

INCH-POUND

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SUPERSEDING
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MILITARY SPECIFICATION

CAPACITORS, CHIP, SINGLE LAYER, FIXED, PARALLEL PLATE,
CERAMIC DIELECTRIC, ESTABLISHED RELIABILITY, GENERAL SPECIFICATION FOR

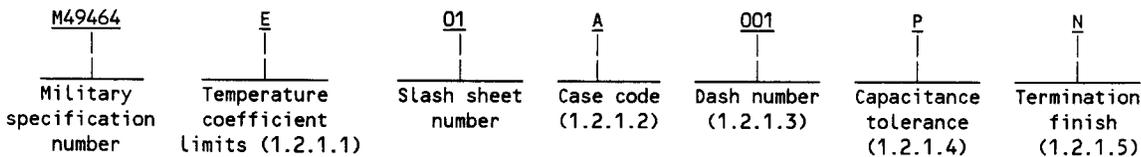
This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers established reliability, ceramic plate, single layer, capacitors. These capacitors are intended for stripline or microstrip applications, usually at frequencies of 1 GHz and higher. Capacitors covered by this specification have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. These failure rate levels are established at a 90-percent confidence level and maintained at a 10-percent producer's risk. They are based on life tests performed at maximum rated voltage at maximum rated temperature. An acceleration factor of 8:1 has been used to relate life test data obtained at 200 percent of rated voltage at maximum rated temperature, to rated voltage at rated temperature. A parts per million (PPM) quality system is used for documenting and reporting the average outgoing quality of capacitors supplied to this specification. Statistical Process Control (SPC) techniques are required in the manufacturing process to minimize variation in production of capacitors supplied to the requirements of this specification.

1.2 Classification.

1.2.1 PIN. The term Part or Identifying Number (PIN) is equivalent to the term (part number, identification number, type designator) which was previously used in this specification. Capacitors specified herein shall be identified by a military PIN which shall consist of the basic number of the military specification sheet followed by a series of coded characters. Each military specification sheet covers a different capacitor style. The coded number shall provide information concerning the capacitor's temperature coefficient, slash sheet number, case code, dash number, capacitance tolerance and termination finish. The PIN shall be in the following form, and as specified (see 3.1).



1.2.1.1 Temperature coefficient limits. The rated temperature and temperature coefficient limits are identified by a single letter. The rated temperature of these parts is -55°C to +125°C; the letter indicates the temperature coefficient limits as shown in table I.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Laboratory Command, (LABCOM), ATTN: SLCET-RS, Fort Monmouth, NJ 07703-5302 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

TABLE I. Temperature coefficient limits.

Symbol	PPM/°C	Class	Symbol	PPM/°C	Class
E	+90 ±30	1A	S	-2400 ±1000	1B
F	0 ±15	1A	T	-3300 ±1000	1C
G	0 ±30	1A	U	-3900 ±1000	1C
N	-750 ±250	1B	V	-4700 ±1000	1C
P	-1500 ±500	1B	X	±15%	2
R	-2200 ±600	1B	Y	±25%	2
			Z	+22 -82%	3 <u>1/</u>

1/ Temperature coefficient measured between +10°C and +85°C.

1.2.1.2 Case code. The case code is identified by a single letter (see 3.1).

1.2.1.3 Dash number. The dash number shall represent a specific capacitance value, voltage and failure rate level (see table II and 3.1).

TABLE II. Failure rate level (established at 90 percent confidence).

Symbol	Failure rate level (% per 1,000 hours)
M	1.0
P	0.1
R	0.01
S	0.001

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
P	±.01 pF
A	±.05 pF
B	±.10 pF
C	±.25 pF
D	±.50 pF
F	± 1 percent
G	± 2 percent
J	± 5 percent
K	± 10 percent
M	± 20 percent
V	-0 +100 percent
Z	-20 +80 percent

1.2.1.5 Termination finish. The termination finish shall be identified by either the letter "N" or "P". The letter "N" shall identify a termination suitable for solder attachment (see 3.5.2). The letter "P" shall identify a termination suitable for attachment by conductive epoxy or eutectic methods (see 3.5.2).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

QQ-S-571 - Solder, Tin Alloy, Tin-Lead Alloy, and Lead Alloy.

MILITARY

MIL-C-39028 - Capacitors, Packaging of.
MIL-C-49464/1 - Capacitors, Chip, Single Layer, Fixed Unencapsulated, Ceramic Dielectric, Established Reliability, Style CPCRO1 (High Frequency).

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-690 - Failure Rate Sampling Plans and Procedures.
MIL-STD-790 - Reliability Assurance Program for Electronic Parts Specifications.
MIL-STD-810 - Environmental Test Methods.
MIL-STD-883 - Test Methods and Procedures for Microelectronics.

(Unless otherwise indicated, copies of federal and military specification, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA-554 - Assessment of Outgoing Nonconforming Levels in Parts Per Million (PPM).
EIA-557 - Statistical Process Control Systems.

(Application for copies should be addressed to the Electronic Industries Association, 2001 Eye Street, NW, Washington, DC 20006.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the reference cited herein (except for associated detail specifications, specifications sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Detail specification sheet. 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 sheet, the latter shall govern.

3.2 Qualification. The capacitors furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.4 and 6.3). In addition, the manufacturer shall obtain certification from the qualifying activity that the reliability assurance requirements of 4.1.2 have been met and are being maintained. Authorized distributors that are approved to MIL-STD-790 distributor requirements by the Qualified Products List (QPL) manufacturer are listed in the QPL.

3.3 Reliability and quality.

3.3.1 Reliability. Reliability of capacitors furnished under this specification shall be established and maintained in accordance with the procedures and requirements specified in MIL-STD-790 and MIL-STD-690 with details specified in 4.1.1, 4.4.4, and 4.5.

