without magnification other than those required to correct eyesight. Radial lead type capacitors shall be tested with the leads bent into the axial position.

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

4.4.1 Sample size. The number of capacitors to be subjected to qualification inspection shall be as specified in the appendix to this specification.

4.4.2 Inspection routine. The sample shall be subjected to the inspections specified in table IV, in the order shown. All sample units shall be subjected to the inspection of group I. The sample shall then be divided as specified in table IV for groups II to V inclusive.

4.4.3 Failures. Failures in excess of those permitted in table IV will be cause for refusal to grant qualification.

TABLE IV. Qualification inspection.

Examination or test	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures permitted 1/	
Group I 2/					
Visual and mechanical examination					
Material, design, construction and	3.1, 3.3, 3.4.3, incl, and 3.20 to 3.20.2, incl	4.6.1	2	0	
Visual and mechanical examination		4.6.1	61 4/ or 62 5/	1	
Physical dimensions, marking 3/ and workmanship	3.4 and 3.19 to 3.20.2, incl				
Dielectric withstanding voltage	3.5	4.6.2			
Barometric pressure	3.6	4.6.3			
Insulation resistance	3.7	4.6.4			
Capacitance	3.8	4.6.5.1			
Dissipation factor (DF)	3.9	4.6.6			
Quality factor (Q)	3.10	4.6.7			
Group II					2
Shock (specified pulse)	3.11	4.6.8	12	1	
Vibration, high frequency	3.12	4.6.9			
Thermal shock and immersion	3.13	4.6.10			
Group III					
Moisture resistance	3.14	4.6.11	12	1	
Group IV					
Life	3.15	4.6.12	24	1	
Group V					
Solderability	3.16	4.6.13	12	1	
Terminal strength	3.17	4.6.14			
Temperature coefficient and capacitance drift	3.18	4.6.15			

1/ A sample unit having one or more defects shall be considered as a single failure.
2/ With the exception of the internal visual and mechanical examination, all tests of this group are nondestructive tests.
3/ Marking will be considered a failure only if it becomes illegible as a result of any of the tests.
4/ For single-type submission, 1 additional sample unit is included in each sample of 63 sample units to permit substitution for failure permitted.
5/ For combined-type submission, 2 additional sample units (1 of the highest and 1 of the lowest capacitance value) are included in each sample of 64 sample units to permit substitution for the permitted failure (either the highest or lowest capacitance value).

4.4.4 Verification of qualification. Every 6 months, the manufacturer shall verify the retention of qualification to the qualifying activity. In addition, the manufacturer shall immediately notify the qualifying activity whenever group B inspection results indicate failure of the qualified product to meet the requirements of the specification. Verification of qualification shall be based on meeting the following requirement

a. The capacitor has not been modified.

b. Lot rejection for group A inspection does not exceed the group A sampling plan.

c. Periodic group B inspection requirements have been met.

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 Inspection lot. An inspection lot shall consist of all capacitors of the same style produced under essentially the same conditions, and offered for inspection at one time.

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

4.5.1.2.1 Sampling plan. The sampling plan shall be as specified in table V In the event of one or more failures, the lot shall be rejected.

4.5.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. A new sample of parts shall be randomly selected in accordance with table V. Such lots shall be kept separate from new lots, and shall be clearly identified as reinspected lots. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE V. Group A inspection.

Examination or test	Requirement paragraph	Test method paragraph	Sampling procedure
Visual and mechanical examination: Material Physical dimensions Design and construction (other than physical dimensions) Marking 1/ Workmanship	 3.3 to 3.3.2, incl 3.4 3.4 to 3.4.3, incl 3.19 3.20 to 3.20.2, incl	4.6.1	See table VI
Dielectric withstanding voltage Insulation resistance Capacitance Dissipation factor Barometric pressure	3.5 3.7 3.8 3.9 3.6	4.6.2 4.6.4 4.6.5.2 4.6.6 4.6.3	See table VI
Life (performance check)	3.15.1	4.6.12.2.1	See table VII

1/ Marking defects are based on visual examination only. Any subsequent electrical defects shall not be used as a basis for determining marking defects.

