

MILITARY SPECIFICATION

CAPACITORS, FIXED, CERAMIC DIELECTRIC (GENERAL PURPOSE),
 GENERAL SPECIFICATION FOR

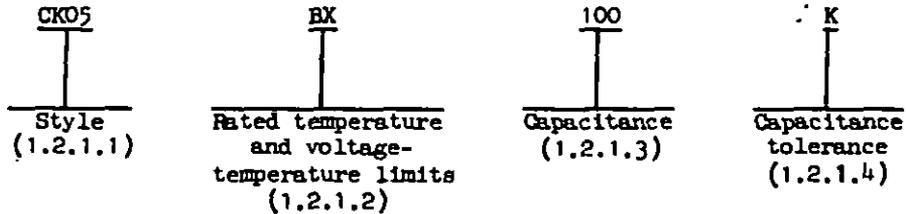
This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for general purpose, ceramic dielectric, insulated, fixed capacitors for use in applications where variations in capacitance with respect to temperature, voltage, frequency, and life can be tolerated.

1.2 Classification.

1.2.1 Type designation. The type designation shall be in the following form, and as specified (see 3.1 and 6.1):



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

1.2.1.2 Rated temperature and voltage-temperature limits. The rated temperature and voltage-temperature limits are identified by a two-letter symbol. The first letter indicates the rated temperature as shown in table I; the second letter indicates the voltage-temperature limits as shown in table II.

TABLE I. Rated temperature.

Symbol	Temperature (range) °C
A - -	-55 to +85
B - -	-55 to +125
C - -	-55 to +150

TABLE II. Voltage-temperature limits.

Symbol	Capacitance change with reference to 25 °C		Rated temperature symbol (see table I)
	Steps A to D incl of table VIII	Steps E to G incl of table VIII	
	<u>Percent</u>	<u>Percent</u>	
R - - - -	+15, -15	+15, -40	B
W - - - -	+22, -56	+22, -66	A
X - - - -	+15, -15	+15, -25	A, B
Y - - - -	+30, -70	+30, -80	A
Z - - - -	+20, -20	+20, -30	C

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" shall be used to indicate the decimal point and the succeeding digits of the group shall represent significant figures. Example: 2R2 indicates 2.2 pf.

1.2.1.4 Capacitance tolerance. The capacitance tolerance is identified by a single letter as shown in table III.

TABLE III. Capacitance tolerance.

Symbol	Capacitance tolerance
	<u>Percent (±)</u>
K - - -	10
M - - -	20

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

- MIL-C-39028 - Capacitors, Packaging of, General Specification
For.
MIL-C-45662 - Calibration of Standards.

(See supplement 1 for list of associated specification sheets.)

STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection
by Attributes.
MIL-STD-202 - Test Methods for Electronic and Electrical
Component Parts.

MIL-STD-456 - Electronic Parts, Date and Source Coding For.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.)

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between requirements of this specification and the specification sheets, the latter shall govern. (See 6.1.)

3.2 Qualification. Capacitors furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.2).

3.3 Materials. Materials 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 Insulating and impregnating compounds. Insulating and impregnating compounds, including resins, varnishes, waxes, and the like, shall be suitable for each particular application. Compounds shall preserve the electrical characteristics of the insulation to which they are applied.

3.3.2 Soldering flux. Soldering flux shall be rosin, rosin and alcohol, or rosin and turpentine. No acid or acid salts shall be used in preparation for or during soldering.

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

3.4.1 Threaded parts. All threaded parts (see 3.1) shall be in accordance with Handbook H28.

3.4.2 Solder-type terminals. Solder-type terminals shall be coated with solder having a 40- to 70-percent tin content.

3.4.3 Mounting hardware (when specified, see 3.1). Capacitors shall be furnished with the mounting hardware specified (see 3.1).

3.5 Dielectric withstanding voltage. When capacitors are tested as specified in 4.6.2, there shall be no breakdown or evidence of damage.

3.6 Barometric pressure (reduced). When tested as specified in 4.6.3, capacitors shall withstand the dc potential specified (see 3.1) without flashover.

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

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

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

3.10 Seal (styles CK18 and CK19). When tested as specified in 4.6.7, capacitors shall meet the following requirements:

- Insulation resistance - - - - As specified in 3.7.
- Capacitance - - - - - Change not more than the percent specified (see 3.1) from the initial measured value (see 3.8).
- Dissipation factor - - - - - Not more than the value specified (see 3.1).

