REQUIREMENT 18

DETAILED REQUIREMENTS FOR RESISTORS

18. General. This section describes detailed requirements for a DPA of commonly used resistors. These requirements supplement the general requirements in section 4. Examples of typical configuration sketches are included. When applicable, specification numbers or types 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.

18.1 Resistors, variable wire wound (MIL-PRF-39015). Typical resistors are shown on figures 18-1 and 18-2. It is recommended that variable resistors not be used in space applications.

18.1.1 Method.

18.1.1.1 External visual. Conduct visual examination at 20X minimum magnification and examine terminals, leads, marking, case, and adjustment screw.

18.1.1.2 Sample preparation. During the process of opening the enclosure, care must be exercised to assure that external liquid, gaseous, particulate, or other types of contamination do not enter the interior areas. The three basic types should be opened as follows:

a. Resistor with a round lid seal in a square plastic enclosure (see figure 18-1). Insert probe under edge of lid and pry lid off. Remove gear and actuator screw, then chemically strip in accordance with EIA-469 the remainder of assembly to expose all terminations.

b. Resistor assembly with an oblong plastic case with solid molded ends and base (see figure 18-2). Scribe a notch along the bond between case and body. Insert a probe into the notch and pry cover from body. This separates the worm screw drive and wiper arm from the resistance winding. The base containing the resistance wire shall be carefully broken by means of a vise or similar device to expose the wire and lead terminations.

c. Single-turn type. This resistor consists of an extended shaft, metal case, and a plastic insulated end containing the terminals. Disassemble by straightening the case roll-over, which holds the plastic end and removing the internal rotor assembly.