4.5.2 Periodic inspection. Periodic inspection shall consist of group B. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.2.1.4), delivery of products which have passed group A shall not be delayed pending the results of these periodic inspections.

TABLE VI. Sampling plans for Group A tests.

Lot size	Sample size
1 - 13	100%
14 - 150	13
151 - 280	20
281 - 500	29
501 - 1,200	34
1,201 - 3,200	42
3,201 - 10,000	50
10,001 - 35,000	60
35,001 - 150,000	74
150,001 - 500,000	90
500,001 - Up	102

* TABLE VII. Sampling plans for Group A Life (performance check).

Lot size	Sample size
1 - 11	100%
12 - 150	11
151 - 280	13
281 - 500	16
501 - 1,200	19
1,201 - 3,200	23
3,201 - 10,000	29
10,001 - 35,000	35
35,001 - 150,000	40
150,001 - 500,000	40
500,001 - Up	40

* 4.5.2.1 Group B inspection. Group B inspection shall consist of the tests specified in table VIII and shall be made on sample units selected from inspection lots that have passed the group A inspection. Styles CY10 and CY15 may be maintained by like ER styles from MIL-PRF-23269.

4.5.2.1.1 Sampling plan. Sample units shall be selected in accordance with 4.5.2.1.2 and 4.5.2.1.3. The number of sample units to be inspected for each sampling period shall be as specified in table VIII. A different sample shall be selected for each subgroup.

4.5.2.1.2 Every 4 months (subgroups 1 through 3). Every 3 months sample units shall be selected and subjected to the tests of subgroups 1 through 3 of table VIII.

4.5.2.1.3 Every 6 months (subgroup 4). Every 6 months sample units shall be selected and subjected to the test of subgroup 4 of table VIII.

4.5.2.1.4 Failures. If the number of failures exceeds the number allowed in table VIII, the sample shall be considered to have failed.

4.5.2.1.5 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract or purchase order.

4.5.2.1.6 Noncompliance. If a sample fails to pass group B inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product that can be corrected, and that were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspection, or the inspection that the original sample failed, at the option of the Government). Group A inspection may be re-instituted; however, final acceptance shall be withheld until the group B re-inspection has shown that the corrective action was successful. In the event of failure after re-inspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

TABLE VIII. Group B inspection.

Test	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of defectives permitted
Subgroup I (Every 4 months)				
Shock (specified pulse) Vibration, high frequency Thermal shock and immersion	3.11 3.12 3.13	4.6.8 4.6.9 4.6.10	12	1 2/
Subgroup II (Every 4 months)				
Moisture resistance	3.14	4.6.11	12	1 2/
Subgroup III (Every 4 months)				
Solderability Terminal strength Temperature coefficient and capacitance drift	3.16 3.17 3.18	4.6.13 4.6.14 4.6.15.2 to 4.6.15.2.2 incl	12	1
Subgroup IV (Every 6 months)				
Life (continuation test)	3.15.2	4.6.12.2.2	24 1/	1

1/ Sample units to be inspected shall be selected from sample units that have been subjected to the 250-hour performance-check test.
2/ If the failures exceed the total number permitted by 1, the inspection shall be rerun with the same sample size with zero failures permitted.

4.6 Methods of examination and test.

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, 3.3 to 3.4.3, inclusive, and 3.19 to 3.20.2, inclusive).

4.6.2 Dielectric withstanding voltage (see 3.5). Capacitors shall be tested in accordance with method 301 of MIL-STD-202. The following details and exceptions shall apply:

a. Magnitude and nature of test potential: a minimum of 200 percent - 2 percent of the dc rated voltage (see 3.1).

b. Duration of application of test voltage: Not less than 1 second nor more than 5 seconds.

c. Points of application of test voltage: Between the terminals.

d. Limiting value of surge current: Shall not exceed 50 milliamperes (mA).

e. Examinations after test: Capacitors shall be examined for evidence of damage, arcing, and breakdown.

