INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION

CAPACITORS, FIXED, SUPERMETALLIZED PLASTIC FILM DIELECTRIC, DIRECT CURRENT FOR LOW ENERGY, HIGH IMPEDANCE APPLICATIONS, HERMETICALLY SEALED IN METAL CASES, HIGH 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 the general requirements for high reliability, supermetallized plastic film dielectric, fixed capacitors, hermetically sealed in metal cases. Capacitors covered by this specification have a failure rate (FR) level established in accordance with MIL-STD-690. This FR level is established at a 90-percent confidence level and maintained at a 10-percent producer's risk and, unless otherwise specified (see 3.1), is based on MIL-PRF-83421 life tests performed at maximum rated voltage at maximum rated temperature.

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

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-83421 - Capacitors, Fixed, Supermetallized Plastic Film Dielectric, (DC, AC, or DC and AC), Hermetically Sealed In Metal Cases, Established Reliability, General Specification For

MIL-PRF-83421/1 - Capacitors, Fixed, Supermetallized Plastic Film, Dielectric, DC and AC, Hermetically Sealed in Metal Cases, Established Reliability, Styles CRH01, CRH02, CRH03, CRH04, CRH05, CRH06, CRH07, CRH08, CRH09, and CRH00.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC/VAM, 3990 East Broad Street, Columbus, OH 43213-1199, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5910

MIL-PRF-87217/1 - Capacitors, Fixed, Supermetallized Plastic Film Dielectric, Direct Current, For Low Energy, High Impedance Applications, Hermetically Sealed in Metal Cases, High Reliability, Styles CHS01, CHS02, and CHS03.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-690 - Failure Rate Sampling Plans and Procedures.
MIL-STD-790 - Standard Practice for Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automated Printing Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following document forms a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

ANSI/NCSL Z540-1 - General Requirements for Calibration Laboratories and Measuring and Test Equipment. (DoD adopted).

(Application for copies should be addressed to the American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036-0350.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D92 - Standard Test Method for Flash and Fire Points by Cleveland Open Cup. (DoD adopted).

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

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

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between requirements of this specification and the specification sheet, the latter shall govern (see 6.2).

3.2 Qualification. Capacitors furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award. In addition, the manufacturer shall obtain certification from the qualifying activity that the QPL system requirements of 3.3 and 4.2 have been met and are being maintained. Authorized distributors who are approved to MIL-STD-790 distributor requirements by the QPL manufacturer are listed in the QPL.

3.3 QPL system. The manufacturer shall establish and maintain a QPL system for parts covered by this specification. Requirements for this system are specified in MIL-STD-690 and MIL-STD-790 and herein. As part of the MIL-STD-790 QPL system, the manufacturer shall establish and document a system which would include the following:

a. Traceability of materials.
b. Capacitor design requirements.
c. Dielectric film type.
d. Dielectric film thickness and width.
e. Metallization thickness and width.
f. Metallization resistivity.
g. Case length and diameter.
h. Additional material wound at start and stop.
i. Visual inspection criteria.

3.4 Materials. The 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.

3.4.1 Impregnant and filling compounds. Compounds used in the impregnation and filling of capacitors shall be chemically inactive with respect to the capacitor element and the case. The compound, either in the state of original application or as a result of having aged, shall have no adverse effect on the performance of the capacitor. For liquid-filled capacitors, the same material shall be used for impregnating as is used for filling.

3.4.2 Metals. Metals shall be of a corrosion-resistant type or shall be plated or treated to resist corrosion. Silver plating shall not be used in any external portions of these capacitors.

3.4.2.1 Dissimilar metals. Where dissimilar metals are used in intimate contact with each other, provision shall be made to provide protection against electrolysis and corrosion. The use of dissimilar metals in contact, which may tend toward active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy), shall not be acceptable. However, metal plating or metal spraying of dissimilar metals to base metals to provide similar or suitable abutting surfaces will be permitted (for example, the spraying of copper on aluminum for soldering operations will be permitted). The use of dissimilar metals separated by insulating material will also be permitted.

3.4.3 Solder. Solder shall not contain more than 97 percent tin.

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

3.5.1 Case. Each capacitor shall be enclosed in a hermetically-sealed case (see 3.1) which will protect the capacitor element from moisture, impregnant or filling compound leakage, and mechanical damage under all test conditions specified herein.

3.5.2 Sleeving. The sleeving material shall not soften, creep, or shrink to a point where any part of the cylindrical portion of the case is left uncovered at any test temperature specified herein. The sleeving shall not obscure the part marking.

3.5.3 Leads. Leads shall be solderable and meet the requirements of 3.15.

3.6 Thermal shock. When tested as specified in 4.7.2, capacitors shall withstand the extremes of high and low temperatures without visible damage.

3.7 Burn-in. When tested as specified in 4.7.3, capacitors shall withstand the exposure to high temperature and voltage without visible damage.

3.8 High-impedance temperature and voltage ramp. When tested as specified in 4.7.4, capacitors shall withstand the extremes of high and low temperatures without visible damage. Any dc leakage current greater than 0.05 µA during ramp test shall be considered a failure.