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

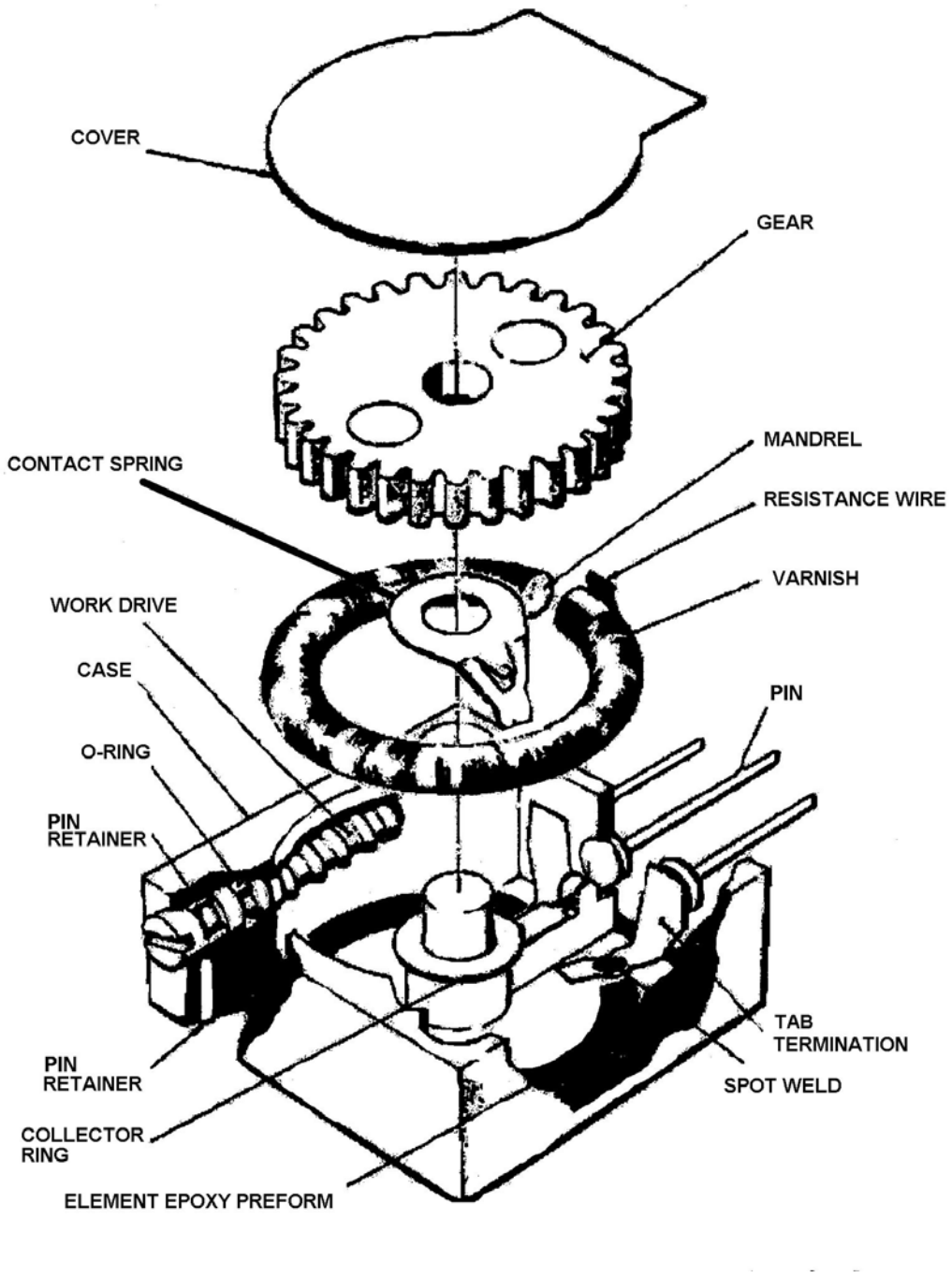


FIGURE 18-1. Variable wire wound resistor (typical).