3.11 Shock, medium impact (all styles except CK21, CK22, CK26, and CK27). When capacitors are tested as specified in 4.6.8, there shall be no momentary or intermittent contacts of 0.5 millisecond (ms) or greater duration, or other indication of breakdown or arcing, nor shall there be any evidence of mechanical damage.

3.12 Vibration, high frequency. When capacitors are tested as specified in 4.6.9, there shall be no intermittent contacts of 0.5 ms or greater duration, open or short-circuiting, or evidence of mechanical damage.

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

- Visual examination - - - - - No mechanical damage.
- Dielectric withstanding voltage (when specified, see 3.1) - As specified in 3.5.
- Insulation resistance - - - - - Not less than value specified (see 3.1).
- Capacitance (when specified, see 3.1) - - - - - As specified in 3.8.
- Dissipation factor (when specified, see 3.1) - - - - - As specified in 3.9.

3.14 Salt spray (corrosion) (styles CK70, CK72, CK80, and CK81). When capacitors are tested as specified in 4.6.11, there shall be no harmful or extensive corrosion, and at least 90 percent of any exposed metal surface of the capacitor shall be protected by the finish. There shall be no mechanical damage to insulating surfaces. In addition, corrosion of the mounting hardware or of the terminals shall not exceed 10 percent of the surface area.

3.15 Terminal strength (direct load) (when specified, see 3.1). When capacitors are tested as specified in 4.6.12, the terminals shall not loosen or rupture.

3.16 Moisture resistance. When tested as specified in 4.6.13, capacitors shall meet the following requirements:

- Visual examination - - - - - No mechanical damage.
- Dielectric withstanding voltage (when specified, see 3.1) - As specified in 3.5.

Insulation resistance - - - - - Not less than the value specified (see 3.1).
 Capacitance (when specified, see 3.1) - - - - - As specified in 3.8.

3.17 Solderability. When capacitors are tested as specified in 4.6.14, the dipped surface shall be at least 95 percent covered with a new, smooth, solder coating. The remaining 5 percent may contain only small pinholes or rough spots; these shall not be concentrated in one area. Bare base metal where the solder dip failed to cover the original coating is an indication 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.

3.18 Resistance to soldering heat (all styles except CK21, CK22, CK26, and CK27) (qualification test). When tested as specified in 4.6.15, capacitors shall meet the following requirements:

Insulation resistance - - - - - Not less than the initial measured value (see 3.1).
 Capacitance - - - - - Change not more than ± 5 percent from the initial measured value.
 Dissipation factor - - - - - Change shall not exceed 0.5 percent.

3.19 Voltage-temperature limits. When capacitors are tested as specified in 4.6.16, the capacitance change shall not exceed the applicable limits specified in table II.

3.20 Life (at elevated ambient temperature). When tested as specified in 4.6.17, capacitors shall meet the following requirements:

Visual examination - - - - - No mechanical damage.
 Dielectric withstanding voltage (when specified, see 3.1) - - - - - As specified in 3.5.
 Insulation resistance - - - - - Shall be not less than the value specified (see 3.1).
 Capacitance (when specified, see 3.1) - - - - - As specified in 3.8.
 Dissipation factor - - - - - Shall not exceed the value specified (see 3.1).

3.21 Marking. Unless otherwise specified (see 3.1), capacitors shall be permanently and legibly marked with the type designation, the manufacturer's name or symbol, and the date code. Paper labels shall not be used. Other markings which in any way interfere with, obscure, or confuse those specified herein are prohibited. The marking shall remain legible after all tests.

3.21.1 Type designation. There shall be no space between the symbols which comprise the type designation. When the size of the capacitor does not permit the type designation to be marked on one line, it may be divided into two or three lines as shown in the following examples:

Examples:

CK60BX	or	CKD5
2R2K		EX
		100K

3.21.2 Date code. The date code shall be in accordance with MIL-STD-456 and, unless otherwise specified (see 3.1), shall be marked on the capacitor wherever capacitor size permits.

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

3.22.1 Soldering. All excess flux or solder shall be removed. Electrical connections shall be mechanically secured before soldering, where possible, and electrically continuous after soldering.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities. The supplier shall establish and maintain a calibration system in accordance with MIL-C-45662.

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

- (a) Qualification inspection (see 4.4).
- (b) Quality conformance inspection (see 4.5).

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.

4.4 Qualification inspection. ^{1/} Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.2) 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 inspections of group I. The sample shall then be divided as specified in table IV for groups II to VI inclusive and subjected to the inspection for their particular group.

