REQUIREMENT 10

DETAILED REQUIREMENTS FOR CAPACITORS

10. General. This section describes detailed requirements for a DPA of commonly used capacitors. These requirements supplement the general requirements in section 4. Examples of typical configuration sketches are included. Specification numbers are referenced to assist in identification. Pre-DPA tests, such as functional tests and solderability tests, are assumed to have been satisfied by normal inspection and testing and are therefore not addressed.

10.1 Capacitors, fixed ceramic (MIL-PRF-20, MIL-PRF-123, MIL-PRF-39014 and MIL-PRF-49470). A typical radial leaded device is shown on figure 10-1 and a typical axial leaded device is shown on figure 10-2.

10.1.1 Method.

10.1.1.1 External visual. Visually inspect each part for physical size and at 20X minimum magnification for cracks, pinholes, or chips in the case material. Inspect the leads for evidence of physical damage (cuts, nicks, crushing, or exposure of the base metal not allowed by the specification).

10.1.1.2 Terminal strength. Perform a lead pull strength test on all parts (two parts minimum) in accordance with the applicable specification.

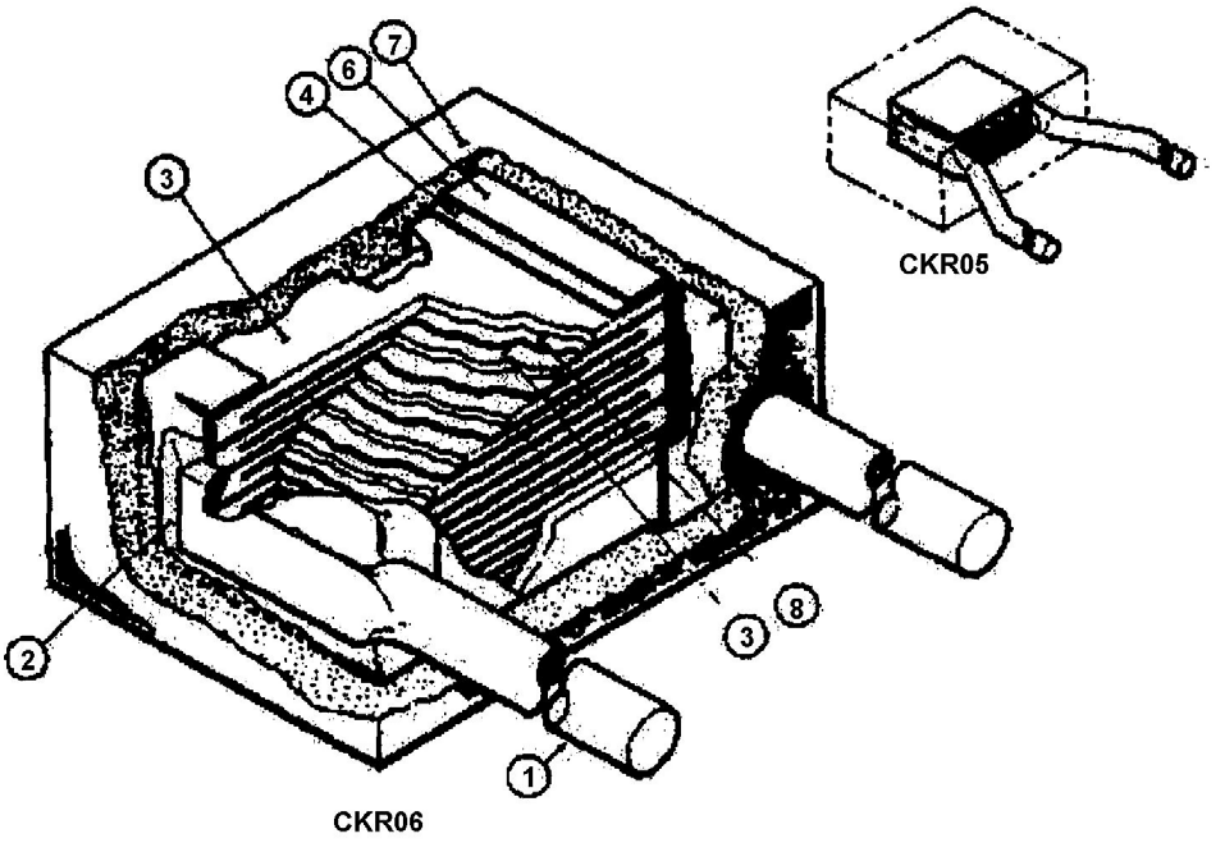
10.1.1.3 Capacitor element visual after removal of encapsulation. Strip plastic coating or case from 50 percent (round down) of the encapsulated devices. Chemical solvents or plasma etch specified in EIA-469 are recommended. Examine capacitor element for cracks, chips, delaminations, and exposed electrodes at 50X minimum magnification. Please be careful to note if damage occurred due to the decapsulation procedure itself (i.e. lead separation, chipped edges, etc.). Verify the use of high temperature solder, SN10 or equivalent, through SEM EDS, differential thermal analysis, thermal galvanometric analysis, or other equivalent means of verification.

10.1.1.4 Sectioned sample preparation. Parts shall be cleaned, mounted, and polished in accordance with EIA-469.

10.1.1.5 Microscopic examination. The sectioned and polished samples shall be examined microscopically at 50X minimum magnification in accordance with EIA-469. The decapsulated samples shall be sectioned in the direction which will not display lead attachment. On those samples with the encapsulant intact, sectioning shall be performed in the plane which will display lead attachment. On the samples sectioned with the encapsulant intact, cracks in the coverplate ceramic may be introduced by the sectioning procedure. These will not be a cause for concern.

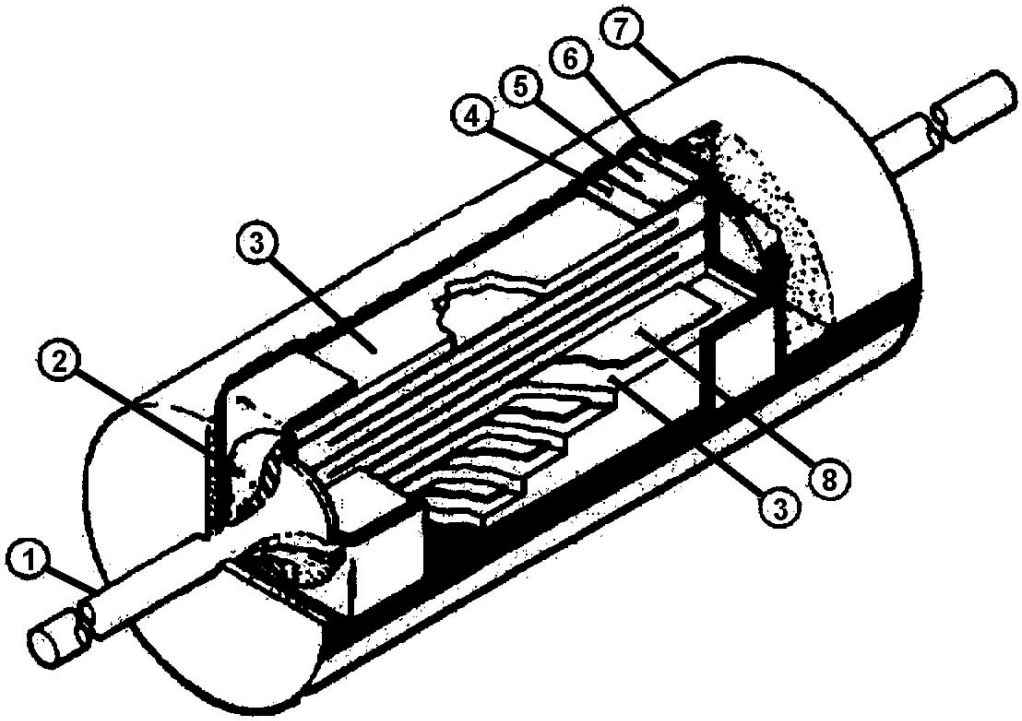
10.1.2 Data records. DPA findings that deviate from the specification configuration or other requirements shall be documented as defects. DPA findings shall be documented in a format equivalent to that given in EIA-469.