3.3.2 Quality.

3.3.2.1 Statistical process control. The contractor shall implement and use statistical process control techniques in the manufacturing process for parts covered by this specification. The SPC program shall be developed and maintained in accordance with all the requirements of EIA-557. The SPC program shall be documented and maintained as part of the overall reliability assurance program as specified in MIL-STD-790. The implementation of statistical process control shall be 12 months from the date of this specification. Processes for application of SPC techniques should include but are not limited to:

- a. Raw material mixing and blending.
- b. Dielectric sheet manufacture.
- c. Firing
- d. Metallization
- e. Dicing
- f. Packaging

3.3.2.2 Quality levels. The quality of lots that have been subject to an passed the subgroup 1 100 percent screening inspection of the group A inspection shall be established and maintained in accordance with 4.4.4.2 and EIA-554 method B. Individual PPM defect level (i.e., PPM-2, and PPM-3) and an overall PPM defect level (i.e., PPM-5) shall be established based on the tests prescribed in the subgroup 2 tests of the group A inspections. The defect level for PPM-2 shall be less than 100 PPM. The implementation of parts per million verification shall be 12 months from the date of this specification.

3.3.2.2.1 Noncompliance. The contractor shall notify the qualifying activity when the 100 PPM level is reached or exceeded for PPM-2. The contractor shall provide sufficient information to the qualifying activity documenting the causes of the problem and what corrective action is being taken. Failure to correct this problem shall be the basis for removal of the affected product from the QPL.

3.4 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.

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

3.5.1 Body structure. The body shall be a single ceramic plate which shall meet the requirements as specified herein (see 3.1).

3.5.2 Terminations. The terminations shall be a minimum of 50 microinches of gold over a suitable barrier base metal "N" or a termination suitable for attachment by conductive epoxy or eutectic methods "P".

3.6 Voltage conditioning. When tested as specified in 4.7.2, capacitors shall meet the requirements of 3.6.1 through 3.6.4 inclusive.

3.6.1 Capacitance. Capacitance at +25°C shall be as specified in 3.7.

3.6.2 Dissipation factor. Dissipation factor at +25°C shall be as specified in 3.8.

3.6.3 Insulation resistance. Insulation resistance at +25°C shall be as specified in 3.9.

3.6.4 Dielectric withstanding voltage. Dielectric withstanding voltage at +25°C shall be as specified in 3.10.

3.7 Capacitance. When measured as specified in 4.7.3, the capacitance shall be within the applicable tolerance specified, (see 3.1).

3.8 Dissipation factor. When measured as specified in 4.7.4, the dissipation factor for capacitors of 4.7 pF or greater shall not exceed:

- .15 percent for class 1A characteristics
- .25 percent for class 1B characteristics
- 1.5 percent for class 1C characteristics
- 2.5 percent for class 2 characteristics
- 4.0 percent for class 3 characteristics

3.9 Insulation resistance. When measured as specified in 4.7.5, the insulation resistance at +25°C shall be not less than:

- 10^6 megohms for classes 1A, 1B, and 1C
- 10^5 megohms for classes 2 and 3

At +125°C it shall be not less than:

- 10^5 megohms for classes 1A, 1B, and 1C
- 10^4 megohms for classes 2 and 3

3.10 Dielectric withstanding voltage. When capacitors are tested as specified in 4.7.6, there shall be no evidence of breakdown or visible evidence of arcing or damage.

3.11 Solderability. Capacitors shall be tested as specified in 4.7.8, except Sn62 solder, in accordance with QQ-S-571, shall be used in lieu of Sn60. The immersed metallized surface shall be 95 percent covered with a smooth solder coating. The remaining 5 percent of the surface may contain small pinholes or rough spots; however, these shall not be concentrated in one area.

3.12 Bond strength. When tested as specified in 4.7.9, bond strength shall be at least 3.0 grams force, and there shall be no fracturing of the bond at the wire to electrode interface or separation of the electrode from the dielectric.

3.13 Die shear strength. When tested as specified in 4.7.10, parts shall not shear from their mountings within the gram force limits specified.

3.14 Temperature coefficient limits. When capacitors are tested as specified in 4.7.11, the capacitance change shall not exceed the applicable limits specified in table I.

NOTE: For negative temperature characteristics P, R, S, T, U, and V, the negative tolerance from +25°C to -55°C shall be calculated according to the formula: Negative tolerance (PPM/°C) = $-36 - (1.22 \times \text{specified positive tolerance}) + (0.22 \times \text{nominal temperature coefficient})$.

3.15 Thermal shock and immersion. When tested as specified in 4.7.12, capacitors shall meet the following requirements of 3.15.1 through 3.15.5 inclusive.