^{1/} Application for qualification tests shall be made in accordance with "Provisions Governing Qualification" (see 6.2.1).

TABLE IV. Qualification inspection.

Examination or test	Requirement paragraph	Test paragraph	Number of sample units to be inspected	Number of failures allowed $\frac{1}{}$
<u>Group I</u> $\frac{2}{}$				
Visual and mechanical examination: - - - - -	---	4.6.1	} $\frac{4}{51}$ or $\frac{4}{63}$	} 1
Materials, design, construction, and workmanship - - - - -	3.3, 3.4, and 3.22	---		
Physical dimensions and marking $\frac{3}{}$ - - - - -	3.1 and 3.21	---		
Electric withstanding voltage - - - - -	3.5	4.6.2		
Isometric pressure (reduced) - - - - -	3.6	4.6.3		
Insulation resistance - - - - -	3.7	4.6.4		
Capacitance - - - - -	3.8	4.6.5		
Loss factor - - - - -	3.9	4.6.6		
Dielectric loss factor (styles CK18 and CK19) - - - - -	3.10	4.6.7		
<u>Group II</u>				
Shock, medium impact (all styles except CK21, CK22, CK26, and CK27) - - - - -	3.11	4.6.8	} 12	} 1
Vibration, high frequency - - - - -	3.12	4.6.9		
Temperature cycling and immersion - - - - -	3.13	4.6.10		
Corrosion spray (corrosion) (styles CK70, CK72, CK80, and CK81) - - - - -	3.14	4.6.11		
<u>Group III</u>				
Minimum strength (direct load) (when specified, see 3.1) - - - - -	3.15	4.6.12	} 12	} 1
Moisture resistance - - - - -	3.16	4.6.13		
<u>Group IV</u>				
Reliability - - - - -	3.17	4.6.14	10	1
<u>Group V</u>				
Resistance to soldering heat (all styles except CK21, CK22, CK26, and CK27) - - - - -	3.18	4.6.15	4	0
<u>Group VI</u>				
Storage-temperature limits - - - - -	3.19	4.6.16.1	} 12 or $\frac{5}{24}$	} 1
Life (at elevated ambient temperature) - - - - -	3.20	4.6.17.1		

A sample unit having one or more defects shall be considered as a single failure.

Nondestructive examinations and tests (see #0.2).

Marking defects shall be based on visual examination only and shall be charged only for illegible, incomplete, or incorrect marking.

One additional sample unit is included in each sample size to permit substitution for the failure allowed in group I.

For styles CK05 and CK06 capacitors with dual temperature ratings (see 3.1), 12 sample units shall be subjected to the group VI tests at 125°C; the remaining 12 sample units shall be subjected to the group VI tests at 150°C.

4.4.3 Failures. Failures in excess of those allowed in table IV shall be cause for refusal to grant qualification approval.

4.5 Quality conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections. Except as specified in 4.5.1.4.4, delivery of products which have passed groups A and B inspections shall not be delayed pending the results of group C 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. The capacitance values and voltages produced shall be represented in the lot in approximately the ratio of production. (The sample units included in the lot may be marked with various date codes.)

4.5.1.2 Group A inspection. Group A inspection shall consist of the examination and tests specified in table V, and shall be performed on the same set of sample units, in the order shown.

TABLE V. Group A inspection.

Examination or test	Requirement paragraph	Test paragraph	AQL (percent defective)	
			Major	Minor
Visual and mechanical examination:	---	4.6.1	} 1.0	} 4.0
Materials - - - - -	3.3	---		
Body dimensions - - - - -	3.1	---		
Design and construction (other than body dimensions) - - - - -	3.4	---		
Marking ^{1/} - - - - -	3.21	---		
Workmanship - - - - -	3.22	---	} 1.0	---
Dielectric withstanding voltage --	3.5	4.6.2		
Insulation resistance - - - - -	3.7	4.6.4		
Capacitance - - - - -	3.8	4.6.5		
Dissipation factor - - - - -	3.9	4.6.6		
Seal (styles CK18 and CK19) - - - -	3.10	4.6.7		

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

4.5.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be as specified in table V. Major and minor defects shall be as defined in MIL-STD-105 and as specified in table V.

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. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as re-inspected lots.

4.5.1.3 Group B inspection. Group B inspection shall consist of the tests specified in table VI, in the order shown, and shall be performed on sample units which have been subjected to and have passed the group A inspection.