10.1.3 Evaluation criteria. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA samples does not meet any of the microscopic examination and the capacitor element visual requirements specified herein.




| ITEM | ITEM NAME | MATERIALS OF CONSTRUCTION |
|---|---|---|
| 1 | Lead Wire | Gold-Plated Nickel or Solder-Coated Copper |
| 2, 6 | Solder | High-Temperature Alloy |
| 3 | Dielectric | Proprietary Ceramic Blend |
| 4 | End Termination | Silver (or It's Alloy)-Glass Frit Compound |
| 7 | Case | Encapsulating Media |
| 8 | Metal Electrode | Proprietary |

FIGURE 10-1. Typical radial leaded ceramic capacitor molded case.




| ITEM | ITEM NAME | MATERIALS OF CONSTRUCTION |
|---|---|---|
| 1 | Lead Wire | Gold-Plated Nickel or Solder-Coated Copper |
| 2, 6 | Solder | High-Temperature Alloy |
| 3 | Dielectric | Proprietary Ceramic Blend |
| 4 | End Termination | Silver (or It's Alloy)-Glass Frit Compound |
| 5 | Intermediate End Layer* | Electrodeposited Metal |
| 7 | Case | Encapsulating Media |
| 8 | Metal Electrode If used. | Proprietary |

FIGURE 10-2. Typical axial leaded ceramic capacitor.

10.2 Capacitors, fixed, ceramic chip (MIL-PRF-123 and MIL-PRF-55681). The configuration of these capacitors is similar to the radial leaded capacitor illustrated on figure 10-1 except that they are not enclosed in plastic and do not have leads.

10.2.1 Method.

10.2.1.1 External visual. Visually inspect each part at 20X minimum magnification for chips, cracks, solder or metallization splatter or smear, exposed electrodes, end termination metallization configuration, warpage, and physical dimensions. It is recommended that parts also be examined with a fluorescent penetrant that meets the requirements of SAE-AMS2644, for fine cracks and other surface defects not resolvable at 50X magnification. A suitable part-cleaning procedure must also be developed and used with any penetrant examination to ensure that a harmful residue is not left on part surfaces.

10.2.1.2 Sample preparation. Parts shall be cleaned, oriented, mounted, and polished in accordance with EIA-469.

10.2.1.3 Microscopic examination. The sectioned and polished samples shall be examined microscopically at 50X minimum magnification in accordance with EIA-469.

10.2.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects on a form similar to that given in EIA-469.

10.2.3 Evaluation criteria. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA samples does not meet any of the microscopic examination requirements specified herein.

10.3 Capacitor, fixed mica (MIL-PRF-87164 and MIL-PRF-39001). A typical fixed mica capacitor is illustrated on figure 10-3. MIL-PRF-87164 capacitors have soldered foil-to-clamp connections.

10.3.1 Method.

10.3.1.1 External visual. Visually inspect each part at 20X minimum magnification in accordance with applicable procurement specification to examine leads, markings, dimensions, and case.

10.3.1.2 Terminal strength. Conduct terminal strength test (pull test only) on all samples in accordance with the applicable specification.

10.3.1.3 Chemical removal of encapsulation. Chemically strip the encapsulation from one-half of the samples.

10.3.1.4 Capacitor element visual. Examine decapsulated samples at 20X minimum magnification for configuration compliance, uniformity of stacking, lead attachment, clamp, solder coverage, and cracked or cold solder connections. Disassemble units to permit evaluation of stacking workmanship, intrusion of impregnant into clamp area, and cracks on the mica plates.

10.3.1.5 Sectioned sample preparation. Cast remaining half of samples in clear epoxy and cross section in a plane perpendicular to the lead plane to permit evaluation of the dielectric stacking, lead-to-clamp or foil-to-clamp connections, and the degree of impregnant intrusion.

10.3.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.

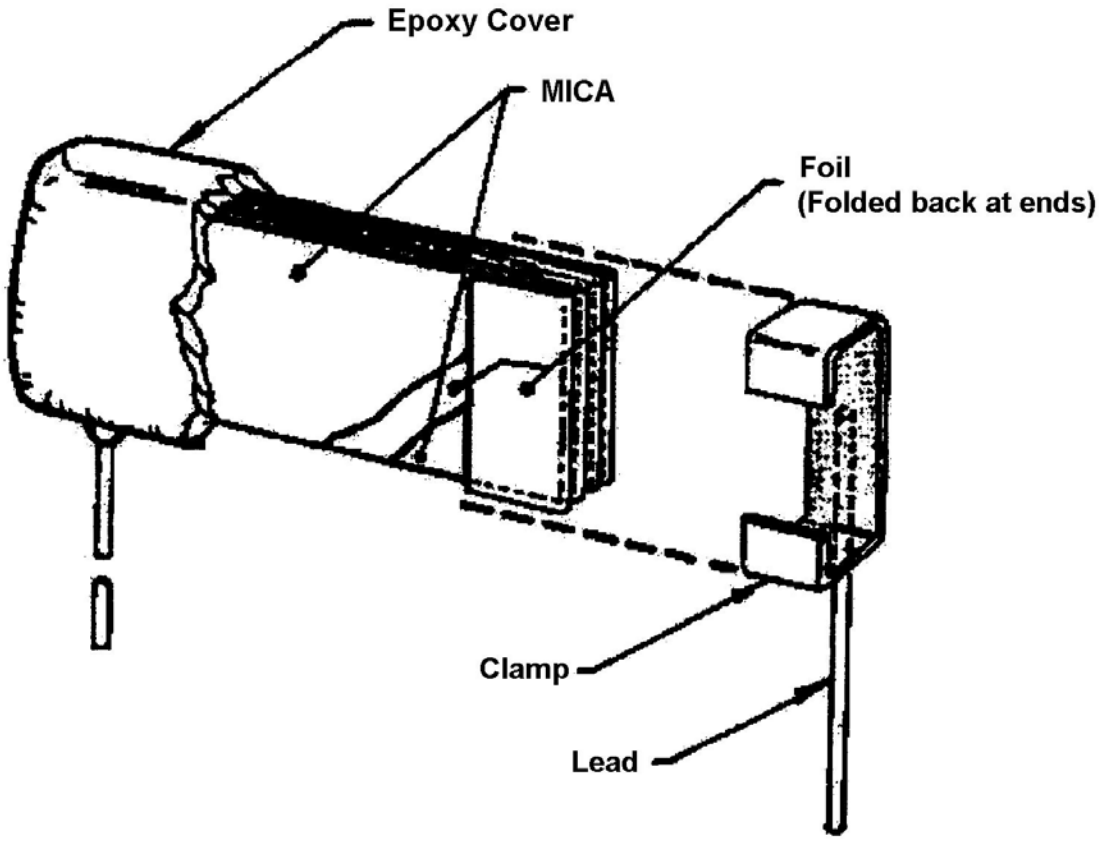



FIGURE 10-3. Typical mica capacitor (CMR style).

10.3.3 Evaluation criteria. With mica capacitors, particular attention should be given to ascertaining that the devices are solidly and uniformly constructed and that the end clamps make good metallurgical contact with the electrode foils. Microscopic examination shall be performed at 20X minimum magnification. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA sample parts exhibit any of the following defects:

a. Failure to meet external visual requirements or configuration requirements.

b. Excessive voids, thin spots, or cracks in the dielectric.

c. Inadequate stack clamping.

d. Excessive intrusion of impregnant into the foil/ clamp interface.

e. Cracks in the case or encapsulating plastic extending through to the capacitor element.

f. Inadequate lead to clamp attachment.

g. Solder used is not a high-temperature alloy. Verify this through SEM EDS, differential thermal analysis, thermal galvanometric analysis, or other equivalent methods.

h. Inadequate solder between foil and clamp and between clamp and lead, when applicable.

i. Failure to pass lead pull tests.

j. Any defect that reduces part reliability.