3.9 Insulation resistance. When measured as specified in 4.7.5, the insulation resistance shall be not less than the values specified (see 3.1).

3.10 Capacitance. When measured as specified in 4.7.6, the capacitance shall be within the applicable tolerance specified (see 3.1).

3.11 Dissipation factor. When measured as specified in 4.7.7, the dissipation factor shall not exceed 0.15 percent.

3.12 Seal. When capacitors are tested as specified in 4.7.8, there shall be no repetitive bubbling, and for liquid-impregnated capacitors, there shall be no evidence of leakage.

3.13 Radiographic inspection. When the capacitors are radiographed in accordance with 4.7.9, there shall be no evidence of improperly made connections, substandard soldering, structural weakness, or attached solder particles or slivers (see appendix).

3.14 High impedance dc life. When tested as specified in 4.7.10, capacitors shall meet the following requirements:

a. Insulation resistance (terminal to terminal): Shall meet the initial requirements (see 3.1).

b. Capacitance: Shall meet the initial requirements (see 3.1).

c. Dissipation factor: Shall meet the initial requirements (see 3.1).

d. Visual inspection: There shall be no corrosion, leakage of impregnant, or mechanical damage either during or after the test.

3.15 Solderability. When capacitors are tested as specified in 4.7.11, the dipped portion of the terminals shall conform to the solid-wire termination criteria of method 208 of MIL-STD-202.

3.16 Marking. Marking of capacitors shall conform to method I of MIL-STD-1285, and shall include the part number, "JAN" marking, date code, lot symbol, manufacturer's source code, capacitance (in µF), capacitance tolerance, and rated voltage.

Example of marking:	M87217/01-2107A	-	PIN (may be on one line if space permits).
	.018 µF 5% 50 V	-	Capacitance, capacitance tolerance, and rated voltage.
	JAN 8433A 12345	-	"JAN" marking, date code, lot symbol and source code.
	AAA	-	Serialized marking, each part, alpha or numeric (no limit on the number of spaces).

The manufacturer shall provide for lot traceability by date code and lot symbol. Manufacturing records shall include these same date codes and lot symbols.

3.16.1 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 items so marked or identified are manufactured to, and meet all the requirements of specifications. Accordingly, items acquired to and meeting all of the criteria specified herein and in applicable specification, shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein and in applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets or associated specifications, the manufacturer shall remove completely the military part number

and the "JAN" or the "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate of Registration Number 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark "J".

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

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

4. VERIFICATION

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

a. Qualification inspection (see 4.4) via MIL-PRF-83421.

b. Verification of qualification (see 4.5).

c. Conformance inspection (see 4.6).

4.2 QPL system. The manufacturer shall establish and maintain a QPL system in accordance with 3.3. Evidence of such compliance is a prerequisite for qualification and retention of qualification.

4.3 Inspection conditions and methods.

4.3.1 Test equipment and inspection facilities. The supplier shall establish and maintain a calibration system in accordance with ANSI/NCSL Z540-1 or equivalent system.

4.3.2 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, except relative humidity shall not exceed 75 percent. Unless otherwise specified (see 3.1), accuracy of all test voltage measurements shall be within ±2.0 percent of the specified voltage.

4.3.3 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 ±3°C prior to conditioning. Unless reference measurements have been made within 30 days prior to the beginning of conditioning, they shall be repeated.

4.3.4 Power supply. The power supply used for life testing shall have a regulation of ±2 percent or less of the rated voltage. The power source employed for dc leakage current measurements shall be stabilized to at least 100 ppm. No voltage fluctuations shall occur during measurements that would produce a variation in the current measurement as read with any acceptable dc leakage current tester used to test capacitors.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production. Parts shall be "S" failure rate level and selected from manufacturers qualified to MIL-PRF-83421/1 "S" failure rate level.

4.4.1 Sample size. The number of capacitors to be subjected to qualification inspection shall be as specified in MIL-PRF-83421.

4.5. Verification of qualification. Every 6 months the manufacturer shall provide verification of qualification to the qualifying activity. Continuation of qualification shall be based on meeting the following requirements:

a. The manufacturer has not modified the design of the item.

b. The specification requirements for the item have not been amended so as to affect the character of the item.

In the event that there is no production of a single style device during a reporting period and the manufacturer is listed for more than one style on the QPL, the manufacturer shall certify that they retain the capabilities and facilities necessary to produce that product. If during three consecutive reporting periods there has been no production of a given style, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative product of that style to testing.

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A.

4.6.1.1 Inspection lot. An inspection lot shall consist of capacitors of the same style, voltage rating, design and nominal capacitance rating produced in the same case size. 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 tests specified in table I in the order shown, and shall be performed on units that have passed subgroup 1, subgroup 2, and subgroup 4 tests in group A inspection of MIL-PRF-83421. There shall be a maximum total of 5 percent defectives allowed (PDA) on the 100 percent tests of subgroups 2 and 3 for catastrophic failures. A catastrophic failure is defined as insulation resistance (IR) less than 100 megohms, capacitance value ±20 percent or greater of its nominal value, or dissipation factor (DF) of .25 percent or greater.