TABLE VI. Group B inspection.

Test	Requirement paragraph	Test paragraph
Voltage-temperature limits - - - - -	3.19	4.6.16.2
Life (at elevated ambient temperature) (performance check) - - -	3.20	4.6.17.2.1

4.5.1.3.1 Sampling plan. The sampling plan shall be in accordance with MIL-STD-105 for special inspection level S-4. The AQL shall be 4.0 percent defective.

4.5.1.3.2 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. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

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

4.5.1.4 Group C inspection. Group C inspection shall consist of the tests specified in table VII, in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed groups A and B inspections.

4.5.1.4.1 Sampling plan. Sample units shall be selected in accordance with 4.5.1.4.1.1 and 4.5.1.4.1.2. The number of sample units to be inspected for each sampling period shall be as specified in table VII. A different sample shall be selected for each subgroup.

4.5.1.4.1.1 Every month. Every month, sample units shall be selected and subjected to the tests of subgroups 1, 2, and 3 of table VII. Subgroups 1 and 2 may be checked during alternate biweekly periods.

4.5.1.4.1.2 Every 2 months. Every 2 months, sample units shall be selected and subjected to the test of subgroup 4 of table VII. These sample units shall be selected from sample units which have been subjected to the 250-hour performance test (see table VI).

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

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

TABLE VII. Group C inspection.

Test	Requirement paragraph	Test paragraph	Number of sample units to be inspected	Number of failures, allowed ^{1/}
<u>Every month (Subgroup 1)</u>				
Shock, medium impact (all styles except CK21, CK22, CK26, and CK27) - - - - -	3.11	4.6.8	} 12	} 1
Vibration, high frequency - -	3.12	4.6.9		
Temperature cycling and immersion - - - - -	3.13	4.6.10		
Salt spray (corrosion) (styles CK70, CK72, CK80, and CK81) - - - - -	3.14	4.6.11		
<u>Every month (Subgroup 2)</u>				
Barometric pressure (reduced) - - - - -	3.6	4.6.3	} 12	} 1
Terminal strength (direct load) (when specified, see 3.1) - - - - -	3.15	4.6.12		
Moisture resistance - - - - -	3.16	4.6.13		
<u>Every month (Subgroup 3)</u>				
Solderability - - - - -	3.17	4.6.14	10	1
<u>Every 2 months (Subgroup 4)</u>				
Life (at elevated ambient temperature) (continuation test) - - - - -	3.20	4.6.17.2.2	12	1

^{1/} A sample unit having one or more defects shall be charged as a single failure.

4.5.1.4.4 Noncompliance. If a sample fails to pass group C inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which 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 C inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Groups A and B inspections may be reinstated; however, final acceptance shall be withheld until the group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.2 Retention of qualification. To retain qualification, the supplier shall forward, at 6-month intervals, to the qualifying activity, a summary of the results of groups A and B tests, indicating as a minimum the number of lots which passed and the number which failed, and a summary of the results of group C tests, including the number and type of any part failures. The summary shall include those tests

performed during that 6-month period. If the summary of the test results indicates nonconformance with specification requirements, action shall be taken to remove the failing product from the qualified products list. Failure to submit the summary shall result in loss of qualification for that product. In addition to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time during the 6-month period that the inspection data for group C inspection indicates failure of the qualified product to meet the requirements of the specification. In the event that no production occurred during the reporting period, a negative report shall be submitted.

4.5.3 Inspection of preparation for delivery. Sample packages or packs and the inspection of the preservation, packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of MIL-C-39028.

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, 3.4, 3.21, and 3.22).

4.6.2 Dielectric withstanding voltage (see 3.5).

4.6.2.1 Dielectric. 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 voltage - As specified (see 3.1).
- (b) Duration of application of test voltage - 5 ± 1 seconds.
- (c) Points of application of test voltage - Unless otherwise specified (see 3.1), between the capacitor-element terminals.
- (d) Limiting value of surge current - Shall not exceed 50 milliamperes (ma).
- (e) Examination after test - Capacitors shall be examined for evidence of damage and breakdown.

4.6.2.2 Body insulation (when applicable, see 3.1). Unless otherwise specified (see 3.1), capacitors shall be placed in a container of stainless steel powder so that the powder will not be less than 0.065 inch and not more than 0.125 inch away from the lead wires. A dc potential (see 3.1) shall be applied between the two leads connected together and the steel powder for a period of 5 ± 1 seconds. The test circuit shall be so arranged that the surge current will not exceed 50 ma. Grains of stainless steel powder shall not exceed 0.005 inch diameter. Following the test, capacitors shall be examined for evidence of damage and breakdown.