10.4 Capacitor, fixed, solid tantalum (MIL-PRF-39003). A typical solid tantalum capacitor is illustrated on figure 10-4.

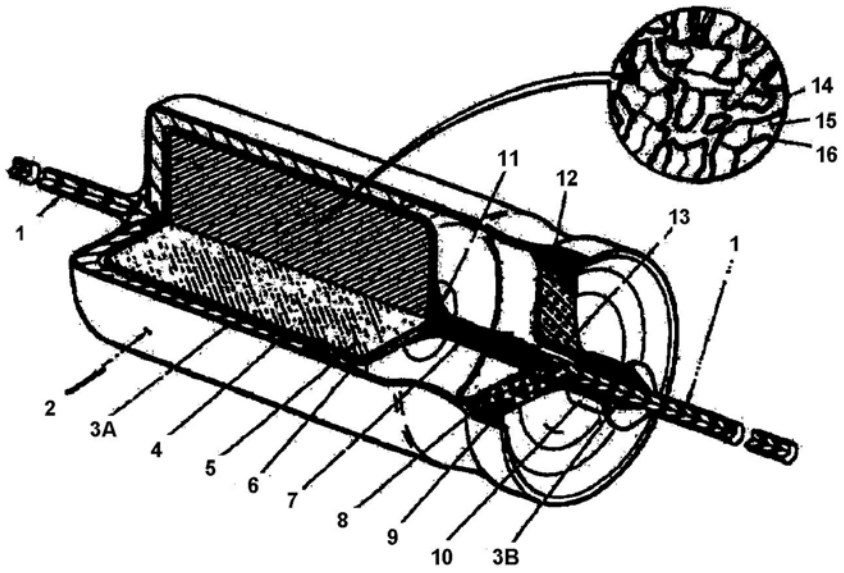
10.4.1 Method.

10.4.1.1 External visual. Examine seal area at a minimum of 20X magnification for defects in the glass seal or tubulet-to-ead solder joint, pinholes or cracks in plastic sleeving, and marking and configuration compliance.

10.4.1.2 Hermeticity. Conduct seal tests on all samples of hermetically-sealed styles in accordance with the requirements of the procurement specification. Sleeving should be removed prior to conducting this test.

10.4.1.3 Sectioned samples. One half of samples (round up) shall be potted in clear plastic sectioned axially to a depth that exposes the anode lead in the header tubulet. Caution should be exercised to ensure cracks are not induced during sectioning. Examine using 30X minimum magnification for configuration compliance, and for defects in lead bond, tubulet solder, slug orientation, and slug-to-case solder joint.

10.4.1.4 Delidded samples. Open remaining half of samples by cutting and peeling the metal can in such a way that the cavity above the tantalum slug can be observed. Examine for loose solder particles, configuration compliance, slug orientation, slug-to- case attachment, and adequate anode riser-to-lead weld joint. Unless otherwise specified, the capacitors shall meet the requirements of MIL-PRF-39003, for acceptable parts and major/minor defects as specified in the radiographic inspection criteria.




| ITEM | ITEM NAME | MATERIAL OF CONSTRUCTION |
|---|---|---|
| 1 | External leads | Solder-Coated Nickel |
| 2 | Case | Solder-Plated Brass |
| 3A | Solder | Low-Temperature Alloy |
| 3B | Solder | High-Temperature Alloy |
| 4 | Conductive Paint | Silver-based |
| 5 | Slug | See Item No. 14, 15, 16 |
| 6 | Carbon film | Colloidal Carbon |
| 7 | Anode Riser | Tantalum Wire |
| 8, 9, 10 | Seal Assembly | Glass-To-Metal Seal |
| 11 | Anode riser wire to slug interface (may be a weld at the surface or the wire may be buried in the slug) | |
| 12 | Case crimp | |
| 13 | Anode riser-to-lead Lap weld | |
| 14 | Oxide coating | |
| 15 | Core | |
| 16 | Dielectric film | |

FIGURE 10-4. Typical solid tantalum capacitor.

10.4.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.

10.4.3 Evaluation criteria. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA sample parts exhibit any of the following defects:

a. Cracks extending through the glass header. NOTE: Care must be taken to avoid inducing cracks during sectioning. Minor chips or flaking at the tip of the glass meniscus shall not be considered an anomaly.

b. Tubulet filled with solder less than 25 percent of its length when solder-coated leads are used and less than 50 percent of its length when gold-plated leads are used. Voids in tubulet solder or solder separation from lead or tubulet that reduces the fill to less than 25 percent of tubulet height for solder-coated leads or to less than 50 percent for gold-plated leads.

c. Voids in header to case solder attach which exceed 50 percent of the header thickness.

d. Anode (tantalum slug) not parallel to case within 15 degrees.

e. Solder spikes inside unit or eyelet solder extending beyond bottom of tubulet.

f. Broken or cracked anode lead weld.

g. Anode immersed in solder that is less than one-third of its height (see radiographic inspection criteria of MIL-PRF-39003).

h. Anchor solder cracked or pulled away from anode slug, except as noted in the radiographic inspection criteria of MIL-PRF-39003.

i. Solder buildup on inside of can with height greater than 0.50 mm (.020 inches) resulting from solder rundown during sealing process.

j. Anode totally immersed in solder.

k. Anode broken, cracked, or distorted.

l. Loose material 0.25 mm (.010 inches) or large enough to bridge the shortest distance between lead and can, or between tantalum pellet and can.

m. Seal leakage in excess of specification requirements.

n. Any defect that reduces part reliability (e.g., bulge or dents on the case).

o. Failure to meet external visual requirements:

    (1) Cracks on the glass seal.

    (2) Cracked or cold solder joint around seal area.

    (3) Flux or foreign material on anode lead and around seal area.

10.5. Capacitor, fixed, tantalum foil (MIL-PRF-39006). A typical tantalum foil capacitor is illustrated on figure 10-5.

**NOTE: Obsolete part, no longer in production.**

10.5.1 Method.

10.5.1.1 External visual. Perform external visual inspection at a minimum of 20X magnification. Check condition of glass seal and the nickel-to-tantalum lead weld. Check for physical damage to weld area that could be evidence of bending leads too sharply in the critical weld zone.

10.5.1.2 Hermeticity. Conduct seal tests on each sample in accordance with the requirements of the procurement specification. Remove sleeving before conducting the tests.

10.5.1.3 Removal of encapsulation. Remove cases to permit internal visual inspection at 30X minimum magnification. Two methods have proven satisfactory. Circumferential cuts (one at each end) followed by two longitudinal cuts allows the case to be removed in two pieces. The other method uses a lathe or grinder to cut away the circumferential weld to the header at each end of the part. After de-burring, it is often possible to slide the capacitor core intact out of the case. If not, it may be necessary to make a longitudinal cut and spring the case slightly to release the core. After examination of the core, the capacitor element shall be unwrapped for examination of the lead-to-foil welds and the foils. Inspect for configuration compliance during each step.

10.5.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.

10.5.3 Evaluation criteria. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if the DPA sample parts exhibit any of the following defects:

a. Cracks, chips, or breaks extending through the end seal. Broken or incompletely welded end seals. Minor chips or flaking at the tip of the glass meniscus shall not be considered an anomaly.

b. Cracks or breaks in lead weld joints, or greater than 30-percent misalignment of butt welds.

c. Anode lead uninsulated and positioned such that it can touch case or cathode lead during shock or vibration.

d. Unanchored elements or insufficient impregnant or filler to prevent movement of elements.

e. Absence of spacer material between foils, or unwetted spacer material.

f. Anode foil color not uniform or not indicative of the dc voltage rating of the capacitor.

g. Less than three weld spots, cracked welds on lead-to-foil connection, or lead broken away from foil.

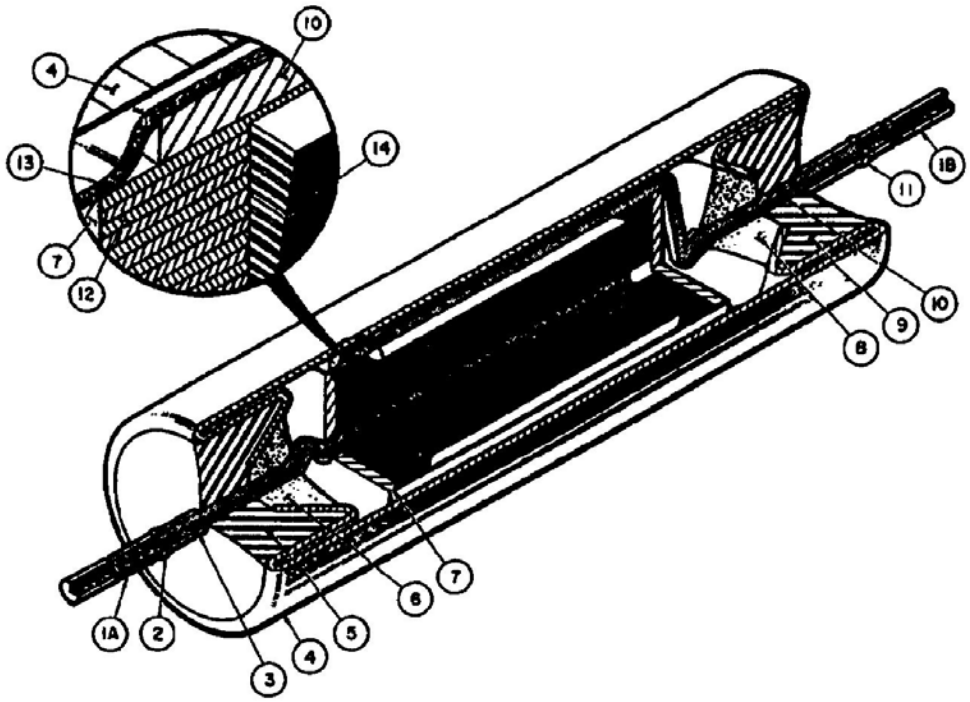
h. Scratches or cracks in leads or foil which penetrate the dielectric.