4.6.3 Barometric pressure (see 3.6). Capacitors shall be tested in accordance with method 105 of MIL-STD-202. The following details shall apply:

a. Method of mounting: Not applicable.

b. Test-condition letter: B.

c. Tests during subjection to reduced pressure: minimum of 150 percent - 2 percent of the dc rated voltage (see 3.1) shall be applied between the terminals for not less than 1 second nor more than 5 seconds.

d. Examinations after test: Capacitors shall be examined for evidence of damage, arcing, and breakdown.

4.6.4 Insulation resistance (see 3.7). Capacitors shall be tested in accordance with method 302 of MIL-STD-202. the following details shall apply:

a. Test potential: A dc potential equal to a minimum of the dc rated voltage - 2 percent of dc rated voltage (see 3.1).

b. Points of measurement: From terminal to terminal. (Condensed moisture may be removed by a blast of air.)

4.6.5 Capacitance (see 3.8).

4.6.5.1 Qualification inspection. Capacitors shall be tested in accordance with method 305 of MIL-STD-202. The following details shall apply:

a. Test frequency - 1 MHz ±200 kHz when the capacitance is 1,000 pF or smaller, and 1 kHz ±100 Hz when the capacitance is greater than 1,000 pF.

b. Limit of accuracy - Shall be ±0.2 percent or ±0.2 pF, whichever is greater.

4.6.5.2 Conformance inspection. Capacitors shall be tested in accordance with method 305 of MIL-STD-202. The following detail shall apply:

a. Test frequency - 1 kHz ±100 Hz, or 1 MHz ±200 kHz. Capacitance measurements made at 1 kHz shall be referred to measurements made at a frequency of 1 MHz.

4.6.6 Dissipation factor. Dissipation factor shall be measured at a frequency of 1 kHz ±100. Measurement accuracy shall be within ±2 percent or 0.0005, whichever is greater, for dissipation factor and within ±5 Hz for frequency (see 3.9).

4.6.7 Quality factor (Q) (see 3.10). Capacitors shall be tested in accordance with method 306 of MIL-STD-202. The following detail shall apply:

a. Test frequency - 1 MHz ±200 kHz.

4.6.8 Shock (specified pulse) (see 3.11). Capacitors shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions 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(100G).

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

d. Examination after shock: Capacitors shall be visually examined for evidence of arcing or mechanical damage.

4.6.9 Vibration, high frequency (see 3.12). Capacitors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions 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 capacitor.

b. Test-condition letter: B.

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

d. Examination after test: Capacitors shall be visually examined for evidence of mechanical damage.

4.6.10 Thermal shock and immersion (see 3.13).

4.6.10.1 Thermal shock. Capacitors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition letter - B.

b. Measurements before and after cycling - Not applicable.

* 4.6.10.2 Immersion. Following thermal shock, capacitors shall be tested in accordance with method 104 of MIL-STD-202. The following details and exceptions shall apply:

a. Test-condition letter - B.

b. Time after final cycle allowed for measurements - Shall not exceed 30 minutes. Surface moisture shall be removed by circulating air at room temperature, or wiping with a clean dry cloth, or both.

c. Examinations and measurements after final cycle - Capacitors shall be visually examined for evidence of corrosion or mechanical damage; the dielectric withstanding voltage, insulation resistance, capacitance, and dissipation factor shall then be measured as specified in 4.6.2, 4.6.4, 4.6.5, and 4.6.6, respectively.