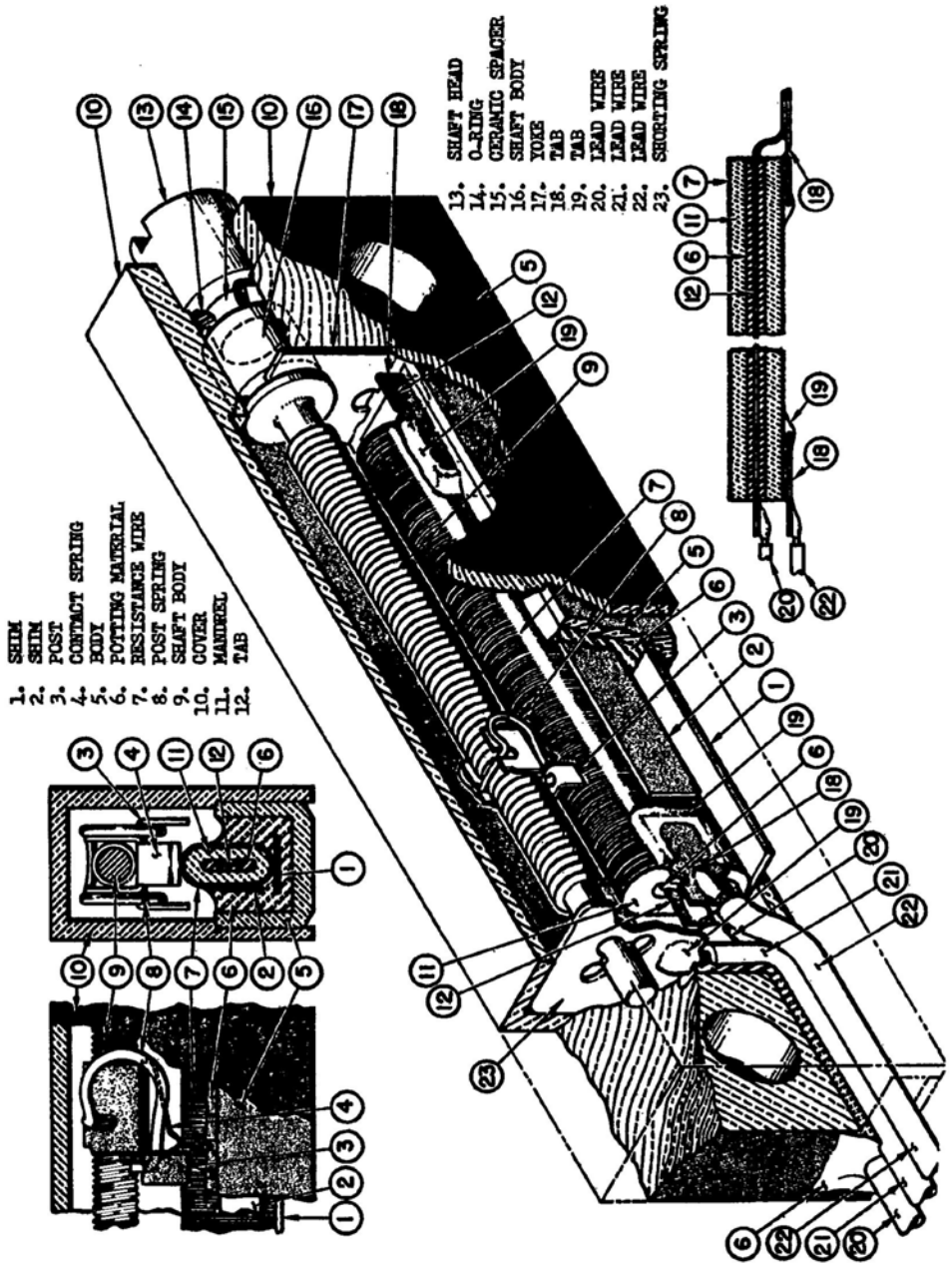


FIGURE 18-2. Variable wire wound resistor.

18.1.3 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 sample parts exhibit any of the defects listed below (as applicable to the type of part being examined). All exposed inner surfaces of each resistor shall be examined at a minimum magnification of 30X during each phase of the opening procedure for the following characteristics:

a. Loose windings on active portion of resistor.

b. Wire kinks, abrupt bends, or overlaps.

c. Loose wire ends or wraps capable of touching each other or other conductive parts.

d. Any lubricant, contamination, or flux residue on resistance element.

e. Resistance element not secure to body.

f. Body and wiper stops cracked, damaged, or distorted.

g. Loose or cracked welds.

h. Burning at weld greater than 1/5th of tab width.

i. Loose, cracked, or broken terminals.

j. Foreign or extraneous material, such as weld or fractures, solder splatter, flux residue, particle slivers, etc.

k. Internal connections that are soldered, not welded.

l. Reductions in diameter of resistance wire to 5/6ths or less of initial diameter.

18.2 Resistors, variable, non-wire-wound (MIL-PRF-39035). Variable resistors are not recommended for critical space applications.

18.2.1 Method.

18.2.1.1 External visual. Conduct visual examination at 20X minimum magnification, and examine the terminals, leads, marking, case, and adjustment screw for defects. Also, check for configuration compliance.

18.2.1.2 Sample preparation. Follow the same procedure as in paragraph 18.1.1.2.

18.2.2 Data records. DPA findings that deviate from configuration and other requirements shall be documented as defects.

18.2.3 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 exhibit any of the following defects listed below. All inner surfaces shall be examined at 30X minimum magnification during each phase of the opening procedure for the following characteristics:

a. Foreign or extraneous material, such as fibers, wear debris, etc., on the resistor element or body.

b. Any scratch, lifting or blistering, or discoloration of the resistor element.

c. Cracks or chip-outs on ceramic substrate in and around the resistor element.

d. Contamination, such as flux residue, lubricant not intended by design, etc., on the resistor element.

e. Wiper arm cracked, damaged, or distorted.

f. Loose or cracked welds.

g. Burning at weld greater than 1/5 of tab width.

h. Cracks on the outer casing.

18.3 Resistor, metallized film (MIL-PRF-55182 and MIL-PRF-39017). Typical configurations are shown on figures 18-3 and 18-4. DPA shall not be required when a precap visual inspection has been performed on 100 percent of the lot using the criteria listed herein. Otherwise, resistors shall be examined using the following procedures:

18.3.1 Method.

18.3.1.1 External visual. Examine resistors at 30X minimum magnification for cracks on the epoxy coating or glass seal, flaws on the leads (nicks, cuts, crushing, or exposure of copper or base metal) and marking, and nonconformance with configuration requirements.

18.3.1.2 Hermeticity. Conduct seal test on each sample, when applicable, after all other tests have been performed and just prior to sample preparation for internal inspection. Seal test shall be performed in accordance with the requirements of the procurement specification.

18.3.1.3 Sample preparation.

18.3.1.3.1 Conformally coated resistors. Conformal coating can be mechanically or chemically removed. When mechanical means are employed, potential physical and mechanical damage could be induced; therefore, extreme care must be taken in order not to introduce defects to the resistor itself that could cause the lot to be rejected. When chemically stripping the coating, use a process and material which dissolves the coating and exposes, but not attacks, the metal film, core, and terminations, leads, and welded connections, and which does not discolor or stain any surface. As required, perform SEM inspection and check for corrosion.