i. Contamination or foreign material inside capacitor.

j. Abnormal telescoping of the capacitor element.

k. Seal leakage in excess of specification requirements.

l. Any other defect that reduces part reliability.




| ITEM | ITEM NAME | MATERIAL OF CONSTRUCTION |
|---|---|---|
| 1A, 1B | Nickel Lead | Nickel (MIL-STD-1276, Type N) |
| 2, 11 | Butt Weld | |
| 3, 10 | Tantalum Lead | 99.9 percent Tantalum |
| 4 | Tantalum Case | 99.9 percent Tantalum |
| 5, 9 | Seal Assembly | Glass-To-Metal Seal |
| 6, 8 | Header Ring | 99.9 percent Tantalum |
| 7 | End Insulation | Elastomeric Material |
| 12 | Dielectric | Tantalum Pentoxide |
| 13 | Insulating Tape | Polyester Film |
| 14 | Electrode | Tantalum Foil (May be etched) |

FIGURE 10-5. Typical tantalum foil capacitor.

REQUIREMENT 10

10.6 Capacitor, fixed, paper or plastic film (MIL-PRF-19978). A typical paper or plastic film capacitor is illustrated on figure 10-6.

10.6.1 Method.

10.6.1.1 External visual. Conduct visual inspection, at 20X minimum magnification, for defects in case seal, eyelet solder, glass headers, leads, and markings.

10.6.1.2 Hermeticity. Conduct seal tests on each sample of hermetically-sealed parts in accordance with the requirements of the procurement specification. These tests are not required if they have previously been conducted as part of receiving inspection.

10.6.1.3 Sample preparation. Remove case from all samples by making two circumferential cuts just inside each header plus longitudinal cut to permit removal. Carefully remove cutting debris before opening case. Section headers, after completing visual inspection, through eyelet longitudinal center line to verify eyelet solder integrity.

a. Internal visual. Examine the parts at a minimum of 30X magnification for configuration compliance and for tubulet solder fill, contamination, insulation, spacers, impregnation, element stability, and lead spiral to end spray solder connection. Note that this connection is critical and should be subjected to a pull test to ensure that it is not a cold solder or "low strength" joint. All lead to end spray terminations shall be pull tested to the following criteria:

    (1) Case diameter up to 17.01 mm (.670 inch); minimum pull force- 4 pounds.

    (2) Case diameter 17.04 mm (.671 inch) and up- minimum pull force- 6 Pounds.

If necessary, remove the encapsulation from the capacitor element. Unwrap the capacitor element of all samples to examine foil and dielectric condition.

10.6.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.

10.6.3 Evaluation criteria. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if the one or more DPA sample parts exhibit any of the defects listed below. Note that the defects in this list are based on the typical part shown on figure 10-6. Defect criteria should be adjusted as applicable for other designs.

a. Cracked or broken glass in end seal.

b. Solder rundown inside case in area of rolled-foil or end spray.

c. Loose (or moveable) element due to insufficient impregnant or inadequate restraint. When impregnant is not used, other physical restraints may be provided to restrict element movement. The DPA shall be conducted so that the existence and suitability of these restraints are verified. When impregnant is used to stabilize the element, it must be free of voids that would permit the element to move during shock or vibration.

d. Absence of insulator caps over end of element.

e. Loose lead wire or broken solder where lead attaches to the extended foil end spray.

f. Broken or damaged lead wire (internal or external).

g. Contamination and foreign material embedded between windings of the capacitor element.

h. Burned or charred regions in the capacitor element area which damage the dielectric.

i. Less than 25-percent eyelet solder fill (from outer end of eyelet).

j. Eyelet solder separation from lead or inside diameter of eyelet.

k. Voids or holes through the outer end seal.

l. Scratches or cracks in the foil which penetrate the dielectric.

m. Folds, blisters, or wrinkles in the dielectric winding.

n. End spray coverage that does not provide at least 75% area contact to all winding turns.

o. Poor adhesion between end spray and foil, or between end spray and external lead connection.

p. Seal leakage in excess of specification requirements.

q. Any other defect that reduces part reliability.

10.7 Capacitor, fixed, metallized film (MIL-PRF-87217 and MIL-PRF-83421). A metallized film capacitor is shown on figure 10-7. The part in this illustration has the conventional lead attached to the element end spray. Parts may also utilize other means, e.g., a wire braid or several flexible leads to make this connection.

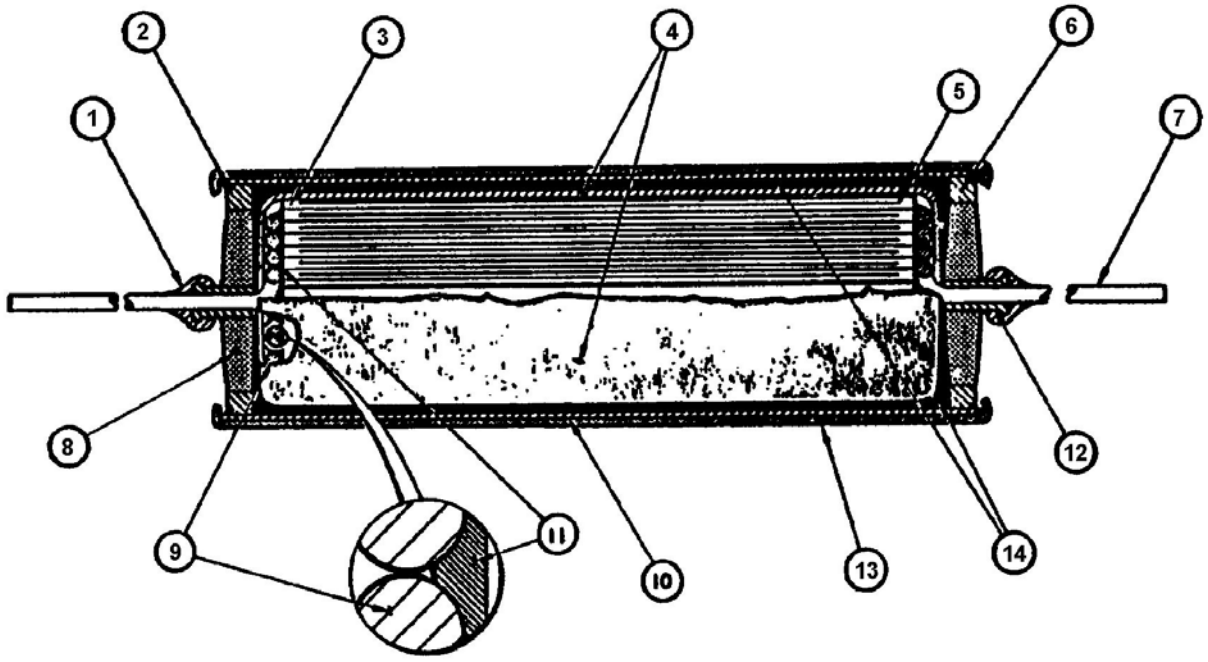
10.7.1 Method.

10.7.1.1 External visual. Conduct visual examination, at 20X minimum magnification, for defects in case seal, eyelet solder, glass headers, leads, and marking.

10.7.1.2 Hermeticity. Conduct seal tests on each sample in accordance with the requirements of the procurement specification. These tests are not required if seal tests have already been conducted as a part of receiving inspection.