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

- (a) Method of mounting - Securely fastened by their normal mounting means.
- (b) Test conditions - As specified (see 3.1).
- (c) Test during subjection to reduced pressure - A dc potential as specified (see 3.1) shall be applied for a period of 5 ± 1 seconds.

- (d) Points of application of test voltage - Unless otherwise specified (see 3.1), between the capacitor-element terminals.
- (e) Surge current - Shall not exceed 50 ma.

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 conditions - As specified (see 3.1).
- (b) Special conditions - If a failure occurs at a relative humidity over 50 percent, the insulation resistance may be measured again at any relative humidity less than 50 percent.
- (c) Points of measurement - Unless otherwise specified (see 3.1), between the capacitor-element terminals.

4.6.5 Capacitance (see 3.8). Capacitors shall be tested in accordance with method 305 of MIL-STD-202. The following detail and exception shall apply:

- (a) Test frequency - As specified (see 3.1).
- (b) Test voltage - 1.0 ± 0.2 volt rms.

NOTE: Following a dielectric withstanding voltage or insulation resistance test, capacitance may be measured after holding the capacitor for a period of time not to exceed 12 hours.

4.6.6 Dissipation factor (see 3.9). Dissipation factor shall be measured with a bridge or other suitable equipment at the frequency and voltage specified in 4.6.5.

4.6.7 Seal (styles CK18 and CK19) (see 3.10). Capacitors shall be subjected to a saturated steam atmosphere of 5 pounds per square inch gage for a period of 20 to 30 minutes. Insulation resistance, capacitance, and dissipation factor measurements shall then be made as specified in 4.6.4, 4.6.5, and 4.6.6, respectively.

4.6.8 Shock, medium impact (all styles except CK21, CK22, CK26, and CK27) (see 3.11). Capacitors shall be tested in accordance with method 205 of MIL-STD-202. The following details and exception shall apply:

- (a) Mounting - Capacitors shall be rigidly mounted by the body.
- (b) Test-condition letter - C (50 G's).
- (c) Measurements during shock - During the last shock in each direction, an electrical measurement shall be made to determine intermittent contacts of 0.5 ms or greater duration, or open- or short-circuiting.
- (d) Examination after shock - Capacitors shall be visually examined for evidence of breakdown, arcing, and 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 - Unless otherwise specified (see 3.1), capacitors shall be rigidly mounted on a mounting fixture by the body with their leads secured to rigidly supported stud-terminals, so spaced that the length of each lead from the capacitor is approximately .375 inch when measured from the

edge of the supporting terminal. Leads shall be within 30 degrees of being parallel; each lead in disk types shall be in the plane of the flat surface from which it extends. When securing leads, care should be taken to avoid pinching the leads. The mounting fixture shall be so constructed as to preclude any resonances within the test range. An examination of the mounting fixture shall be made on a vibrator. If any resonant frequencies are observed, adequate steps shall be taken to damp the structure.

- (b) Electrical-load conditions - During the test, a dc potential equal to 125 percent of the rated voltage (see 3.1) shall be applied between the terminals of the capacitor.
- (c) Test-condition letter - B (15 G's) or D (20 G's) (see 3.1).
- (d) Duration and direction of motion - 2 hours in each of three mutually perpendicular directions (total of 6 hours).
- (e) Measurements during vibration - During the last cycle in each direction, an electrical measurement shall be made to determine intermittent operation or open- or short-circuiting. Observations shall also be made to determine intermittent contacts or open- or short-circuiting. Detecting equipment shall be sufficiently sensitive to detect any interruption of 0.5 ms or greater duration.
- (f) Examination after vibration - After the test and with the capacitors still mounted in the mounting fixture (except instances where inspection cannot be made without removal of the capacitor), the capacitor shall be visually examined for evidence of mechanical damage.

4.6.10 Temperature cycling and immersion (see 3.13).

4.6.10.1 Temperature cycling. Capacitors shall be tested in accordance with method 102 of MIL-STD-202. The following details shall apply:

- (a) Test-condition letter - D, except that in step 3, sample units shall be tested at the maximum rated temperature (see table I and 3.1).
- (b) Measurements before and after cycling - Not applicable.