18.3.1.3.2 Hermetically sealed resistors.

a. Conformally coated, ceramic body. Strip resistor's conformal coating in accordance with 18.3.1.3.1, then examine the hermetic packaging for any signs of contamination, cracks on the ceramic sleeve, and pits or voids on the solder seal. Open the ceramic outer packaging by using a small lathe machine to expose the metallized resistor, being careful not to introduce any contamination. Prepare the lathe by cleaning both jaws and tool bit with alcohol to remove the oils. Carefully place the resistor between the jaws so that one end protrudes. (NOTE: Do not close the jaws too tightly.) Cut the metal end cap, keeping the lead attached, just beyond the corner radius. Repeat this procedure for the other end, then slide the ceramic sleeve out to expose the internal resistor.

b. Glass body. Scribe the glass sleeve with a diamond wire saw, then place the resistor on a lint-free tissue, and fold the tissue over. Lightly tap the device with a small hammer until the glass breaks and the glass chips can be removed. Care must be exercised in performing this procedure in order not to induce damage to the internal resistor.

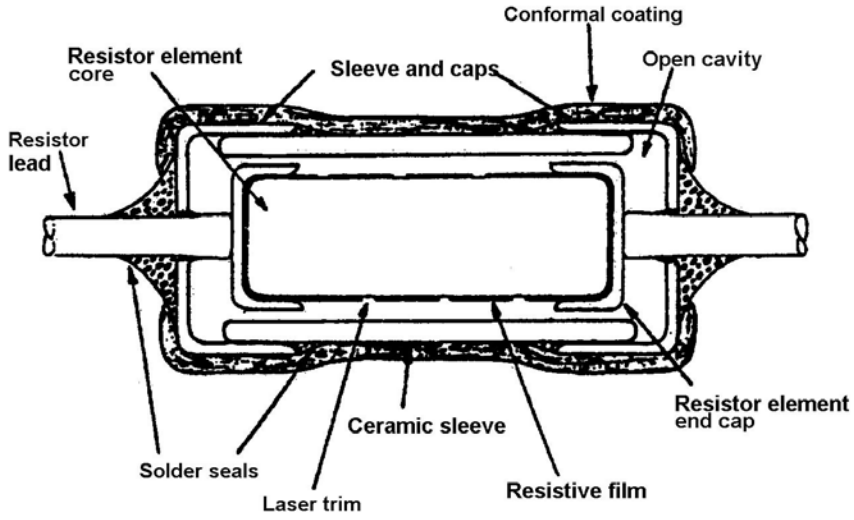


FIGURE 18-3. Typical Hermetically Sealed Metal-Film Resistor, RNR Style.

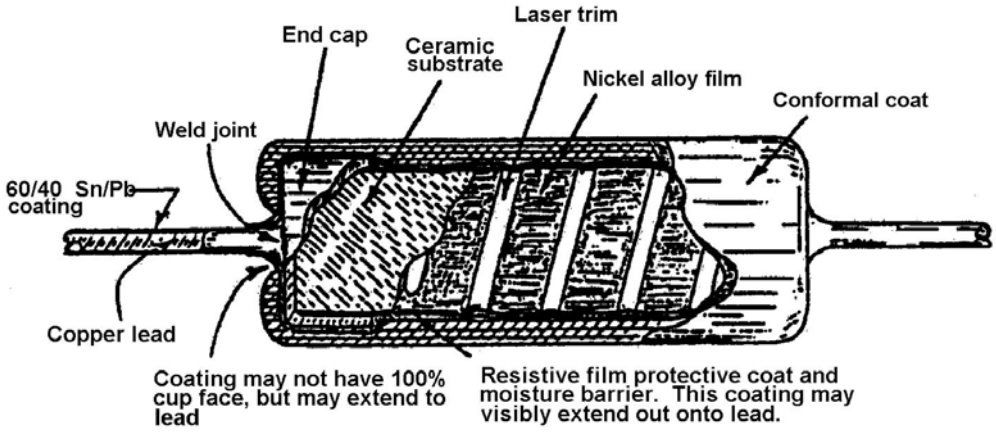


FIGURE 18-4. Nonhermetically Sealed Metal-film Resistor, RNC Style.