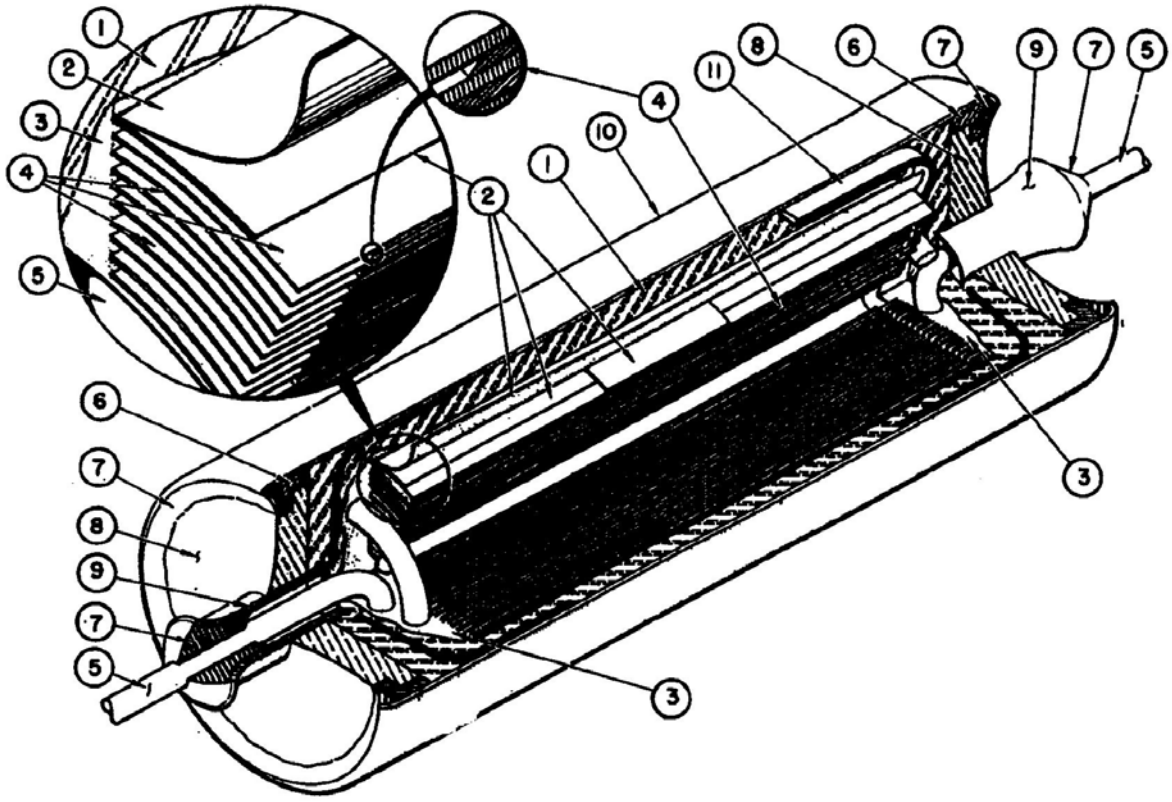
10.7.1.3 Sample preparation. Remove case from all samples by making two circumferential cuts just inside each header plus a longitudinal cut to permit removal. After internal visual has been completed (10.7.1.4), section each header through the eyelet, pinhole, or other longitudinal center line to verify tubulet integrity.

10.7.1.4 Internal visual. Examine the parts at a minimum of 30X magnification for configuration compliance and for external plastic wraps, tubulet solder fill, contamination, solder splatter, insulation spacers and washers, impregnation, element stability, and lead-to-end spray termination (babbitt) integrity. Note that the lead-to-end spray termination is critical and should be pull tested to ensure that it is not a cold solder or "low strength" joint. Lead attachment configurations for this part type are manufacturer and case size specific so providing pull test limits is impractical, instead, the leads should be axially pulled to destruction and examined for evidence of end spray removal with the wire, which should not be less than 50 percent of the intended attachment area. Unwrap the metallized plastic of all samples and examine them for workmanship defects such as wrinkled film, evidence of charring, nonuniformity of film conductor end margin, pinholes, or other defects.




| ITEM | ITEM NAME | ITEM | ITEM NAME |
|---|---|---|---|
| 1 | Solder-Lead Seal | 7 | Lead |
| 2 | Seal Solder | 9 | Lead-To-Foil Attachment |
| 3 | Dielectric | 10 | Can |
| 4 | Capacitor Element-to-case Insulator | 11 | End Spray |
| | | 12 | Header |
| 5 | Electrode | 13 | Case Insulation |
| 6, 8 | End Seal Assembly | 14 | Potting |

FIGURE 10-6. Typical extended foil (paper/film) capacitor.




| ITEM | ITEM NAME | MATERIAL OF CONSTRUCTION |
|---|---|---|
| 1 | Filler | Polymeric Compound |
| 2 | Conductor/Dielectric | Metalized Polycarbonate |
| 3 | End Spray | Proprietary |
| 4 | Dielectric Interleaf | Polycarbonate |
| 5 | Leads | Copper Clad Steel, Tin Coated |
| 6, 7, 8, 9 | End Seal Assembly | Glass-To-Metal Seal |
| 10 | Case | Tin Coated Brass |
| 11 | End Cap | Polymeric Material |

FIGURE 10-7. Typical metallized film capacitor.

REQUIREMENT 10

10.7.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.

10.7.3 Evaluation criteria. This inspection should be adjusted as necessary to accommodate variations in design. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA samples exhibit any of the following defects:

a. Cracked or broken glass end seal.

b. Solder rundown or splatter inside case in area of rolled film.

c. Loose (or moveable) element due to insufficient potting or inadequate restraint when potting is not used, (other physical restraints may be provided to restrict element movement). The DPA shall be conducted so that the existence and suitability of these restraints are verified. When potting is used to stabilize the element it must be free of voids that would permit the element to move during shock and vibration.

d. Absence of insulator caps over ends of element.

e. Loose wire or broken solder joint where lead attaches to element end spray (babbitt).

f. Broken or damaged lead wire (internal or external).

g. Contamination or foreign material embedded between windings.

h. Less than 25-percent eyelet solder fill (from outer end of eyelet).

i. Eyelet solder separation from lead or from inside diameter of eyelet.

j. Voids or holes through the outer end seal.

k. Scratches in the metallization which penetrate the dielectric. Note that it is characteristic of these parts to have burned-out areas in the metallization caused by the high voltage "clearing" process. These spots should not be classified as defects unless there is obvious damage to the dielectric.

l. Folds, blisters, or wrinkles in the dielectric winding.

m. End spray coverage that does not provide at least 75% area contact to all winding turns.

n. Poor adhesion between end spray and element, or between end spray and external lead connection.

o. Seal leakage in excess of specification requirements.

p. Any other defect that may reduce part reliability.

10.8 Capacitors, fixed, tantalum slug, wet electrolyte (MIL-PRF-39006/22 and MIL-PRF-83500/01). Two typical capacitor designs are shown on figures 10-8 and 10-9.

10.8.1 Method.

10.8.1.1 External visual. Perform external visual inspection at a minimum of 20X magnification. Check condition of glass seal and the nickel-to-tantalum lead weld. Check for physical damage to weld area that could be evidence of bending leads too sharply in the critical weld zone. Check for any bulges or dents in the case.

10.8.1.2 Hermeticity. Conduct seal tests on each sample in accordance with the requirements of the procurement specification. Remove sleeving before conducting the tests.

10.8.1.3 Decapsulation. CAUTION: Capacitor electrolyte is an acid solution and must be handled with extreme care. When performing DPA, ensure that handling of acid is performed using all applicable safety equipment per state, federal or other local quidelines for handling and disposal of hazardous materials.

Cut case around anode end to a depth equivalent to the case thickness being careful not to cut into the anode. Some capacitors have a groove in the case on the anode end. The cut must be between the groove and the cathode end, and as near to the groove as possible. Separate the two sections and remove the spacer by cutting with an Exacto blade (or equivalent) longitudinally along the lead.

10.8.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.

10.8.3 Visual evaluation criteria. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA sample parts exhibit any of the following defects.