4.6.11 Moisture resistance (see 3.14). Capacitors shall be tested in accordance with method 106 of MIL-STD-202. 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. Polarization and load - Not applicable.

d. Final measurements - The insulation resistance shall be measured as specified in 4.6.4 at a temperature of 25° ±5°C and a relative humidity of 90 to 95 percent. Between 4 and 24 hours after this measurement, capacitors shall be visually examined for evidence of corrosion or mechanical damage; the dielectric withstanding voltage, insulation resistance, capacitance, and dissipation factor shall then be measured as specified in 4.6.2, 4.6.4, 4.6.5, and 4.6.6, respectively, at a temperature of 25° ±5°C and a relative humidity of 50 ±5 percent.

4.6.12 Life (see 3.15).

4.6.12.1 Qualification inspection. Capacitance shall be measured as specified in 4.6.5 at a temperature of 125° +4,-0°C. The capacitors shall then be subjected to a minimum of 150 percent - 2 percent of the dc rated voltage (see 3.1) for 2,000 hours at a temperature of 125° +4, -0°C. The surge current shall not exceed 50 mA. The insulation resistance, capacitance, and dissipation factor shall be measured as specified in 4.6.4, 4.6.5, and 4.6.6, respectively, at a temperature of 125° +4,-0°C. The capacitors shall then be returned to the inspection conditions specified in 4.3, and the 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 then be visually examined for evidence of corrosion or mechanical damage.

4.6.12.2 Conformance inspection.

4.6.12.2.1 Performance check (see 3.15.1). Capacitors shall be tested as specified in 4.6.12.1, except that the duration of the test shall be 250 hours and that only the measurements at the inspection conditions specified in 4.3 need be made (see 3.15.1 and table V).

4.6.12.2.2 Continuation test. Capacitors which have been subjected to the 250-hour performance-check specified in 4.6.12.2.1 shall be tested for an additional period of 1,750 hours in accordance with 4.6.12.1, with voltage applied with the same polarity as when subjected to the performance check (see 3.15.2 and table VIII).

4.6.13 Solderability (see 3.16). Capacitors shall be tested in accordance with method 208 of MIL-STD-202.

4.6.14 Terminal strength (see 3.17).

4.6.14.1 Pull test. The body of the capacitor shall be secured, and each terminal in turn shall be subjected to a gradually applied axial-pull of 5 pounds maintained at its maximum value for 5 seconds.

4.6.14.2 Twisting test. All terminals shall be bent through 90° at a point .25 inch from the body of the capacitor, with the radius of curvature at the bend approximately .031 inch. The terminals shall be clamped, to within .047 ± .016 inch of the bend on the side between the bend and the remaining portion of the lead, away from the body. The body of the capacitor shall then be rotated about the original axis of the bent terminal through 360° in alternating directions for three such 360° rotations, at the rate of approximately 5 seconds per rotation. The capacitors shall then be examined for evidence of loosening or rupture, and damage to the terminals or seal.

NOTE: For the purpose of this test, the original axis is considered to be the axial position of all leads.

4.6.15 Temperature coefficient and capacitance drift (see 3.18).

4.6.15.1 Qualification inspection. Capacitance measurements shall be made at the following temperatures, in the order listed:

Temperatures (°C)
25 ±2
-55 +0, -2
-10 ±2
25 ±2
65 ±2
85 +2, -0
125 +2, -0
25 ±2

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 temperature at the time of measurement shall be measured to an accuracy of ±1 percent of the temperature difference between the nominal test temperature and the nominal reference temperature +0.5°C. Measurements shall be made 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.

4.6.15.1.1 Continuous curve temperature coefficient. As an alternate to the measurements specified in 4.6.15.1, 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° to -55° to +125° 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° or 125°C. Measurements shall be made at a frequency of 100 kHz ±10 kHz. Accuracy shall be as specified in 4.6.15.1.

4.6.15.1.2 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 centigrade.
C_1 = capacitance at the middle 25°C (reference) temperature in pF.
C_2 = capacitance at test temperature in pF.
T_1 = 25°C.
T_2 = test temperature in degrees centigrade.