4.6.10.2 Immersion. Following temperature cycling, capacitors shall be tested in accordance with method 104 of MIL-STD-202. The following detail and exception shall apply:

- (a) Test-condition letter - B.
- (b) Examinations and measurements after final cycle - Capacitors shall be visually examined for evidence of mechanical damage; dielectric withstanding voltage (when specified, see 3.1), insulation resistance, capacitance (when specified, see 3.1), and dissipation factor (when specified, see 3.1) shall then be measured as specified in 4.6.2.1, 4.6.4, 4.6.5, and 4.6.6, respectively.

4.6.11 Salt spray (corrosion) (styles CK70, CK72, CK80, and CK81) (see 3.14). Capacitors shall be tested in accordance with method 101 of MIL-STD-202. The following details and exception shall apply:

- (a) Applicable salt solution - 5 percent.
- (b) Test-condition letter - B (48 hours).

- (c) Measurements after exposure - Not applicable.
- (d) Examinations after test - Capacitors shall be visually examined for evidence of harmful and extensive corrosion.

4.6.12 Terminal strength (direct load) (when specified, see 3.1) (see 3.15). Capacitors shall be held by one terminal and the specified load (see 3.1) gradually applied to the other terminal. The pull shall be applied for at least 5 seconds. Capacitors shall then be examined for evidence of loosening and rupturing of the terminals.

4.6.13 Moisture resistance (see 3.16). Capacitors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Initial measurements - Not applicable.
- (b) Number of cycles - 20 continuous cycles.
- (c) Loading voltage - During the first 10 cycles, a dc potential of 100 volts or rated voltage, whichever is less, shall be applied across the capacitor terminals. Once each day, a check shall be performed to determine whether a capacitor has shorted.
- (d) Final measurements - After the final cycle, capacitors shall be conditioned at $25^{\circ} \pm 5^{\circ}\text{C}$ and a relative humidity of 50 ± 5 percent for a period of 18 hours minimum, 24 hours maximum, and shall be visually examined for mechanical damage. Dielectric withstanding voltage (when specified, see 3.1), insulation resistance, and capacitance (when specified, see 3.1) shall be measured as specified in 4.6.2.1, 4.6.4, and 4.6.5, respectively.

4.6.14 Solderability (see 3.17). Capacitors shall be tested in accordance with method 208 of MIL-STD-202. The following detail shall apply:

- (a) Number of terminations of each part to be tested - As specified (see 3.1).

4.6.15 Resistance to soldering heat (all styles except CK21, CK22, CK26, and CK27) (see 3.18). Capacitors shall be tested in accordance with method 210 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Depth of immersion in the molten solder - To a minimum of 0.01 inch from the capacitor body.
- (b) Test-condition letter - B ($260 \pm 5^{\circ}\text{C}$).
- (c) Cooling time prior to measurement after test - 10 ± 1 minutes.
- (d) Measurements after test - Insulation resistance, capacitance, and dissipation factor shall be measured as specified in 4.6.4, 4.6.5, and 4.6.6, respectively.

4.6.16 Voltage-temperature limits (see 3.19).

4.6.16.1 For qualification inspection. Capacitors shall be tested as specified in 4.6.5, except that the capacitance measurements shall be made at the steps shown in table VIII and at a sufficient number of intermediate points between steps B and G of table VIII to establish a true characteristic curve. The capacitance value obtained in step G of table VIII shall be considered as the reference point. The capacitance measurement at each temperature shall be recorded when two successive readings taken at 5-minute intervals at that temperature indicate a capacitance change of less than 1 percent.

TABLE VIII. Voltage-temperature-limit cycle.

Step ^{1/}	Voltage	Temperature
	volts, dc	°C
A - - - - -	None	+25±2
B - - - - -	None	-55±2
C - - - - -	None	+25±2
D - - - - -	None	Max rated temp ⁺⁴
E - - - - -	^{2/} 500	Max rated temp ⁺⁴
F - - - - -	^{2/} 500	-0
G - - - - -	^{2/} 500	+25±2
		-55±2

^{1/} For styles CK05 and CK06 capacitors with dual temperature ratings (see 3.1), steps D and E shall be performed at each maximum rated temperature.

^{2/} For capacitors with voltage ratings of less than 500 volts, rated voltage (see 3.1) shall be applied.

4.6.16.2 For quality conformance inspection. Capacitors shall be tested as specified in 4.6.16.1, except that measurements shall be made only for steps C, D, E, and G of table VIII.