- 3.15.1 Visual inspection. There shall be no mechanical damage.
- 3.15.2 Dielectric withstanding voltage. Dielectric withstanding voltage shall be as specified in 3.10.
- 3.15.3 Insulation resistance. Insulation resistance at +25°C shall be not less than 30 percent of the initial requirement (see 3.9).
- 3.15.4 Capacitance change.
- a. Class 1A and 1B characteristics shall change not more than 0.5 percent of the nominal value or 0.5 pF, whichever is greater, from the initial measured value.
 - b. Class 1C, 2, and 3 shall change not more than ±10 percent from the initial measured value.
- 3.15.5 Dissipation factor. Dissipation factor shall be as specified in 3.8.
- 3.16 Resistance to soldering heat. When tested as specified in 4.7.13, capacitors shall meet the following requirements of 3.16.1 and 3.16.2.
- 3.16.1 Visual inspection. There shall be no evidence of mechanical damage.
- 3.16.2 Capacitance change.
- a. Classes 1A and 1B characteristics shall change not more than 0.5 percent of the nominal value or 0.5 pF, whichever is greater, from the initial measured value.
 - b. Classes 1C, 2, and 3 shall change not more than ±10 percent from the initial measured value.
- 3.17 Moisture resistance. When tested as specified in 4.7.14, capacitors shall meet the following requirements:
- a. Visual examination: There shall be no mechanical damage, and marking shall remain legible.
 - b. Dielectric withstanding voltage. Shall be as specified in 3.10.
 - c. Insulation resistance (at +25°C): Shall be not less than 30 percent of initial requirement (see 3.9).
 - d. Capacitance change:
 - (1) BX characteristic: Shall change not more than +10 percent from the initial measured value.
 - (2) BP and BG characteristics: Shall change not more than 0.5 percent of the nominal value or 0.5 pF, whichever is greater, from the initial measured value.
- 3.18 Life (at +125°C). When tested as specified in 4.7.15, capacitors shall meet the following requirements of 3.18.1 through 3.18.4 inclusive.
- 3.18.1 Visual inspection. There shall be no mechanical damage.
- 3.18.2 Insulation resistance. Insulation resistance at +25°C and +125°C shall be not less than 30 percent of initial requirement.
- 3.18.3 Capacitance change.
- a. Classes 1A and 1B characteristics shall change not more than 2.0 percent of the nominal value or 0.5 pF, whichever is greater, from the initial measured value.
 - b. Classes 1C, 2, and 3 shall change not more than ±10 percent from the initial measured value.
- 3.18.4 Dissipation factor. Dissipation factor shall be as specified in 3.8.

3.19 Fungus. The manufacturer shall certify that all materials are fungus resistant or shall perform the test specified in 4.7.16. When capacitors are tested as specified in 4.7.16, inspection shall not disclose evidence of fungus growth or damage.

3.20 Low voltage humidity. When tested as specified in 4.7.17, capacitors shall meet the following requirements of 3.20.1 through 3.20.4 inclusive.

3.20.1 Visual inspection. There shall be no mechanical damage.

3.20.2 Dielectric withstanding voltage. Dielectric withstanding voltage shall be as specified in 3.10.

3.20.3 Insulation resistance. Insulation resistance at +25°C shall be not less than 30 percent of initial requirement (see 3.9).

3.20.4 Capacitance change.

a. Classes 1A and 1B characteristics shall change not more than 0.5 percent of the nominal value or 0.5 pF, whichever is greater, from the initial measured value.

b. Classes 1C, 2, and 3 shall change not more than ±10 percent from the initial measured value.

3.21 Marking (all styles). There shall be no marking on the capacitors. Capacitor packaging containers shall be marked with the PIN, capacitance, capacitance tolerance, voltage, date code and lot symbol 'JAN' brand, and the Commercial and Government Entity (CAGE) code.

3.21.1 "JAN" and "J" marking. The United States Government has adopted, and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that electrical equipment, namely, resistors, capacitors, electron tubes and the like, acquired by, or manufactured for use by, or for the Government in accordance with standard Government specifications. Accordingly capacitors acquired to, and meeting all of the criteria specified herein, and in applicable specification sheets shall bear the certification mark "JAN" shall bear the letter "J". Capacitors furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein and in applicable specification sheets, the manufacturer shall remove the "JAN" or the "J" from the sample tested and also from all capacitors represented by the sample. The United States Government has obtained Certificate of Registration No. 504,860 for the certification mark "JAN".

3.21.2 Substitutability of failure rate levels. A manufacturer may supply to all higher failure rate levels than to which he is qualified. Parts qualified and marked to lower failure rate levels, with acquiring agency approval, are substitutable for higher failure rate levels, and shall not be remarked unless specified in the contract or acquisition document (see 6.2 and 6.6).

3.21.3 Substitutability of capacitance tolerance and rated voltage. Parts qualified and marked to tighter capacitance tolerance or higher rated voltage, with acquiring agency approval, are substitutable for parts marked to looser capacitance tolerance or lower rated voltage, provided all other values, such as case size, characteristic and terminations are the same. The substitutable parts shall not be remarked unless specified in the contract or acquisition document (see 6.2 and 6.7).

3.22 Workmanship. Capacitors shall be so processed that when inspected under 20X to 40X magnification, they shall be uniform in quality and shall be free from pits, cracks, rough edges, adhered foreign material and other defects which will affect life or serviceability. The capacitors shall exhibit no demetallization (lift-off, blisters, or roll back) or voids or scratches on the electrodes which expose the dielectric over more than 5 percent of the area.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by 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 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Reliability assurance program. A reliability assurance program shall be established and maintained in accordance with MIL-STD-790. Evidence of such compliances shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification.

4.1.3 Statistical process control (SPC). A SPC program shall be established and maintained in accordance with EIA-557. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification and retention of qualification.

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

- a. Qualification inspection (see 4.4).
- b. Verification of qualification (see 4.5).
- c. Quality conformance inspection (see 4.6).

4.3 Inspection conditions.

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 Method.

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

4.3.3 Power supply. The power supply used for life testing shall have a regulation of ± 2 percent or less of the applicable applied test voltage. The power supply used for insulation resistance measurements shall be stabilized to at least ± 100 parts per million. Voltage fluctuations shall not occur during measurements that would produce a variation in the current measurement.

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

4.4.1 Sample size. The number of sample units comprising a sample of capacitors to be submitted for qualification inspection shall be as specified in table IV. The sample shall be taken from a production run and shall be produced with equipment and procedures normally used in production. Each separate class shall be qualified separately (e.g., 1A, 1B).