4.6.15.1.3 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.

4.6.15.2 Conformance inspection.

4.6.15.2.1 Temperature coefficient. Capacitance measurements shall be made as specified in 4.6.15.1 or 4.6.15.1.1, except that measurements need be made only at 25°C, -55°C, 25°C, 125°C, and 25°C, respectively. The temperature coefficient shall be computed as specified in 4.6.15.1.2.

4.6.15.2.2 Capacitance drift. Capacitance drift shall be computed as specified in 4.6.15.1.3.

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 where known orders of reliability are required, and 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. They are capable of withstanding environmental conditions of shock, vibration, acceleration, extreme moisture, vacuum, extended life of 30,000 hours and more, and high temperatures such as experienced in missile-borne and space electronic equipment.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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

b. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products that are, at the time of award of contract, qualified for inclusion in Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Defense Supply Center, Columbus, ATTN: DSCC-VQP, PO Box 3990, Columbus, OH 43218-3990, or by e-mail to vqp.chief@dla.mil.

* 6.4 Substitution data. The capacitors specified herein are not for use in design after 24 August 1979. They are authorized for use in design contracts effective on or before 24 August 1979, and to support existing military equipment. Capacitors specified in MIL-PRF-23269 are preferred for design and regardless of the failure rate designation can be used as substitutes for the inactive capacitors of the same capacitance value, tolerance, rated voltage and temperature coefficient.

6.4.1 Test data. For the purpose of verification of qualification and conformance inspection (see 4.4.4 and 4.5), test data on identical items covered by MIL-PRF-23269 may be used.

6.5 Subject term (key word) listing.
Dielectric withstanding voltage
Dissipation factor
Insulation resistance
Quality factor

* 6.6 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.

* 6.7. Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmentally Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals is available on their website at http://www.epa.gov/epaoswer/hazwaste/minimize/chemlist.htm. Further information is available at the following EPA site: http://www.epa.gov/epaoswer/hazwaste/minimize/. Included in the EPA list of 31 priority chemicals are cadmium, lead, and mercury. Use of the materials on the list should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

* 6.8 Part or Identifying Number (PIN) (see 1.2.1). The term “Part or Identifying Number (PIN)” is equivalent to the term “type designation” that was used previously in this specification.

* 6.9 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue 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.

APPENDIX A

PROCEDURE FOR QUALIFICATION INSPECTION

A.1. SCOPE

* A.1.1 This appendix details the procedure for submission of samples for qualification inspection of capacitors covered by this specification. The procedure for extending qualification of the required sample to other capacitors covered by this specification is also outlined herein. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

A.2. SUBMISSION

A.2.1 Sample.

* A.2.1.1 Single style submission. A sample consisting of 51 sample units of the highest capacitance value and 13 sample units of the lowest capacitance value, but not lower than 47 pF, in each style and dc rated voltage, for which qualification is sought shall be submitted. The sample units shall be in the J (±5 percent) or closer capacitance tolerance. The sample units subjected to groups II and IV of table IV shall be composed of the highest capacitance values represented in the submission, and the sample units subjected to groups III and V shall be composed of equal numbers of the highest and lowest capacitance values represented. The sample units shall then be subjected to the inspection for their particular group.

A.3. EXTENT OF QUALIFICATION

* A.3.1 Single style submission. Qualification within a style and dc rated voltage will be restricted to capacitance values within the range of values submitted. Qualification of the ±5 percent or closer capacitance tolerance automatically qualifies all other applicable capacitance tolerances. If, where applicable, 47 pF sample units are submitted, qualification will be granted for all capacitance values equal to and less than the highest value submitted.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Review activities:
Army - MI
Navy - MC
Air Force - 19, 99

Preparing activity:
DLA - CC

(Project 5910-2008-010)

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 ASSIST Online database at http://assist.daps.mil