10.8.3.1 Visual examination. All exposed inner surfaces of each capacitor shall be examined for the following characteristics at 30X minimum magnification:

a. Space between the anode bushing and the anode.

b. Broken lead or defective lead welds.

c. Complete absence of electrolyte, or insufficient level of liquid or gel when compared to electrolyte levels of other samples of the same lot.

d. Improper seating (fit) of the Teflon, rubber, or equivalent-type boot between the outside diameter of anode and inside diameter of case, and between anode and bottom of case.

e. Scratches or cracks that are not oxidized, or broken or distorted anode.

f. Color of anode and riser indicative of incorrect formation voltage for the dc voltage rating of the capacitor. Any secondary color or spot graying suggests abusive conditions and may be cause for lot rejection. The color shade of the oxide may differ slightly for different lots of capacitors or may even vary slightly for units within the same lot. This is normal and is not cause for rejection.

g. The external portions of glass seal and around cathode weld area shall be free of acid. A useful test technique is to apply a 0.01 percent thymol blue, which turns red in the presence of acid.

h. Cracked or broken glass in seal assembly.

i. Seal leakage in excess of specification requirements.

j. Any other defect that may reduce part reliability.

k. Foreign material in electrolyte.

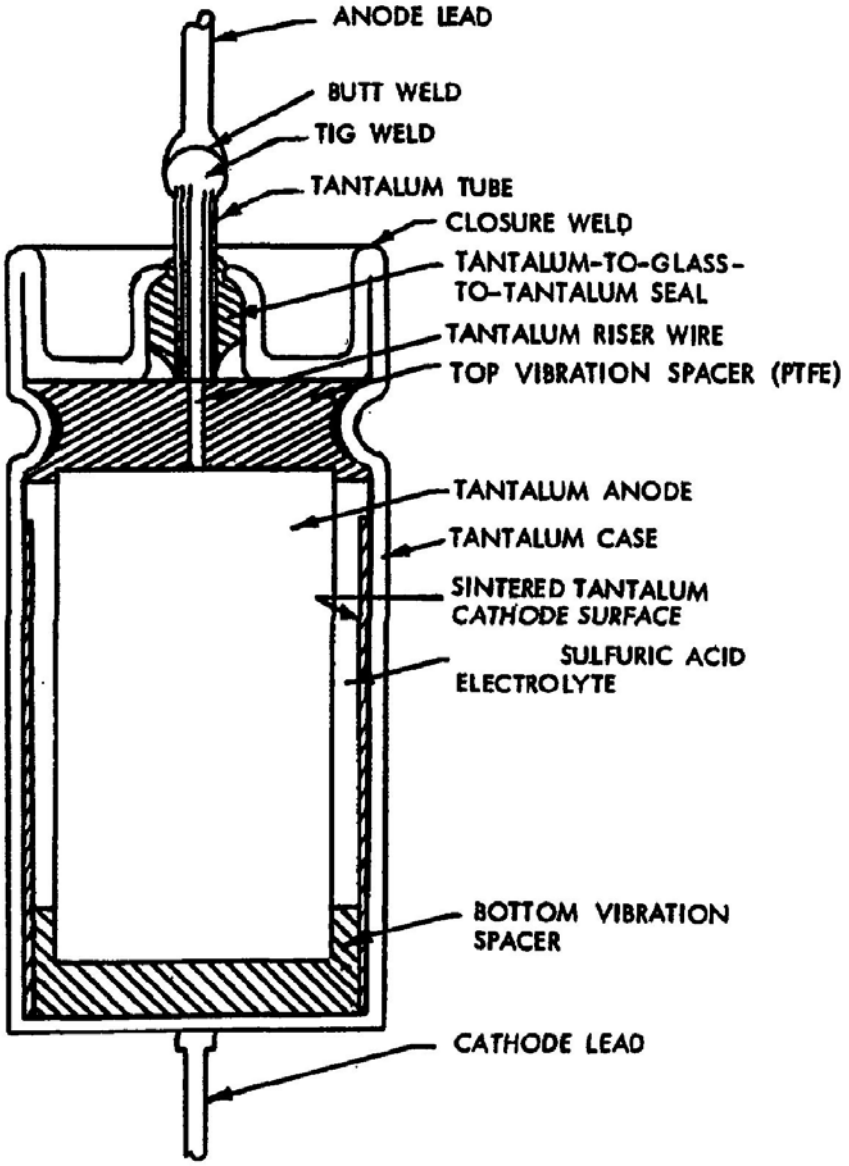
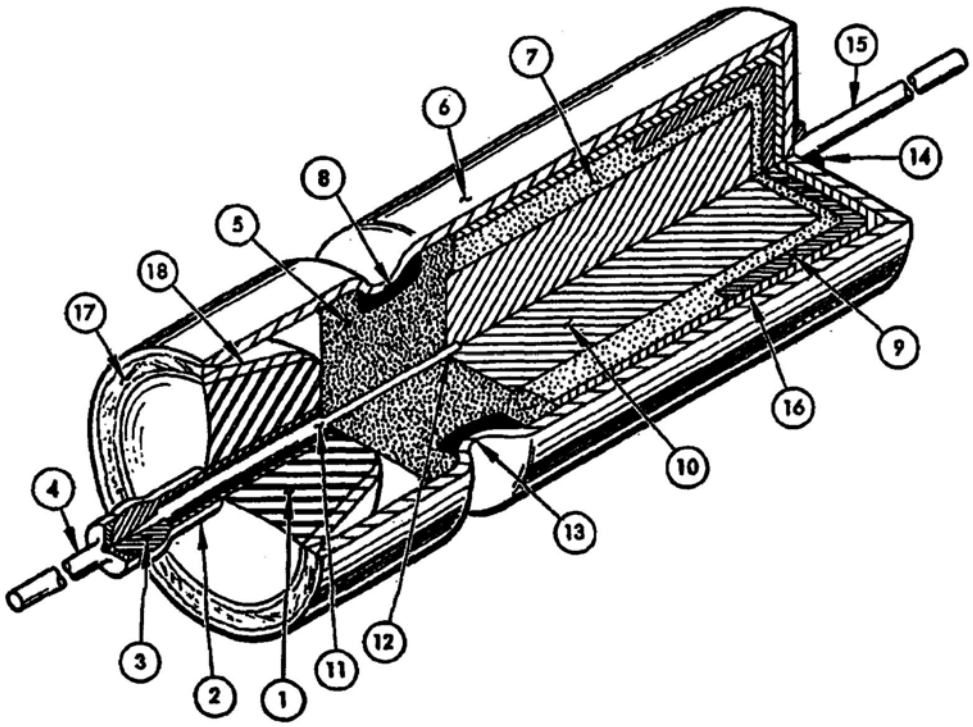



FIGURE 10-8. Capacitor, fixed, tantalum, wet slug.




| ITEM | ITEM NAME | ITEM | ITEM NAME |
|---|---|---|---|
| 1 | Glass Insulator | 10 | Tantalum Anode |
| 2 | Eyelet Tubulet | 11 | Anode Riser (Ta) |
| 3 | External Lead Weld | 12 | 10-to-11 Interface |
| 4 | Anode Lead | 13 | Case Crimp |
| 5 | Teflon Bushing | 14 | Cathode Lead-to-case Weld |
| 6 | Taptalum Case | 15 | Cathode Lead |
| 7 | Gelled Acid Electrolyte | 16 | Ta Cathode Sleeve |
| 8 | Silicon Rubber Bushing | 17 | Header Weld |
| 9 | Teflon Cup | 18 | Header |

FIGURE 10-9. Capacitor, fixed, tantalum, wet slug.

REQUIREMENT 10

10.9 Capacitor, fixed, glass (MIL-PRF-23269). A typical glass capacitor construction is shown on figure 10-10.

10.9.1 Method.

10.9.1.1 External visual. Record all markings and identification on each part and package, and check for configuration compliance. Inspect each sample, at 20X minimum magnification, for surface cracks, voids, chip-outs, and defects on the seal and leads.

10.9.1.2 Hermeticity. Conduct seal test on each sample in accordance with the applicable procurement specification.

10.9.1.3 Sample preparation. Parts shall be cleaned, oriented, mounted, and polished in accordance with EIA-469. Polish each sample so that edges of the capacitor plates are clearly visible.

10.9.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.