4.6.1.2.1 Sampling plan. Subgroup 1, 2, 3 and 4 tests shall be performed on each capacitor offered for inspection. Subgroup 6 test shall be performed on an inspection lot basis. Statistical sampling inspection shall be performed on an inspection lot basis. A sample of 13 parts shall then be randomly selected. If one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall then randomly be selected. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.7 Methods of examination and test.

4.7.1 Visual and mechanical inspection. Capacitors shall be inspected to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4, 3.5, 3.15 and 3.16). A 5X to 7X magnification limit shall apply.

4.7.2 Thermal shock (see 3.6). Capacitors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exception shall apply:

a. Test condition letter B, -55°C to +100°C.

b. Measurements before and after cycling: Not applicable.

c. Number of cycles: As specified (see 3.1).

4.7.3 Burn-in (see 3.7). Capacitors shall be tested as follows:

a. Time: 160 hours minimum.

b. Temperature: +100°C

c. Voltage: 1.5 ±0.5 V dc applied through a resistor of value between 1.0 megohm through 10.0 megohm in series with each capacitor.

TABLE I. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of defectives permitted
Subgroup 1 Thermal shock	3.6	4.7.2	100 percent	
Subgroup 2 1/ Burn-in High impedance temperature and voltage ramp test 2/	3.7 3.8	4.7.3 4.7.4	100 percent	
Subgroup 3 1/ Insulation resistance 3/ Capacitance Dissipation factor	3.9 3.10 3.11	4.7.5 4.7.6 4.7.7	100 percent	
Subgroup 4 1/ Seal Radiographic inspection 4/	3.12 3.13	4.7.8 4.7.9	100 percent	
Subgroup 5 5/ High impedance dc life Insulation resistance 6/ Capacitance Dissipation factor	3.14 3.9 3.10 3.11	4.7.10 4.7.5 4.7.6 4.7.7	20	0
Subgroup 6 Visual inspection (external)	3.1, 3.4, 3.5, 3.16, and 3.18	4.7.1	13	0

1/ Percent defective allowable (PDA) = 5 percent.
2/ DC leakage failure if greater than .05 µA.
3/ At +25°C and +100°C with a 1-2 megohm series resistor, rated voltage.
4/ This test can be any place in sequence following subgroup 1.
5/ Parts may not be shipped.
6/ At +25°C rated voltage and initial limits.

4.7.4 High impedance temperature and voltage ramp (see figure 1).

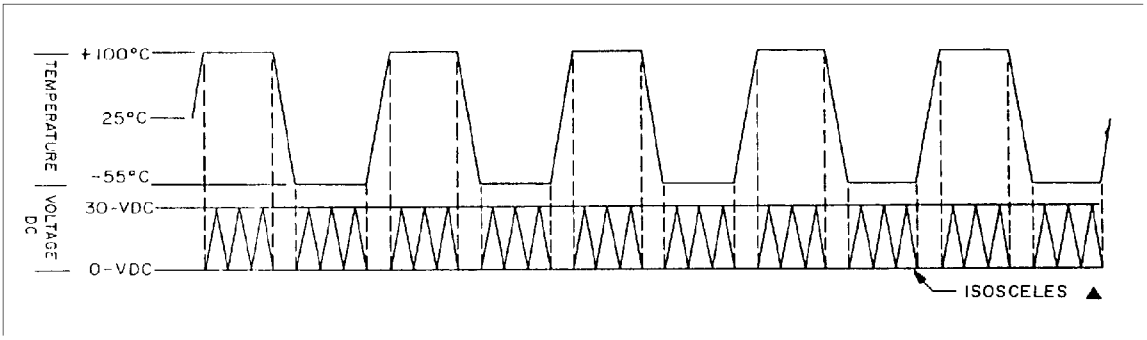
a. Each part shall be connected with 1-10 megohms in series.

b. Parts shall be temperature ramped for 5 cycles from 25°C to 100°C, to -55°C, and to 25°C with an equally timed stay at the temperature extremes (100°C/-55°C).

c. Parts shall be voltage ramped during the temperature extremes only. A 0 volt to 30 volt (±10%) ramp in 30 minutes (+3 minutes) shall be applied to the RC circuit. After the capacitor reaches 30 volts charge, the capacitors will be linearly discharged within 30 minutes ±3 minutes. When the voltage reaches 200 millivolts, the voltage ramp to 30 volts is repeated (3 ramps during each exposure at the temperature extremes). For capacitance values above 10 microfarads, use a 60 minute ±6 minute ramp to 30 volts.

d. Parts shall be monitored for high leakage current continuously, or scanned at a minimum of once every 0.5 seconds, during the 5 temperature cycles. Noise shall be limited to 6 mV, peak.

e. A permanent record of current excursions in excess of .05 µA shall be maintained.