TABLE IV. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of defective permitted
<u>Group I</u>				
Voltage conditioning	3.6	4.7.2	97	0
Insulation resistance (+125°C) <u>1/</u>	3.9	4.7.5		
Capacitance <u>1/</u>	3.7	4.7.3		
Dissipation factor <u>1/</u>	3.8	4.7.4		
Insulation resistance <u>1/</u>	3.9	4.7.5		
Dielectric withstanding voltage <u>1/</u>	3.10	4.7.6		
Visual and mechanical inspection	3.1, 3.4, 3.5, 3.22	4.7.7		
<u>Group II</u>				
Solderability <u>5/</u>	3.11	4.7.8	6	1
Bond strength	3.12	4.7.9	6	1
Die shear strength	3.13	4.7.10	6	1
<u>Group III</u>				
Temperature coefficient limits	3.14	4.7.11	18	1
Thermal shock and immersion	3.15	4.7.12		
<u>Group IV</u>				
Resistance to soldering heat	3.16	4.7.13	18	1
Moisture resistance	3.17	4.7.14		
<u>Group V</u>				
Life	3.18	4.7.15	25	1
<u>Group VI</u>				
Fungus <u>2/</u>	3.19	4.7.16	6	0
<u>Group VII</u>				
Low voltage humidity	3.20	4.7.17	12	0

1/ Performed as part of the voltage conditioning test.

2/ Only 91 samples are needed if certification is given for fungus (see 3.19).

3/ Only 91 samples are needed if solderability is not applicable.

4/ Only 85 samples are needed if solderability is not applicable and certification is given for fungus.

5/ Solderability test is only applicable to termination N capacitors.

4.4.2 Test routine. Sample units shall be subjected to the qualification inspection specified in table IV, in the order shown. All sample units shall be subjected to the group I tests. These sample units shall then be divided as shown in table IV for groups II to VI inclusive, and subjected to the tests for their particular group.

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

4.4.4 Failure rate level and quality level verification.

4.4.4.1 Failure rate (FR) qualification and lot conformance FR inspection. FR qualification and lot conformance FR inspection shall be in accordance with the general and detailed requirements of MIL-STD-690 and the following details:

- a. Procedure I: Qualification at the initial FR level. Level "M" (1.0 percent) of Failure Rate Sampling Plan-90 (FRSP) shall apply. Sample units shall be subjected to the qualification inspection specified in group I, table IV prior to being tested as specified in group V, table IV (see 4.4.2).
- b. Procedure II: Extension of qualification to lower FR levels. To extend qualification to the "P" (0.1 percent), "R" (0.01 percent), and "S" (0.001 percent) FR levels, data from two or more voltages within a temperature coefficient limit may be combined. For FR levels "R" and "S", two or more voltage temperature characteristics may be combined.
- c. Procedure III: Maintenance of FR level qualification. Maintenance period B of FRSP-10 shall apply. Regardless of the number of production lots produced during this period, the specified number of unit hours shall be accumulated to maintain qualification (see 4.5f).

4.4.4.2 Quality level verification. The contractor is responsible for establishing a quality system to verify the PPM defect level of lots that are subjected to subgroup 2 tests of the group A inspections. The PPM defect level shall be maintained for each specification sheet. The PPM defect level shall be based on a 6 month moving average. The contractor shall verify and report individual PPM categories (i.e., PPM-2 and PPM-3) and an overall PPM defect level (i.e., PPM-5). In the event that the contractor meets or exceeds 100 PPM for PPM-2 the actions specified in 3.3.2.2.1 shall be taken.

4.5 Verification of qualification. Every 6 months the manufacturer shall compile a summary of the results of quality conformance inspections and extended FR test data, in the form of a verification of qualification report, and forward it to the qualifying activity within 30 days after the end of the reporting period as the basis of continued qualification approval. In addition, the manufacturer shall immediately notify the qualifying activity whenever the FR data indicates that the manufacturer has failed to maintain the qualified FR level, or the group C inspection data indicates failure of the qualified product to meet the requirements of this specification. Continuation shall be based on evidence that over the 6 month period the following has been met:

- a. Verification by the qualifying activity that the manufacturer meets the requirements of MIL-STD-790.
- b. The manufacturer has not modified the design of the item.
- c. The specification requirements for the item have not been amended so as to affect the character of the item.
- d. Lot rejection for group A or B inspection does not exceed 10 percent or one lot, whichever is greater.
- e. The requirements of group C inspection are met.
- f. The records of all tests combined substantiate the "M" (1.0 percent) or "P" (0.1 percent) FR level has been maintained or that the manufacturer continued to meet the "R" (0.01 percent) or "S" (0.001 percent) FR level for which qualified, although the total component hours of testing does not, as yet, meet the requirements of 4.4.4.1c.

- g. The contractor shall provide documentation to the qualifying activity pertaining to PPM calculations including numbers of part types tested, individual PPM defect categories (i.e., PPM-2 and PPM-3) and the overall PPM defect rate (PPM-5). This information shall be submitted on a specification sheet basis.

If group C test requirements were not met and the manufacturer has taken corrective action satisfactory to the Government, the manufacturer shall submit a verification of qualification report within 30 days after completion of the group C testing. In this case, the qualifying activity shall be notified within the time the original verification of qualification report was due. All reports shall be certified by the responsible company official. The qualifying activity shall be contacted for a report format.

4.5.1 Records. Maintenance of life test and FR level records shall be as specified in MIL-STD-690.

4.6 Quality conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections.

4.6.1.1 Inspection and production lot.

4.6.1.1.1 Inspection lot. An inspection lot shall consist of all capacitors of the same voltage-temperature characteristics, produced under essentially the same conditions with the same basic materials, 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.