4.6.17 Life (at elevated ambient temperature) (see 3.20).

4.6.17.1 For qualification inspection. Capacitors shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Distance of temperature measurements from specimens, in inches - Not applicable.
- (b) Test temperature and tolerance - At the applicable maximum rated temperature, ⁺⁴₋₀ °C (see 3.1). For styles CK05 and CK06 capacitors with dual temperature ratings (see 3.1), this test shall be performed at each maximum rated temperature.
- (c) Operating conditions - Capacitors shall be subjected to the specified voltage (see 3.1). The surge current shall not exceed 50 ma. When necessary, a suitable current-limiting resistor shall be inserted into the circuit.
- (d) Test conditions - As specified (see 3.1).
- (e) Measurements during and after exposure - At the conclusion of this test and while the capacitors are still held at the maximum rated temperature, dielectric withstanding voltage (when specified, see 3.1), insulation resistance, and capacitance (when specified, see 3.1), shall be measured as specified in 4.6.2.1, 4.6.4, and 4.6.5, respectively. The capacitors shall then be returned to the inspection conditions specified in 4.3, and shall be visually examined for evidence of mechanical damage and obliteration of marking; dielectric withstanding voltage (when specified, see 3.1), insulation resistance, capacitance (when specified, see 3.1), and dissipation factor shall be measured as specified in 4.6.2.1, 4.6.4, 4.6.5, and 4.6.6, respectively.

4.6.17.2 For quality conformance inspection.

4.6.17.2.1 Performance check. Capacitors shall be tested as specified in 4.6.17.1, except that the duration of the test shall be 250 hours.

4.6.17.2.2 Continuation test. Capacitors shall be tested as specified in 4.6.17.1, except that the duration of the test shall be as specified (see 3.1).

5. PREPARATION FOR DELIVERY

5.1 Capacitors shall be prepared for delivery in accordance with MIL-C-39028.

6. NOTES

6.1 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of the applicable specification sheet, and the complete type designation (see 3.1).
- (c) Required levels of preservation and packaging and packing, and special marking (see section 5).

6.1.1 Indirect shipments. The preservation, packaging, packing, and marking requirements (see section 5) apply only to direct purchases by or direct shipments to the Government and are not intended to apply to contracts or orders between the supplier and the prime contractor.

6.2 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list, whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, 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. The activity responsible for the qualified products list is the Naval Electronic Systems Command, Department of the Navy, Washington, D. C; however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center (DESC-E), Dayton, Ohio 45401. Application for qualification tests shall be made in accordance with "Provisions Governing Qualification" (see 6.2.1).

6.2.1 Copies of "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, U. S. Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

6.3 Ambient operating conditions. Designers are cautioned to give consideration to the change in dielectric constant with temperature, shelf aging, and electric-field intensity, and should recognize that the apparent insulation resistance may vary with humidity and surface conditions.

6.4 Superseded styles. Several styles formerly covered by this specification have been canceled. Recommended substitute items and applicable specification sheets are as listed in table IX.

TABLE IX. Cross-reference of substitute items.

Deleted or superseded style		Recommended substitute style	
Style	Spec sheet	Style	Spec sheet
CK17 - - - -	MIL-C-11015/20	CK15	MIL-C-11015/20
CK33 - - - -	MIL-C-11015/5	CK22	MIL-C-11015/2
CK36 - ● - - -	MIL-C-11015/6	CK21	MIL-C-11015/1
CK37 - - - -	MIL-C-11015/7		No Replacement
CK47 - - - -	MIL-C-11015/8	CK27	MIL-C-11015/4
CK50 - - - -	MIL-C-11015/16	CK61	MIL-C-11015/10
CK51 - - - -	MIL-C-11015/17	CK63	MIL-C-11015/12
CK90 and CK91-	MIL-C-11015/22		No Replacement

6.5 Standard capacitor types. Equipment designers should refer to MIL-STD-198, "Capacitors, Selection and Use of," for a selection of standard capacitor types and values for new equipment design. Application information concerning these capacitors is also provided in MIL-STD-198.

6.6 Revision asterisks. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - EL
Navy - EC
Air Force - 11

Preparing activity:

Navy - EC
(Project 5910-0829)

Review activities:

Army - EL, MI, MJ
Navy - EC, AS, OS, SH
Air Force - 11, 17, 85
DGA - ES

Code "C"

User activities:

Army -
Navy - MC
Air Force - 19

APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

10. SCOPE

10.1 This appendix details the procedure for submission of samples, with related data, 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.