STABILIZE CAPACITORS AT TEMPERATURE EXTREMES AND VOLTAGE RAMP 3 TIMES

(0 TO 30 V dc) ±10% AND (30 TO 0 V dc) ±10% WHILE MONITORING FOR LEAKAGE CURRENT

FIGURE 1. Voltage and temperature ramp test.

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

a. Test potential: Rated voltage, unless otherwise specified (see 3.1).

b. Points of measurement: Between terminals at the applicable specified temperatures (see 3.1), and at 25°C ±3°C.

c. Charge time 5 minutes maximum; however, for capacitance values greater than 1.0 µF, an additional 1 minute per µF is permitted.

4.7.6 Capacitance (see 3.10). Capacitors shall be tested in accordance with method 305 of MIL-STD-202. Unless otherwise specified (see 3.1), the following details shall apply:

a. Test frequency: 1,000 ±100 hertz (Hz).

b. Limit of accuracy: ±0.05 percent.

4.7.7 Dissipation factor (see 3.11). The dissipation factor shall be measured at 1,000 ±100 Hz (for capacitors having a nominal capacitance of 1 microfarad or less) or 100 ±10 Hz (for capacitors having a nominal capacitance greater than 1 microfarad).

4.7.8 Seal (see 3.12). Capacitors shall be tested in accordance with method 112 of MIL-STD-202. The following details shall apply:

a. Test condition letters: As specified (see 3.1).

b. Measurements after test: Not applicable.

4.7.8.1 Alternate test for liquid-impregnated capacitors only. Capacitors shall be placed with the terminals facing sideways (not upward) on a clean sheet of absorbent paper and exposed to a case temperature within +3°C, -0°C of the applicable maximum rated temperature (see 3.1) for a period of 4 hours minimum. After the test, capacitors and absorbent paper shall be visually inspected for evidence of leakage of impregnant.

4.7.9 Radiographic inspection (see 3.13). The capacitors shall be radiographed in accordance with the appendix. The following details shall apply:

a. Number of views: See appendix, figure 3. Axial lead style capacitors: Two views perpendicular to the plane of the leads, with the second view made after rotation of the capacitors 90° around its own axis.

b. Inspection of films: The films shall be inspected on a back-lighted illuminator using a minimum of 10X magnification.

c. Defects: Capacitors containing any defects as specified in 3.13 and appendix, figure 2 shall be rejected.

d. Summary data of inspection results: A summary of the results of radiographic inspection (number of parts inspected, number accepted, number rejected) shall be included on the report of group A inspection furnished with each shipment of capacitors.

e. Retention of films: Radiograph films and test reports shall be retained by the manufacturer for a minimum period of 12 years.

4.7.10 High impedance dc life (see 3.14). The capacitors shall be tested 250 hours at 100°C with 1.5 ±0.5 volts dc and 1 through 10 megohms resistor in series with each capacitor so that the energy from source or across the capacitor is 500 microjoules, maximum.

a. Insulation resistance: Terminal to terminal: Shall meet the initial requirements (see 3.1).

b. Capacitance: Shall meet the initial requirements (see 3.1).

c. Dissipation factor: Shall meet the initial requirements (see 3.1).

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

a. Number of terminations to be tested: Both leads of the capacitor shall be subjected to the solderability test.

b. Depth of immersion in flux and solder: The leads shall be immersed to within .125 inch of the capacitor body.

5. PACKAGING

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

6. NOTES

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

6.1 Intended Use. Capacitors covered by this specification are intended for use in low-energy and high impedance applications such as integrators, RC timing circuits, precision filters and other applications where the ac component of voltage is not significant. Capacitors covered by this specification are unique due to the fact that they are available in tight tolerances and exhibit excellent capacitance stability over long life, as well as high insulation resistance and low loss factor. These devices also must be able to operate satisfactorily in high reliability military systems under demanding conditions such as 50 Gs of high frequency vibration and 100 Gs of shock (specified pulse). Commercial components are not designed to withstand these military environmental conditions.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of the specification.

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).

c. Packaging requirements (see 5.1).

d. Title, number, and date of the applicable specification sheet, and the complete part number and lead material if other than that specified (see 3.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Defense Supply Center, Columbus, ATTN: DSCC/VAM, 3990 E. Broad Street, Columbus, OH 43213-1199.

6.4 Part or Identifying Number (PIN). This specification requires a PIN that is as described in the appropriate reference to associated documents (see 3.1).

6.5 Subject term (key word) listing.

Capacitance
Dissipation factor
Insulation resistance
Radiographic inspection
Thermal shock

6.6 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

RADIOGRAPHIC INSPECTION

10. SCOPE

10.1 Scope. This appendix establishes the X-ray criteria for acceptance and rejection of hermetically sealed plastic dielectric capacitors. Typical examples of acceptable and unacceptable capacitors are shown in figure 2. This appendix is a mandatory part of the specification.

10.2 Facilities. Radiographs of the capacitors may be made by the capacitor manufacturer or a suitable independent laboratory. In either case, facilities, equipment, personnel and techniques shall be in accordance with the requirements specified herein.