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

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

4.6.1.2.1 Subgroup 1 test. Subgroup 1 tests shall be performed on a production lot basis on 100 percent of the product supplied under this specification. Capacitors failing the tests of subgroup 1 shall be removed from the lot. If during the 100 percent inspection, screening requires more than 8 percent of the capacitors be discarded, the entire production lot shall be rejected.

TABLE V. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Sample	Lot criteria
<u>Subgroup 1</u>				
Voltage conditioning	3.6	4.7.2	100% inspection	
Capacitance <u>1/</u>	3.7	4.7.3		
Dissipation factor <u>1/</u>	3.8	4.7.4		
Insulation resistance <u>1/</u>	3.9	4.7.5		
Dielectric withstanding voltage <u>1/</u>	3.10	4.7.6		
<u>Subgroup 2</u> (PPM)				
Capacitance (PPM-2)	3.7	4.7.3	See table VI	Reject one defect
Dissipation factor (at +25°C) (PPM-2)	3.8	4.7.4		
Insulation resistance (at +125°C) (PPM-2)	3.9	4.7.5		
Insulation resistance (at +25°C) (PPM-2)	3.9	4.7.5		
Dielectric withstanding voltage (PPM-2)	3.10	4.7.6	13	0
Mechanical examination external (PPM-3)	3.4	4.7.1		
<u>Subgroup 3</u>				
Visual inspection: Physical dimensions	3.1	4.7.1	13	0
<u>Subgroup 4</u>				
Solderability <u>2/</u>	3.11	4.7.8	13	0

1/ Performed as part of the voltage conditioning test.

2/ Solderability test is only applicable to termination N capacitors.

4.6.1.2.2 Manufacturer's production inspection. If the manufacturer performs tests equal to or more stringent than those specified in subgroup 1, table V, as the final step of the production process, group A, subgroup 1 inspection may be waived and the data resulting from the manufacturer's production tests may be used instead. Authority to waive the subgroup 1 inspection shall be granted by the qualifying activity only. The following criteria shall be met:

- a. Tests conducted by the manufacturer during production shall be clearly identical to or more stringent than that specified for subgroup 1. Test conditions shall be equal to or more stringent than those specified for subgroup 1 tests.
- b. Manufacturer subjects 100 percent of the product supplied under this specification to his production tests.

- c. The parameters measured and the failure criteria shall be the same or more stringent than those specified herein.
- d. The lot rejection criteria is the same or more stringent than that specified herein.
- e. The manufacturer shall make available all information concerning the test procedures and instrumentation used in his production tests which are a substitute for subgroup 1 tests. This data shall be provided as part of the evaluation required for MIL-STD-790. The manufacturer shall also make available to the Government all records of all detail test data resulting from production tests which are a substitute for subgroup 1 tests.
- f. Once approved, the manufacturer shall not change the test procedures or criteria without prior notification and concurrence by the qualifying activity.

TABLE VI. Sampling plans for PPM categories.

Lot size	Sample size
1 - 125	100 percent
126 - 3,200	125
3,201 - 10,000	200
10,001 - 35,000	315
35,001 - 150,000	500
150,001 - 500,000	800
500,001 - up	1,250

4.6.1.3 Subgroup 2 tests (PPM categories).

4.6.1.3.1 Sampling plans. Subgroup 2 tests shall be performed on an inspection lot basis. Samples subjected to subgroup 2 shall be selected in accordance with table VI, based on the size of the inspection lot. In the event of one or more failures, the lot shall be rejected. Equipment and operators used to perform the subgroup 2 tests shall not be the same as those used in the subgroup 1 100 percent tests.

4.6.1.3.2 Rejected lots. The rejected lot shall be segregated from new lots and those lots that have passed inspection. The rejected lot shall be 100 percent inspected for those quality characteristics found defective in the sample and any defective found removed from the lot. A new sample of parts shall then be randomly selected in accordance with table VI. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.3.3 PPM calculations. PPM calculation shall be based on the results of the first sample check as prescribed in 4.6.1.3.1. Calculations and data exclusion shall be in accordance with EIA-554. (NOTE: PPM calculations shall not use data on the second sample submission.)

4.6.1.4 Subgroup 3 tests. Subgroup 3 shall be performed on an inspection lot basis. The sampling procedures shall be as specified in table V.

4.6.1.4.1 Rejected lots. The rejected lots shall be segregated from new lots and those lots that have passed inspection. Lots rejected because of failures in subgroup 3 may be offered for inspection only if the manufacturer inspects all units in the lot for those quality characteristics found defective in the sample and, after removing all defects, reinspect the lot using the sampling procedure specified in table VI. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification. Resubmitted lots shall be kept separate from new lots, and shall be identified as resubmitted lots.

4.6.1.5 Subgroup 4 (solderability).

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

4.6.1.5.2 Rejected lots. In the event of one or more defects, the inspection lot is rejected. The manufacturer may use the following option to rework the lot:

Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test as required in 4.6.1.5.1. Production lots that pass the solderability test are available for shipment.

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

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

TABLE VII. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of samples units to be inspected	Number of failures allowed
<u>Subgroup 1</u>				
Bond strength	3.12	4.7.9	13	0
Die shear strength	3.13	4.7.10		
<u>Subgroup 2</u>				
Temperature coefficient limits	3.14	4.7.11	13	0

4.6.1.6.1 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 inspection. Resubmitted lots shall be inspected using the sampling procedure specified in table VII. If one or more defects are found in the second sample, the lots shall be kept separate from new lots, and shall be identified as resubmitted lots.

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

4.6.2 Periodic inspection. Periodic inspection shall consist of group C inspection. Except where the results of this inspection show noncompliance with the applicable requirements (see 4.6.2.1.3), delivery of products which have passed groups A and B inspections shall not be delayed pending the results of these periodic inspections.