10.9.3 Evaluation criteria. When the DPA is conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA samples exhibit any of the following defects. All exposed inner surfaces of each capacitor shall be examined for the following characteristics at minimum magnification of 30X:

a. Cracked, chipped, or discolored glass.

b. Holes in glass extending into the conductor area.

c. Air bubble bridging plates.

d. Any contamination or foreign material trapped in the glass.

e. Nonuniformity of dielectric thickness.

f. Any defect, like cracks, on plate-to-lead weld, lead-to-glass seal, and ceramic disc fused into glass at lead egress point.

g. Any condition that is an obvious manufacturing defect.

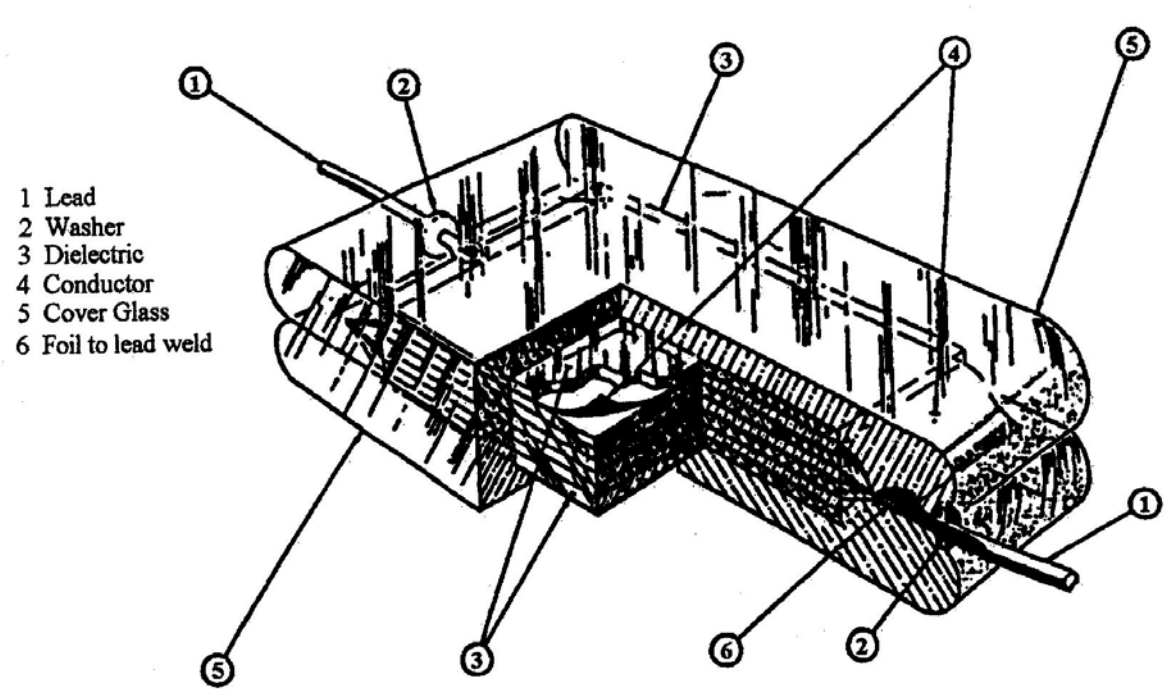



FIGURE 10-10. Typical Glass Capacitor,

10.10 Capacitor, variable, piston type, sealed and unsealed (MIL-PRF-14409). A typical rotating piston, nonrotating piston, and a vertically mounted, sealed, variable capacitor design are illustrated on figure 10-11 through 10-13.

10.10.1 Method.

10.10.1.1 External visual. Record all markings and identification on each part, and inspect for configuration compliance. Perform external visual inspection at 20X minimum magnification. Check condition of seal. Inspect for physical damage to body and leads. The piston shall be checked for ease of rotation (completely in and out) ten times.

10.10.1.2 Hermeticity. Conduct seal tests, if applicable, on each sample in accordance with the requirements of the procurement specification.

10.10.1.3 Examination. Examination and disassembly should be done under a microscope with 30X magnification and in a clean work area.

10.10.1.4 Disassembly.

a. The air dielectric units are opened by rotating their rotor screw counter-clockwise until the rotor assembly is completely disengaged.

   NOTE 1: Two types of friction locks are commonly used, and the presence of the type used must be assessed. One type is a gland of plastic that binds the threads, and the alternate is a screw thread of different pitch from the main body. The "two-pitched" style probably introduces galling of the threads and may result in some minor particle generation which is normal; however, excessive particles are not allowed. No particles are permitted within the inner threads under any circumstances.

   NOTE 2: In some devices it may be necessary to unsolder the end cap containing the adjustment screw to permit removal of internal parts.

b. Nonremovable rotor capacitors shall be opened by lathe-cutting of the rolled end of the bushing and by unsoldering the ceramic insulator from the bushing and stator.

c. Glass dielectric variable capacitors require unsoldering of the "rotor" plate. Internal inspection of this device is similar to the others.

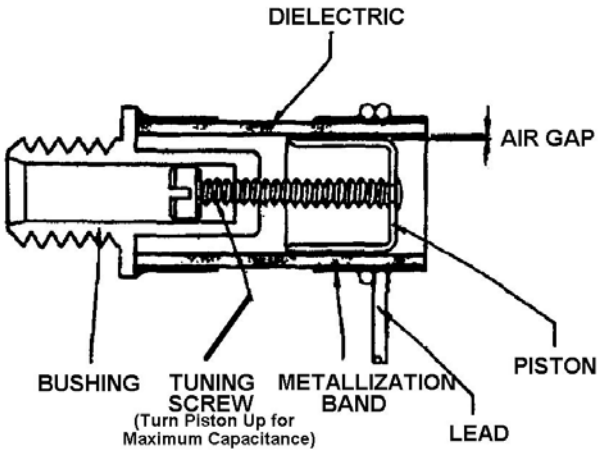
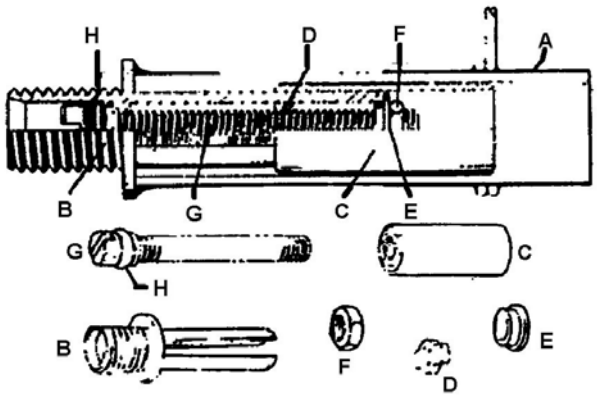



FIGURE 10-11. Rotating piston style.




| | |
|---|---|
| A | Metalized Dielectric Tube |
| B | Bushing |
| C | Piston |
| D | Teflon anti-backlash washer |
| E | End stop (stainless steel) |
| F | Nut - (brass, nickel plated) |
| G | Screw- = 2.72 (stainless steel) |
| H | “O” ring |

FIGURE 10-12. Nonrotating piston style.

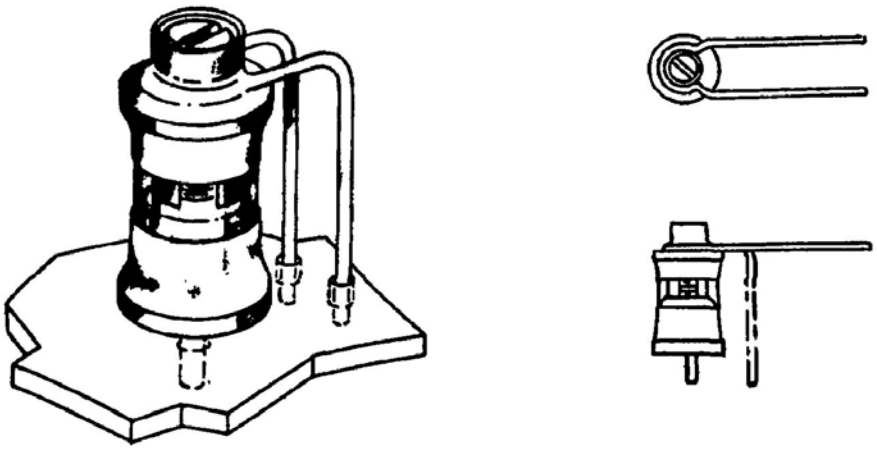


FIGURE 10-13. Vertically mounted printed circuit board sealed style (sealed).