10.3 Responsibility for inspection. The capacitor manufacturer shall perform the inspection of the radiograph films and acceptance/rejection of the capacitors.

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

30. EQUIPMENT

30.1 Radiography. The X-ray equipment shall have sufficient voltage range to produce radiographs in accordance with this document. The equipment shall have a focal spot of 3.5 millimeters (mm) or less and shall maintain a sharply defined image at a focal film distance of 30 to 60 inches (76.20 to 152.40 centimeters).

30.2 Exposure factors. The X-ray exposure factors shall be selected to achieve maximum image detail within the sensitivity requirements. The film shall be exposed in accordance with the following requirements:

a. X-ray voltage: Lowest voltage possible.

b. H and D film density: 1.0 to 2.5.

c. Milliampere and time settings: Adjusted, as necessary, to obtain satisfactory exposure.

30.3 Film. The X-ray film shall be single emulsion and of a grade defined as very fine grain.

30.3.1 Sensitivity. X-ray film and equipment shall be capable of detecting metallic particles with a major dimension of 0.001 inch (.03 mm) or greater.

30.3.2 Exposure. Exposure factors such as KVP, current and time shall be compatible with the sensitivity requirements of 3.3.1.

30.3.3 Film density. The X-ray equipment and processing techniques shall be capable of producing H and D film density of 1.0 to 2.5 in accordance with the American Standard Printing density type P-2.

30.3.4 Film dimensions. Radiographic film shall not exceed 14 inches (35.56 centimeters) in width and 17 inches (43.18 centimeters) in length.

30.3.5 Processing. The exposed X-ray film shall be processed in such manner that the film shall be free of processing defects, i.e., fingerprints, chemical spots, blemishes, etc.

30.3.6 Film identification. Each radiographic film shall be identified with the following information:

a. Part manufacturer's name.

b. Part number (as marked on part).

c. Part cross reference.

40. REQUIREMENTS

40.1 Views

40.1.1 Tubular units. Two planes, normal to the major axis of the part, shall be taken. If deemed necessary by the testing laboratory or acquiring activity representative, additional views shall be required. See figure 3 for part orientation.

40.2 General inspection. The inspection for all capacitors shall include, but not limited to, inspection for faulty lead connections, misalignment of internal parts, solder or weld defects and physical damage of electrical elements.

40.2.1 Faulty lead connection. There shall be no evidence of improperly made lead connections.

40.2.2 Misaligned parts. Criteria for rejection due to misalignment of capacitor section seals, eyelets or spacers shall be as specified in the detail inspections below.

40.2.3 Solder defects. Criteria for rejection due to soldering defects shall be as specified in 40.3.2.

40.2.4 Physical damage. There shall be no holes, cracks, splits or chips of electrical elements.

40.3 Specific inspections. Inspections that are peculiar to plastic capacitors, in addition to the general inspections, are listed below. All capacitors failing to meet these requirements shall be rejected. Examples of typical defects, as well as acceptable devices, are shown.

40.3.1 Extraneous material

40.3.1.1 Any single foreign particle larger than .020 inch (.51 mm) in its longest dimensions, regardless of location, shall be cause to reject the part (see figure 2a). A string of particles less than .020 inch in diameter located between the section and case parallel to the axis of the section and which are continuous for more than 1/4 of the section length shall be cause to reject the part. Random and spray particles which are less than .020 inch (.51 mm) in diameter are typical of these capacitors and shall not be cause for rejection.

40.3.1.2 Foreign particles, looped wire (unless characteristic of qualified design), metallization or excess solder from the end spray cap shall not extend into the capacitor element .050 inch or more when measured from the base of the end spray cap (see figure 2b).

40.3.2 Spikes and excessive solder. Spikes of end spray or solder spikes other than those described above shall not extend through the winding insulation or protrude within .010 inch of capacitor case.

40.3.3 Lead wire bends. Units having the internal lead wire bent/looped shall be rejected, unless bend/loop is characteristic of qualified design.

50. REPORTS AND RECORDS

50.1 Reports of inspection. Unless otherwise specified by the contract, the testing activity shall furnish inspection reports signed by an authorized representative of the testing activity. The reports shall give the results of the radiographic inspection and shall list the purchase order number or equivalent identification, the part number, the number of parts inspected, the number of parts rejected and the date of the test. For each rejected part, the part number, the serial number and the cause for rejection of the part shall be listed. Two copies of the report shall be forwarded to the contracting activity.

APPENDIX

50.2 Records of inspection. A complete record of details of inspection shall be kept by the manufacturer or testing laboratory on a form acceptable to the preparing activity. The record shall list the voltage potentials and currents used in the radiographic process, the time of exposure, the distance of the source of radiation from the surface of the part, the distance of the film from the same surface, the approximate angle between the central beam of radiation and the film, the screens and filters used, the size of the focal spot, the time of development of the film and the serial number of the part under test. When an identical technique is used for a number of parts, a single record, tabulating all identical features, will suffice for all parts. Copies of the records shall be made available to the contracting activity when requested.