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

4.6.2.1.1 Sampling plan (subgroups 1 through 3 (all FR levels)). Sixty one sample units of each temperature coefficient limit shall be selected from the first lot produced and thereafter from each production of 500,000 units, or once every 6 months, whichever occurs first.

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

4.6.2.1.3 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and 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 materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity 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 qualifying activity). Groups A and B inspection may be reinstated; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

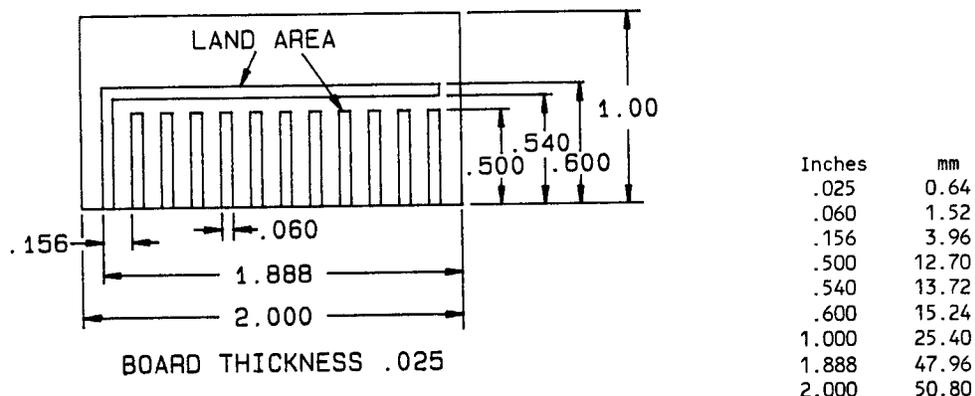
TABLE VIII. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of defectives permitted
<u>Subgroup 1</u>				
Temperature coefficient limits ^{1/}	3.14	4.7.11] 18] 1
Thermal shock and immersion	3.15	4.7.12		
<u>Subgroup 2</u>				
Resistance to soldering heat	3.16	4.7.13] 18] 1
Moisture resistance	3.17	4.7.14		
<u>Subgroup 3</u>				
Low voltage humidity	3.20	4.7.17	18] 1
<u>Subgroup 4</u>				
Life	3.18	4.7.15	25	1

^{1/} Need not be repeated if performed on same samples as group B inspection.

4.6.3 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements of MIL-C-39028.

4.7 Methods of inspection.



NOTES:

- Dimensions are in inches.
- Metric equivalents are given for general information only.
- The metallized land areas of the "test card" selected, to facilitate the testing of the chips, shall be of the proper spacing to accommodate the attachment of the applicable chips to the card.

FIGURE 1. Typical "test card".

4.7.1 Mounting for testing. When it is specified in the test procedure that the capacitors shall be mounted, they shall be mounted on a suitable substrate (e.g., 99 percent alumina). The substrate material shall be such that it will not be the cause of, nor contribute to, the failure of any test for which it may be used. The capacitors shall be mounted on the substrate as follows:

- A substrate shall be prepared with metallized surface land areas. A typical "test card" is shown on figure 1.
- The capacitors to be tested shall each be soldered to one land area by any convenient method (see 1.2.1.5).
- The connection to the common land area shall begin with a thermosonic ball bond of a one mil gold wire to the exposed capacitor terminal and end with a stitch bond on the common land area of the substrate.

4.7.1.1 Test rack. When specified, the substrate shall be mounted on a test rack which shall be so designed as to permit readout for electrical parameters at +25°C and +125°C and to monitor each chip under test for failure. This will insure uniform and uninterrupted voltage and heat stresses.

4.7.2 Voltage conditioning (see 3.6). One of the voltage conditioning tests in 4.7.2.1 or 4.7.2.2 shall be performed. The lot traveler shall indicate which test is used. When the optional voltage conditioning test of 4.7.2.2 is used, the traveler shall include the specific accelerated voltage used and the test time.

4.7.2.1 Standard voltage conditioning. A minimum of twice the rated voltage shall be applied to the unit at the maximum rated temperature +4°C, -0°C for 100 +25, -4 hours. After completion of the exposure period, the unit shall be stabilized (for a period up to 24 hours) at room temperature. The capacitance, dissipation factor, insulation resistance and dielectric withstanding voltage shall be measured as specified in 4.7.3, 4.7.4, 4.7.5, and 4.7.6 respectively.

4.7.2.2 Optional voltage conditioning. The manufacturer, with approval from the qualifying activity, may perform an optional voltage conditioning test instead of the standard voltage conditioning test of 4.7.2.1. All conditions of 4.7.2.1 apply, with the exception of the voltage applied and the test time. The minimum time duration, T(test), shall be calculated as follows:

$$T(\text{test}) = \frac{800}{(E_{\text{test}}/E_{\text{rated}})^3}$$

Where: $2 \times E_{\text{rated}} \leq E_{\text{test}} \leq 4 \times E_{\text{rated}}$

T(test) = Minimum test time in hours

E test = Applied voltage

E rated = Rated voltage of the capacitor

4.7.3 Capacitance (see 3.7). Unmounted capacitors shall be tested in accordance with method 305 of MIL-STD-202. The following detail and exception shall apply:

- a. Test frequency: 1 MHz \pm 50 kHz.
- b. Test voltage: 1.0 \pm 0.2 volt rms.

NOTE (for classes 2 and 3 characteristics only): 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 24 hours.

4.7.4 Dissipation factor (see 3.8). Dissipation factor shall be measured with a bridge or other suitable equipment at the frequency and voltage specified in 4.7.3. The capacitors shall be unmounted.