18.3.1.4 Removal of internal end caps. The end caps shall be removed to inspect for any sign of corrosion, blistering, or peeling away of the plating material or metal film under the caps. This procedure shall be performed after the internal visual inspection has been completed.

Roll the internal resistor between two clean, flat, hard surfaces. Aluminum pads and glass sheets have been used with success. After rolling several times, the end caps should fall off from the resistor core. Typically, the caps come off one at a time. When rolling the remaining cap, care must be taken to ensure that damage is not induced to the exposed end. Inspect caps and ends of resistor element at 30X minimum magnification. Any corrosion, peeling, or blistering of the plating or metal film under the end caps shall be cause for rejection.

18.3.2 Data records.

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

a. Cracked or chipped core.

b. End cap misalignment greater than 10 degrees.

c. Weld splatter at lead-to-end cap termination, or cracks in weld joint. Weld splatter that is confined to the flat surface of the end cap (not the skirt) is acceptable.

d. Cracks, splits, holes (from welding operation) or cold solder joints.

e. Corrosion lifted, blistered or missing plating material on the end cap; discoloration due to welding is not cause for rejection.

f. Foreign material or contamination on the metal film.

g. Any particle seated on the spiral cut.

h. Feathering of the metal film due to laser trimming that extends to more than 50 percent of the width of the trim.

i. Damage to resistance element that reduces the width (from overtrimming) of any of the metallized turns to less than 50 percent of the original design value.

j. Evidence of heavy stain or corrosion on resistance element. Discoloration of tantalum-based resistors due to thermal stabilization or laser trimming shall not be cause for rejection. Watermarks are not considered rejects.

k. Metal film lifting, peeling, or blistering as observed visually or determined by a cellophane tape test.

l. Intermediate coating, when used, that does not extend to one-half the length of the skirt of the end caps.

m. Discoloration, foreign material, bubbles or pinholes on the intermediate coating, or coating that is peeling away.

n. Discolored or hollow core.

o. Excessively deep cuts during laser trimming. Laser trim cuts of more than 0.18 millimeters (.007 inches) deep for thick films or 0.0125 millimeters (.0005 inches) deep for thin films.

p. Uncut material remaining after a laser scribe due to "skipping" of the laser beam.

q. Cracks in the glass seals of hermetically sealed resistors.

18.4 Resistors, fixed, metal-foil (MIL-PRF-55182, RNC90 style).

18.4.1 Method.

18.4.1.1 External visual. Conduct external visual examination as in 18.3.1.1 except use 10X magnification.

18.4.1.2 Terminal strength. A terminal strength test shall be performed on one-third of the samples in accordance with applicable specification.

18.4.1.3 Sample preparation. Either of the following methods may be used in opening (exposing) resistor for internal examination:

a. Mechanical decapsulation (recommended method).

   (1) Gently hold the sample at the two narrow sides parallel to the leads. Slowly grind off the flat (wide) side of the case with a 180 grit paper, or finer, until the plastic is thin enough to break off with pointed tweezers or when the rubber coating starts to show through.

   (2) Repeat step 1 for the other flat side. When only the four narrow sides have the plastic case material still attached to them, gently break these off with a pair of pointed tweezers.

   (3) The rubber film surrounding the substrate package can be easily removed with the tweezers. However, the moisture barrier coating (soft amber color coating) under the rubber may not be as easy to take out. Carefully and slowly scrape the varnish with the toothpick and tweezers, making sure that no rejectable defects are introduced to the resistor element.

18.4.2 Data records. DPA findings that deviate from configuration and other requirements shall be documented as defects.

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

a. A crack or chip in the substrate that extends under the resistive pattern.

b. Substandard welding, such as:

   (1) Weld print missing the film pads by more than 20 percent.

   (2) Half of each weld print is outside the lead outline.

   (3) Lead is over active grid lines.

   (4) Weld splatter.

   (5) Cracked paddle or the flat welded portion of lead terminal.

   (6) Torn ribbon connection.

   (7) Epoxy dot material running under or into weld connections.

c. Cracked, nicked, or dented lead terminal.

d. Resistor images which indicate hot spot possibility by a 75-percent reduction of path-metal.

e. Any loose or lifted active grid lines.

f. Heavy scratches or gouges in active area of resistor element.

g. Any particle large enough to reduce the isolation area width at any point by more than 50 percent.

h. Trim cuts made to adjust the resistance are clean without particles that might cause shorting.