50.3 Records of radiographs. Each radiograph shall carry a radiograph inspection serial number, or code letters, to identify the radiograph with the parts inspected shown in the radiograph. One copy of all radiographs shall accompany the shipment of parts when submitted to the contracting activity. In addition, one complete set of radiographs shall be kept by the manufacturer or testing laboratory for a period of 12 years.

60. Personnel.

60.1 Radiographer. Personnel engaged in radiographic processing shall be familiar with the requirements of this standard and with all other documentation controlling radiographic inspection of parts and materials. They shall be capable of producing radiographs which meet the requirements of all applicable documentation.

60.2 Radiographic interpreters. Personnel engaged in the interpretation of radiographs shall be familiar with the requirements of this standard and with all applicable documentation controlling radiographic quality of parts and materials being inspected. They shall be capable of evaluating radiographs to determine conformance of parts and materials to the requirements of all applicable documentation.

60.3 Vision. The minimum vision requirements for visual acuity of personnel inspecting film shall be as follows:

a. Distant vision shall equal 20/30 in at least one eye, either corrected or uncorrected.

b. Near vision shall be such that the individual can read Jeager type number 2 at a distance of 40.64 centimeters (16 inches), either corrected or uncorrected.

60.4 Vision tests. Vision tests shall be performed by an oculist, optometrist or by other professionally recognized personnel. One year from the effective due date of qualification, and each year thereafter, qualified personnel shall be required to pass the vision test specified herein.

The part shall be rejected if any one of the defects listed below is observed:

1. Length of eyelet to header less than 50% filled with solder. See Figure 2C for details.
2. Solder in header/case joint less than 50% of length of joint. See Figure 2C for details.
3. Loose particles larger than .020 inch in any dimension.
4. Particles larger than .020 inch in any dimension.
5. Shadowing due to plating solder or seal solder reflow is acceptable providing termination and lead wire is visible.

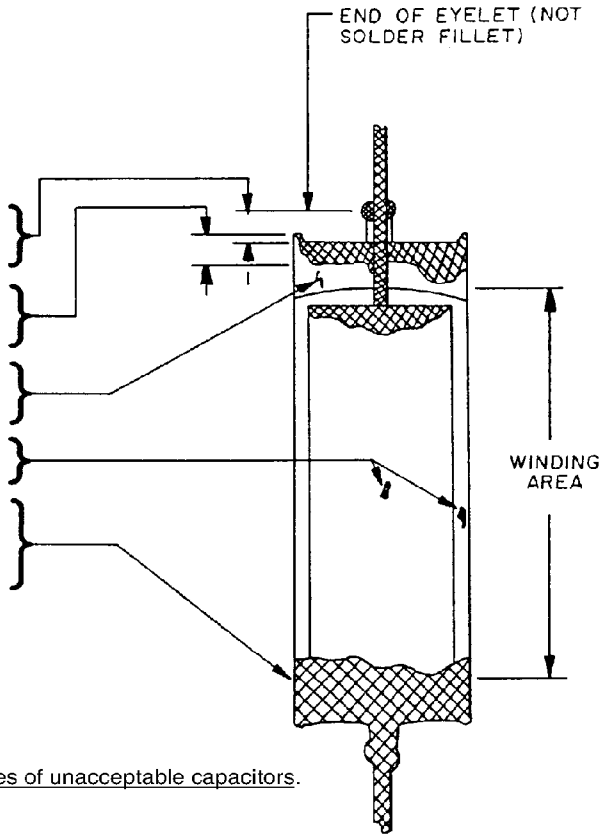


FIGURE 2a. Examples of unacceptable capacitors.

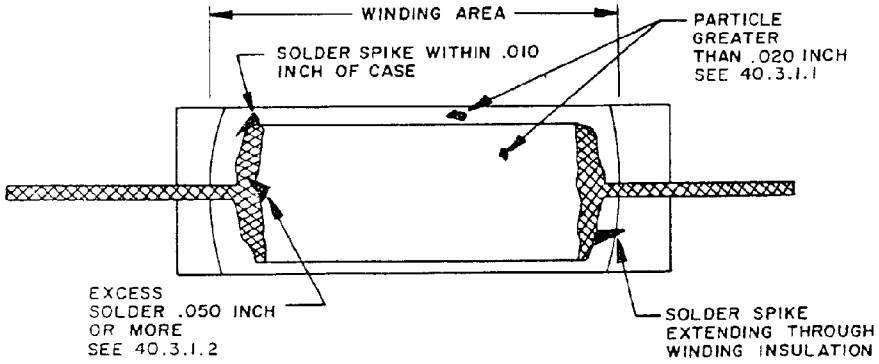
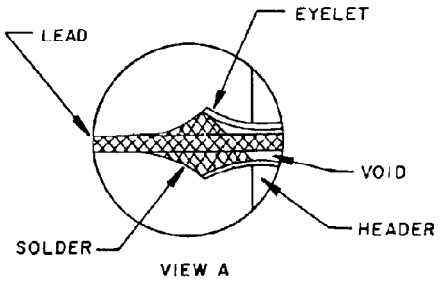


FIGURE 2b. Examples of unacceptable capacitors.