4.7.5 Insulation resistance (see 3.9). Unmounted capacitors shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

PRECAUTIONARY NOTE: Prior to performing this test, capacitors shall be carefully cleaned to remove any contamination including fingerprints. Care must be taken to maintain cleanliness in test chamber and while making measurements.

- a. Test conditions: Rated voltage as specified (see 3.1) applied through a series resistor sufficient to limit the charging current to a maximum of 50 milliamperes.
- b. Special conditions: If a failure occurs at a relative humidity above 50 percent, the insulation resistance may be measured again at any relative humidity less than 50 percent.
- c. Points of measurement: Between the terminations.

4.7.6 Dielectric withstanding voltage (see 3.10). Unmounted 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: 250 percent of rated voltage.
- b. Duration of application of test voltage: 2 seconds minimum.
- c. Points of application of test voltage: Between the capacitor element terminals.
- d. Limiting value of the surge current shall not exceed 50 mA.
- e. Inspection after test: Capacitors shall be inspected for evidence of damage and breakdown.

4.7.7 Visual and mechanical inspection. Capacitors shall be inspected to verify that the materials, design, construction, physical dimensions, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4, 3.5, and 3.22).

4.7.8 Solderability (see 3.11). Capacitors shall be tested in accordance with method 208 of MIL-STD-202. The following details and exceptions shall apply:

- a. The terminals shall be immersed to a depth of $.020 +.010, -.000$ ($0.51 +0.25, -0.00$ mm).
- b. Inspections of terminations shall be in accordance with 3.11. In case of dispute, the percent coverage with pinholes or rough spots shall be determined by actual measurement of these areas, as compared to the total area.
- c. No physical damage after test.

4.7.9 Bond strength (see 3.12). Capacitors shall be tested as specified in method 2011 of MIL-STD-883. The following details shall apply:

- a. Capacitors shall be mounted as specified in 4.7.1.
- b. Test condition D.

4.7.10 Die shear strength (see 3.13). Capacitors shall be mounted as specified in 4.7.1 and tested as specified in method 2019 of MIL-STD-883.

4.7.11 Temperature coefficient limits (see 3.14). Capacitors shall be tested as specified in 4.7.3 except that the capacitance measurements shall be made at the steps shown in table IX and at a sufficient number of intermediate points between steps B and D of table IX to establish a true characteristic curve. The capacitance value obtained in step C of table IX shall be considered as the reference point. Capacitors shall be kept at each temperature until a temperature equilibrium is attained. These measurements need be performed only on capacitors having a value of 10 pF or greater. Capacitors of less than 10 pF shall be characterized as having the same temperature coefficient limits as those of 10 pF or more manufactured in the same lot.

TABLE IX. Temperature coefficient limit cycle.

Step	Voltage	Temperature
	<u>Volts, dc</u>	<u>°C</u>
A	None	+25 ±2
B	None	-55 ±2
C (reference)	None	+25 ±2
D	None	+125 +4 -0

4.7.12 Thermal shock and immersion (see 3.15).

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

- a. Test condition A, except that in step 3, sample units shall be tested at +125°C.
- b. Minimum time (for steps 1 and 3) shall be 1/4 hour.
- c. Measurements before and after cycling: not applicable.

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

- a. Test condition B.
- b. Inspections and measurements after final cycle: Capacitors shall meet the requirements of 3.15.

4.7.13 Resistance to soldering heat (see 3.16). Capacitors shall be mounted as specified in 4.7.1 and tested in accordance with method 210 of MIL-STD-202, test Condition G. Capacitors shall be allowed to cool 10 minutes minimum and up to 24 hours maximum prior to measurement. After mounting, capacitors shall meet the requirements of 3.16.

4.7.14 Moisture resistance (see 3.17). Capacitors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- a. Initial measurements: Capacitance as specified in 3.7.
- b. Number of cycles: Twenty continuous cycles except that steps 7a and 7b shall be omitted.
- c. Polarizing voltage shall be 50 V dc.
- d. Final measurements: Capacitance as specified in 3.17.

4.7.15 Life (at +125°C) (see 3.18). Capacitors shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

- a. Capacitors shall be mounted as specified in 4.7.1 and 4.7.1.1.
- b. Test temperature and tolerance: +125°C +4°C, -0°C.
- c. Operating conditions: Capacitors shall be subjected to 200 percent of rated 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 condition F (2,000 hours).
- e. Measurements during and after exposure: After 1,000 hours and at the conclusion of this test and while the capacitors are still held at +125°C, insulation resistance shall be measured as specified in 4.7.5. The capacitors shall then be returned to the inspection conditions specified in 4.3 and shall be visually inspected for evidence of mechanical damage; capacitance, dissipation factor, and insulation resistance shall be measured as specified in 4.7.3, 4.7.4, and 4.7.5, respectively.
- f. Final measurement: Capacitors shall meet the requirements of 3.18.

4.7.16 Fungus, when applicable (see 3.19). Capacitors shall be tested in accordance with method 508 of MIL-STD-810.

4.7.17 Low voltage humidity (see 3.20). Capacitors shall be mounted as specified in 4.7.1 and 4.7.1.1 and placed in a test chamber at +85°C ±2°C and 85 percent ±5 percent relative humidity for 240 hours. During the entire test, a bias voltage of 1.5 volts dc ±10 percent will be applied to the capacitors.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-C-39028.

6. NOTES

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

6.1 Intended use. Single plate ceramic capacitors are intended for stripline or microstrip applications, usually at frequencies of 1 GHz and higher.