20. SUBMISSION

20.1 Sample.

20.1.1 Single-style submission. A sample consisting of 51 sample units (63 sample units are required for styles CK05 and CK06) of the highest capacitance value in each voltage rating, in each rated temperature and voltage-temperature limits, in each style for which qualification is sought shall be submitted.

20.1.2 Combined-voltage submission (styles CK60, CK63, and CK70). A sample consisting of 26 sample units of the highest capacitance value in each voltage rating, in each rated temperature and voltage-temperature limits, in each style for which qualification is sought shall be submitted (see table X).

TABLE X. Combined-voltage submission.

Style	No. of sample units to be submitted	Type designation	Rated voltage
CK60	26	CK60AW152M	500
	26	CK60AW102M	1,000
	26	CK60AX471K	500
	26	CK60AX221K	1,000
	26	CK60BX151K	500
	26	CK60BX101K	1,000
CK63	26	CK63AW103M	500
	26	CK63AW472M	1,000
CK70	26	CK70AX681K	500
	26	CK70AX101K	1,000

20.1.3 Combined-style submission (styles CK18 and CK19). Styles CK18 and CK19 may be submitted simultaneously by the submission of 26 sample units of the highest capacitance value in each style. Failure of one style will disqualify the entire submission.

20.2 Test data. When examinations and tests are to be performed at a Government laboratory, prior to submission all sample units shall be subjected to all of the examinations and tests indicated as nondestructive in table IV. Each submission shall be accompanied by the test data obtained from these examinations and tests. The performance of the destructive tests by the supplier on a duplicate set of sample units is encouraged, although not required. All test data shall be submitted in duplicate.

20.3 Certification of material. When submitting samples for qualification, the supplier shall submit certification, in duplicate, that the materials used in his components are in accordance with the applicable specification requirements.

20.4 Description of items. The supplier shall submit a detailed description of the capacitors being submitted for inspection, including body, coating, electrode material, terminal leads, etc.

30. EXTENT OF QUALIFICATION

30.1 Single-style submission. Capacitance-range qualification will be restricted to values equal to and less than the capacitance value submitted. Capacitance-tolerance qualification will be restricted to tolerances equal to and wider than the tolerance submitted. Voltage rating qualification will be restricted to that submitted. Rated temperature and voltage-temperature-limit qualification will be restricted to that submitted. Qualification of one style may be the basis for qualification of another style, as shown in table XI, provided that the dielectric material, rated temperature and voltage-temperature limits, and dielectric thickness are essentially the same.

TABLE XI. Style qualification.

Style	May also qualify
CK09 - - - - -	CK08
CK10 - - - - -	CK09, CK08
CK13 - - - - -	CK12
CK14 - - - - -	CK13, CK12
CK15 - - - - -	CK14, CK13, CK12
CK16 - - - - -	CK15, CK14, CK13, CK12
CK61 - - - - -	CK60
CK62 - - - - -	CK61, CK60
CK63 - - - - -	CK62, CK61, CK60
CK65 - - - - -	CK64
CK66 - - - - -	CK65, CK64
CK67 - - - - -	CK66, CK65, CK64
CK69 - - - - -	CK68

30.2 Combined-voltage submission (styles CK60, CK63, and CK70). Capacitance-range qualification will be restricted to values equal to and less than the capacitance value submitted. Capacitance-tolerance qualification will be restricted to tolerances equal to and wider than the tolerance submitted. Voltage rating qualification will be restricted to those submitted. Rated temperature (range) qualification will be restricted to ranges equal to and narrower than the widest range submitted. Voltage-temperature-limit qualification will be restricted to limits equal to and wider than the narrowest limit submitted.

30.3 Combined-style submission (styles CK18 and CK19). Qualification of capacitance tolerance K in the style submitted will be the basis for qualification of capacitance tolerance M.

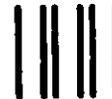
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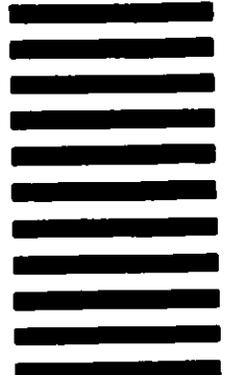
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		<input type="checkbox"/> USER	
		<input type="checkbox"/> MANUFACTURER	
		<input type="checkbox"/> OTHER (Specify): _____	
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c. Reason/Rationale for Recommendation:			
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