CROSS SECTION THROUGH
EYELET AND HEADER

Details of End Seal Installation.

The part shall be rejected if any one of the defects listed below is observed.

1. Length from end of eyelet to header less than 50% filled with solder.

NOTE: When excess solder does not permit easy distinction of eyelet end point, the point may be established by radiographic comparison of identical parts on the same film. Two different KV settings may be necessary to accomplish the complete inspection.

2. Solder in header/case joint less than 50% of length of joint.

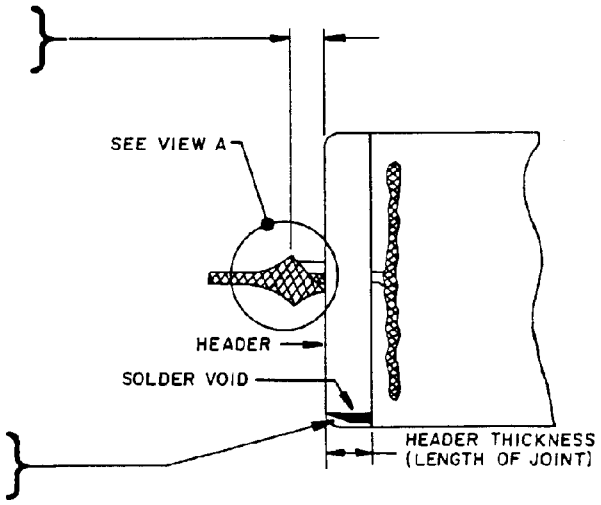


FIGURE 2c. Examples of acceptable and unacceptable capacitors.

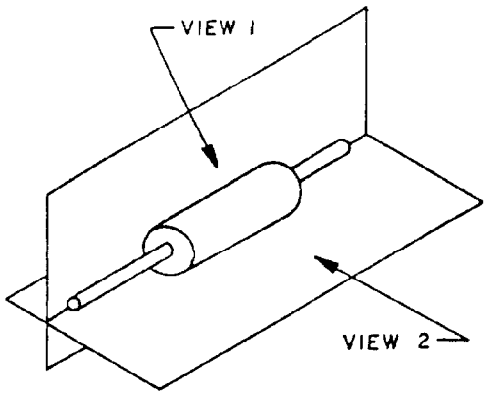


FIGURE 3. Part/Exposure Orientation.

IQI NO.	TUNGSTEN WIRE DIAMETERS						LEAD PARTICLE DIAMETERS						STEEL SHIM STOCK
	A	B	C	D	E	F	G	H	I	J	K	L	
1	.002	.001	.0005	.0005	.001	.002	.015	.010	.008	.006	.004	.002	None
2	"	"	"	"	"	"	"	"	"	"	"	"	.002
3	"	"	"	"	"	"	"	"	"	"	"	"	.005
4	"	"	"	"	"	"	"	"	"	"	"	"	.007
5	.003	.002	.001	.001	.002	.003	"	"	"	"	"	"	.010
6	"	"	"	"	"	"	"	"	"	"	"	"	.015
7	.005	.003	.002	.002	.003	.005	"	"	"	"	"	"	.025
8	"	"	"	"	"	"	"	"	"	"	"	"	.035

TABLE OF IMAGE QUALITY INDICATORS (IQI)

NOTES:

1. Wires to be tungsten, shim stock to be carbon steel, particles to be lead. Center section to be .125 layers of clear acrylic plastic, bonded with clear plastic cement of low X-ray density. Fasteners may be used within 0.250 or less from each corner, but shall not interfere with end use of the IQI. Bottom surface shall be flush.
2. All dimensions, shown are ±0.001 and lead particles which shall be ±0.0005. Groove details are not critical except that wire must be embedded flush or below surface of plastic and centered at location shown. Particle-hole sizes are not critical, but should not exceed .031 in diameter and depth, and must be centered as shown ±0.005.
3. Additional layers of shim stock may be used as necessary.
4. Identification marking shall be permanent and legible. Location and size of characters is not critical but shall not interfere with or obscure the radiographic image details.

FIGURE 4. Image quality indicator.