6.2 Ordering data. Acquisition 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 PIN (see 3.1 and 1.2.1).

6.3 Qualification. With respect to products requiring qualifications, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List (QPL 49464), 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 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 purchase order for the products covered by this specification. The activity responsible for the Qualified Products List is the US Army Laboratory Command (LABCOM), ATTN: SLCET-R-S, Fort Monmouth, NJ 07703-5302, however, information pertaining to qualification of products may be obtained from Defense Electronics Supply Center (DESC-E), 1507 Wilmington Pike, Dayton, Ohio 45444-5000 and information pertaining to qualification of products may be obtained from the activity.

6.4 Miscellaneous notes.

6.4.1 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 insulation resistance may vary with humidity and organic contamination of the ceramic chip surfaces. Care should be taken to assure that the capacitors are properly and thoroughly cleaned of organic contamination especially before the insulation resistance test.

6.4.2 Barometric pressure test. These units are not subject to the barometric pressure test since the likelihood of their failure is remote.

6.5 Subject term (key word) listing.

Capacitance
Microstrip
Stripline

6.6 Substitutability by failure rate levels. Substitutability for failure rate levels shall be as follows:

<u>Failure rate level</u>	<u>Will replace failure rate level</u>
S	R, P, M
R	P, M
P	M
M	

6.7 Substitutability by capacitance tolerance. Substitutability for capacitance tolerance shall be as follows:

<u>Temperature coefficient</u>	<u>Capacitance tolerance</u>	<u>Will replace capacitance tolerance</u>		
E F G	< 5 pF	P	A, B, C, D	
		A	B, C, D	
		B	C, D	
		C	D	
	D	≥ 5 pF	F	G, J, K
			G	J, K
N P R S	< 10 pF	J	K	
		K		
	≥ 10 pF	C	D	
		D		
		G	J, K, M	
T U V	< 10 pF	J	K, M	
		K	M	
	≥ 10 pF	M		
		J	K, M	
X Y	M	K	M	
		M		
Z	M	V, Z		
	V	Z		
	Z			

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

10. SCOPE

10.1 Scope. 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. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS. This section is not applicable to this appendix.

30. SUBMISSION

30.1 Samples. A sample of 97 units consisting of the smallest and largest case sizes, highest capacitance value in each voltage rating, in each rated temperature coefficient limits for which qualification is sought, shall be submitted (see table X).

30.2 Test data. When inspections and tests are to be performed at a Government laboratory, prior to submission, all sample units shall be subjected to all of the inspections and tests indicated as nondestructive in table VII. Each submission shall be accompanied by the test data obtained from these inspections 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.

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

30.4 Description of items. The supplier shall submit a detailed description of the capacitors being submitted for inspection, including body, electrode material, terminals, etc.

40. EXTENT OF QUALIFICATION

40.1 Qualification of voltage rating. Voltage rating qualification will be restricted to those submitted. Each temperature coefficient limit shall be qualified at the highest standard capacitance value listed.

TABLE X. Combined submission.

Style	PIN <u>1/</u> M49464	Number of units <u>2/ 3/</u>	Rated voltage
CPCRO1	E01A007PN	48	50
"	F01A006PN	"	"
"	G01A009PN	"	"
"	N01A012CN	"	"
"	P01A015CN	"	"
"	R01A021CN	"	"
"	S01A021CN	"	"

See footnotes at end of table.

APPENDIX

TABLE X. Combined submission - Continued.

Style	PIN M49464	Number of units		Rated voltage
		1/ 2/	3/	
CPCR01	T01A033CN		48	50
"	U01A037CN		"	"
"	V01A035CN		"	"
"	X01A047JN		"	"
"	Y01A049JN		"	"
"	Z01A061MN		"	"
"	E01J039FN		49	"
"	F01J037FN		"	"
"	G01J051FN		"	"
"	N01J057GN		"	"
"	P01J061GN		"	"
"	R01J064GN		"	"
"	S01J065GN		"	"
"	T01J066JN		"	"
"	U01J071JN		"	"
"	V01J071JN		"	"
"	X01J167JN		"	"
"	Y01J168JN		"	"
"	Z01J170MN		"	"
"	E01A079PN		48	100
"	F01A078PN		"	"
"	G01A081PN		"	"
"	N01A084CN		"	"
"	P01A087CN		"	"
"	R01A093CN		"	"
"	S01A093CN		"	"
"	T01A105CN		"	"
"	U01A109CN		"	"
"	V01A107CN		"	"
"	X01A119JN		"	"
"	Y01A121JN		"	"
"	Z01A133MN		"	"

See footnotes at end of table.

APPENDIX

TABLE X. Combined submission - Continued.

Style	PIN	Number of units	Rated voltage
	M49464 <u>1/</u>		
CPCRO1	E01J111FN	49	100
"	F01J109FN	"	"
"	G01J123FN	"	"
"	N01J129GN	"	"
"	P01J133GN	"	"
"	R01J137GN	"	"
"	S01J139GN	"	"
"	T01J141JN	"	"
"	U01J150JN	"	"
"	V01J150JN	"	"
"	X01J155JN	"	"
"	Y01J156JN	"	"
"	Z01J158MN	"	"

- 1/ Qualification to N termination will qualify termination P.
2/ Forty-five units of the smallest case and 46 units of the largest case shall be submitted if solderability is not applicable.
3/ Forty-two units of the smallest case and 43 units of the largest case shall be submitted if certification is given for fungus and solderability is not applicable.

CONCLUDING MATERIAL

Custodians:

Army - ER
Navy - EC
Air Force - 85
NASA - NA

Preparing activity:

Army - ER

Agent:

DLA - ES

Review activities:

Navy - AS
Air Force - 17, 99
DLA - ES

(Project 5910-1727)

User activities:

Navy - MC, SH
Air Force - 19