10.10.1.5 Sample sectioning. One sample shall be encapsulated and sectioned axially through the center of the device. A photograph shall be taken of a typical sample and attached to the DPA data sheets. The magnification of the photograph shall be such that the sectioned device fills the entire photograph. Any anomalies noted shall also be photographed.

a. Prior to encapsulation, the protective seal cap, if any, shall be removed and the lead screw rotated clockwise until the piston is fully engaged.

b. The device shall be vacuum-impregnated with encapsulating media such that the entire internal cavity is filled.

10.10.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.

10.10.3 Evaluation criteria. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA sample parts exhibit any of the following defects.

10.10.3.1 Visual examination. All exposed inner surfaces of each capacitor shall be examined for the following characteristics at a minimum magnification of 30X.

a. Scratches or abrasions on any parts or surfaces where movement occurs with respect to other parts or surfaces within the assembly.

b. Loose metallic particles (or any other particles) or other types of contamination, such as flux residue.

c. Corrosion on piston surface, screw, or cylinder walls.

d. Cracked or warped parts.

e. Burrs, gouges, or particles in the threaded areas.

f. Blistering, flaking, bubbles, pits, cracks, foreign material, or peeling of plated surfaces.

g. Nonconcentric, bent, distorted, or misaligned rotors and stators (or piston and bore); or irregularities, such as bumps and nicks on surfaces.

h. Improper seating and solder joints of the tubes.

i. Lack of Apiezon H (where applicable) from threads.

j. Cracks in glass dielectric (where applicable).

k. Insulator (where applicable) damaged or missing from stator.

l. Solder joints (as applicable) that show voids, insufficient filleting, or signs of a cold joint.

m. Noticeable amounts of lubricant.

10.11 Capacitor, fixed, solid tantalum chip style (MIL-PRF-55365). Typical solid tantalum capacitor are illustrated in figures 10-14 and figure 10-15.

10.11.1 Method.

10.11.1.1 External visual. Examine devices at 10-30X magnification for marking and configuration compliance as well as the following:

a. The body encapsulant shall be free of cracks, holes and voids that expose internal elements or chipouts that reduce the case wall thickness by 50% for molded case styles. The openings between the end caps and the body shall be filled for CWR06.

b. The terminations shall be coated with the specified coating material (gold plate or solder). Minor areas of exposed base metal are acceptable provided that they do not collectively exceed 5 percent of the surface area of the terminations.

c. The anode riser shall be welded to the end cap around a minimum of 90 degrees (or one quarter) of the circumference of the wire. (Not applicable for molded styles)

d. There shall be no evidence of lead-forming stress cracks on the external leads of molded style capacitors.

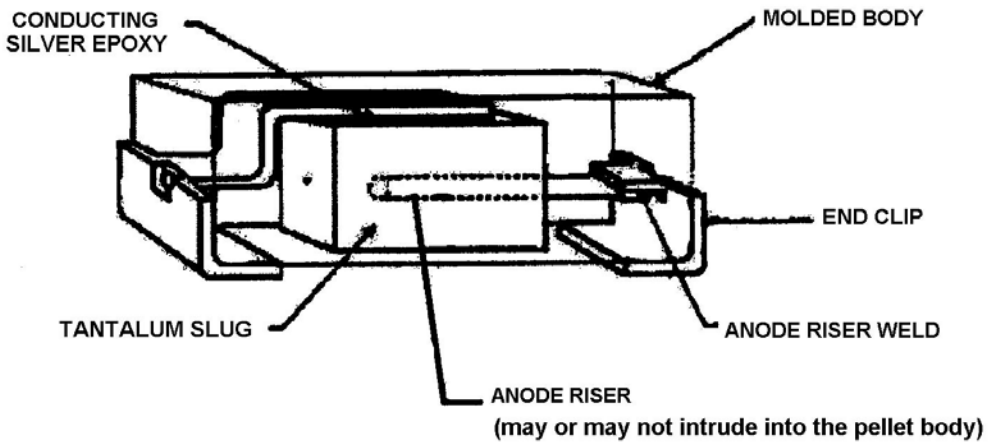



FIGURE 10-14. Typical molded epoxy solid tantalum chip capacitor (CWR09).

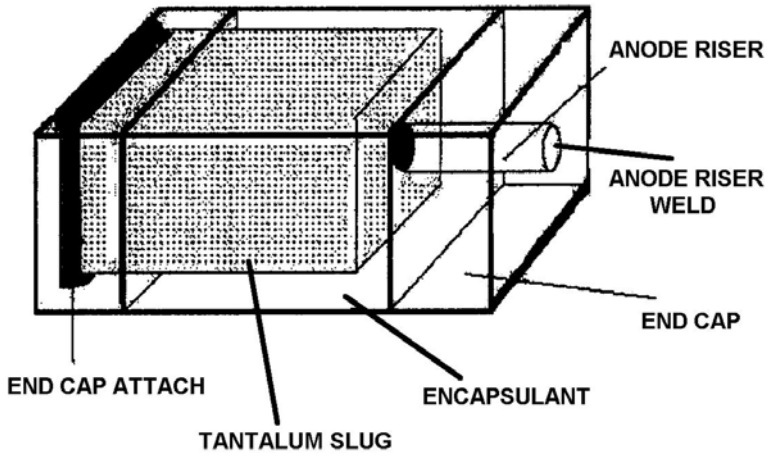



FIGURE 10-15. Typical non-epoxy molded solid tantalum chip capacitor.

10.11.1.2 Sectioned samples. All of the samples shall be potted in clear epoxy and sectioned axially in a plane along the end caps to the midpoint in order to expose the anode riser weld and slug attachment interfaces. Caution should be exercised to ensure damage is not induced during sectioning. Examine using 30X minimum magnification for configuration compliance, and for defects as listed below:

a. For devices without epoxy molded cases (orange, blue), the anode riser shall be welded to the anode (when applicable) and/or the anode end cap, with evidence of a metallurgical bond.

b. There shall be a layer of conductive (silver) epoxy joining the silver coated end of the pellet to the external cathode lead or end cap. For CWR06s, the conductive epoxy may coat the inner surfaces of the cathode end cap on all available sides, but shall not be present along the body or close to the positive end (anode riser) of the pellet. Likewise, for molded styles, evidence of silver going (beyond the shoulder of the pellet) near the riser wire is not acceptable." As in any component with two terminals separated by a dielectric, you don't want metal smears (especially silver, since it migrates) that can create a bridge between the two terminals and cause a short, particularly in the presence of moisture.

c. For epoxy molded cased devices, there shall be a silver epoxy attachment joining the cathode terminal to the silver coated tantalum slug. This attachment shall not be voided or lacking attach across more than one half (50 percent) of its possible attachment interface.

d. For devices without epoxy molded cases (orange, blue), there shall be a silver epoxy attachment joining the cathode end cap to the silver coated tantalum slug. This attachment shall not be voided or lacking attach across more than one half (50 percent)of its possible attachment interface (end of anode slug only).

e. For all styles, significant silver epoxy segregation or seperation/cracking of the silver particles away from the cathode end cap/end clip terminal attach interface with the silver coated tantalum slug shall be unacceptable.

f. For all styles, no gaps in the body coating material shall exist that expose the silver epoxy coated tantalum slug.

g. For devices without epoxy molded cases (orange, blue), the remaining area between the inner surface of the cathode end cap and tantalum slug shall be filled with non-conductive potting material. The positive end cap need not be potted, however, the inner surface of the open end shall be filled so that no gaps are present to the exterior of the device between the end cap and the anode.

h. For epoxy molded cased devices, there shall be evidence of a smooth and continuous metallurgical bond/weld between the anode riser and the external anode lead for no less than 25 percent of the available overlap.

i. For epoxy molded cased devices, the riser wire-to-external lead weld shall not create a misalignment greater than 15 degrees between riser and lead. Additionally, this weld shall exhibit molding compound between the end of the riser wire and the outer package edge.

j. There shall be no pinholes on the conformal coating of CWR06 capacitors that expose any surface of the capacitor element, or cracks on the molded case of all molded capacitors, or chipouts that reduce the case wall thickness by 50%. There shall be no evidence of lead-forming stress cracks on the external leads of all molded capacitors.

10.11.2 Data records. DPA findings that deviate from the specified configuration or other requirements shall be documented as defects.