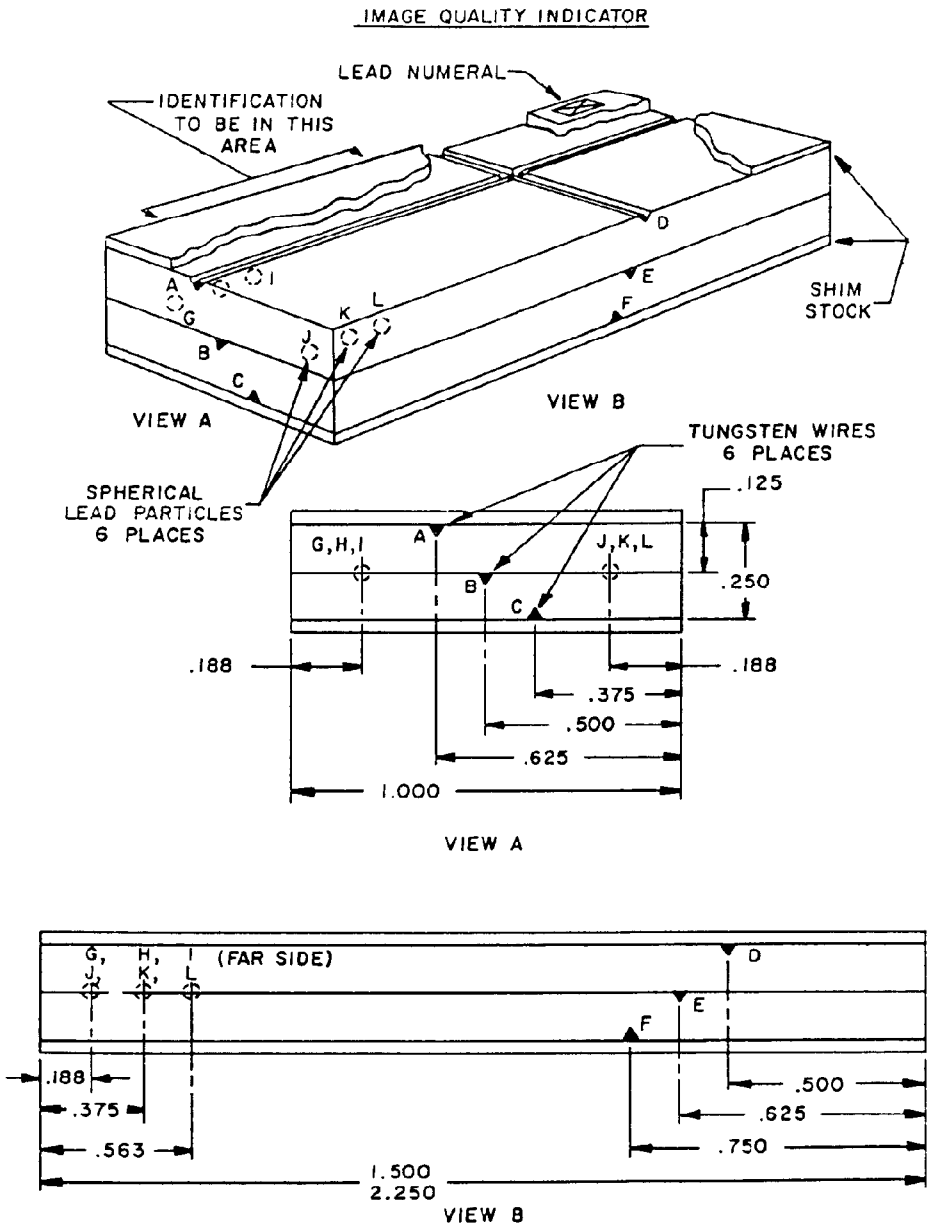


FIGURE 4. Image quality indicator - Continued.

APPENDIX

Image Quality Indicator. Image Quality Indicators (IQI) shall be employed in all radiographic testing and shall be as specified herein (Figure 4). The use of IQI's having only wires is acceptable. However, IQI's having wires and spherical lead articles are preferred. Alternate IQI configurations may be used only with written approval of the preparing activity. The IQI image shall be used to determine radiographic quality. The IQI image shall meet the following requirements:

a. All IQI wires and spherical particles shall be visable on each radiograph.

b. The spacing between wires of the IQI shall not be distorted by more than 10%. The percentage of distortion, as used in this specification, is defined as follows:

$$\text{Percentage Distortion} = \frac{S_1 - S_0}{S_0} = (100)$$

S_0 Where S_0 = actual wire spacing.

S_1 = wire spacing as it appears on the X-ray film.

The film density within the image area of the IQI shall match the film density in the readable inspection area of the part image within 10%. When specific IQI configurations are designated in applicable Detail Specification Sheets, the requirement of this paragraph does not apply. Film density shall be determined by means of a densitometer.

FIGURE 4. Image quality indicator - Continued.

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

Review activities:
Army - AR, MI
Navy - AS, CG, MC, OS, SH
Air Force - 19
NASA - NA

Preparing activity:
DLA - CC

(Project 5910-2015)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete block1s 4, 5, 6, and 7, and send to preparing activity.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-87217A	2. DOCUMENT DATE (YYMMDD)

3. DOCUMENT TITLE CAPACITORS, FIXED, SUPERMETALLIZED PLASTIC FILM DIELECTRIC, DIRECT CURRENT FOR LOW ENERGY, HIGH IMPEDANCE APPLICATIONS, HERMETICALLY SEALED IN METAL CASES. HIGH RELIABILITY, GENERAL SPECIFICATION FOR

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Incl Area Code) (1) Commercial (2) DSN (If applicable)	7. DATE SUBMITTED (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME Defense Supply Center, Columbus ATTN: VAM	b. TELEPHONE (Include Area Code) (1) Commercial (2) DSN
c. ADDRESS (Include Zip Code) 3990 East Broad Street Columbus, OH 43213-1199	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888 DSN 427-6888