18.4.4 Chemical dissolution of the lead welds. Chemical dissolution of the lead weld will be accomplished to allow inspection of the pad beneath the weld. Immerse the lead tabs into a shallow container of nitric acid, (caution should be exercised), for about 4 minutes then rinse in water. Inspect the weld pad area to ensure that all copper has been removed. If not, repeat the acid dip. After the copper has been removed, inspect the weld pads using transmitted light. Reject any part that exhibits a crack or series of cracks that exceed 25 percent of the weld circumference..

18.5 Resistors, fixed, chip, style RM (MIL-PRF-55342).

18.5.1 Method.

18.5.1.1 External visual. Perform visual examination on all samples at 30X minimum magnification.

18.5.2 Data records. DPA findings that deviate from configuration and other requirements shall be documented as defects.

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

a. Cracked or chipped parts.

b. Foreign material or discoloration on the substrate, resistive film, or terminal bands.

c. Lifting, blistering, or peeling of the resistive film, terminal bands, or protective coating (when applied).

d. Any one rejection mode described in Appendix B of MIL-PRF-55342.

e. Uncut material leftover from scribing/trimming.

18.6 Resistor networks (MIL-PRF-83401).

18.6.1 Method.

18.6.1.1 External visual. Conduct visual examination at 20X minimum magnification of terminals, leads, markings, all surfaces, and dimensions. One representative image of one device showing all markings shall be taken and provided.

18.6.1.2 Hermetic seal test. As applicable, hermetic seal testing shall be performed in accordance with MIL-PRF-83401.

18.6.1.3. Pull test. One-third of the samples shall be tested in accordance with the specification requirements.

18.6.1.4. Delid. The following techniques are recommended for delidding samples. Other techniques may be used, providing appropriate prior approval has been obtained.

a. Solder and brazed sealed lids. Using a sharp carbide scribing tool carefully scratch the solder (or braze) down and inward (toward the package center) on all four sides. Continue scribing using moderate pressure until there is sufficient clearance under the lid to insert an Exacto knife blade. Carefully insert the blade and pry up the top at one corner of the lid. Carefully insert the Exacto knife further into the package (holding the blade parallel to the package surface) and work the blade outward from the corner along the joint until the lid separates.

b. Welded packages. Using a fine Swiss file (equivalent file number 1 or 2), carefully file a chamfer approximately 30 degrees around all four sides of the package at the weld seam. Continue filing until microscopic examination at 20X magnification reveals minute cracks forming between the top and case edge on all four sides. Remove all metal filings using an artist brush. Carefully insert a sharp Exacto blade in the crack at one corner and pry the top of the package off in a can opener fashion.

c. Frit-sealed packages. Using a sharp carbide scribing tool, carefully scribe the glass frit on four sides. Scribe the package evenly on all four sides. Using only moderate pressure, grasp the package between thumb and forefinger, top to bottom.
NOTE: Be careful not to touch the leads with the scribing tool.

Continue scribing this area until a crack appears between the top and the remainder of the frit. The frit must show signs of cracking on all four sides. At this point, the operator should be holding the package together with his thumb and forefinger. Lay the package down and carefully pry up the lid at one corner; do not touch the leads.
NOTE: Once the lid has been removed, handle the device only by the sides.

d. Molded packages. The device shall be submerged in a suitable stripping solution to remove the encapsulating material and expose the substrate. The stripping solution, may be used either hot or cold, as applicable; provided that it does not damage or discolor the internal structure.

18.6.1.5 Internal visual. All exposed surfaces of each resistor network and substrate shall be examined at 30X minimum magnification. All anomalies shall be noted and documented.

18.6.2 Data records. DPA findings that indicate deviation from specified configuration or other requirements, or the existence of defects, shall be documented.

18.6.3 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 defects listed below.

18.6.3.1 Particles.

a. Metallic particles.

   (1) Unattached: There shall be no unattached metallic particles.

   (2) Attached: Attached metallic particles shall not exceed 0.125 millimeters (.005 inches) in the major dimension. Particles shall not touch nor extend over the metal film. Particles shall be considered attached when they cannot be removed with a gas blow of dry oil-free nitrogen from a 150 kilopascal (22 psi) gauge pressure source.

b. Nonmetallic particles. Glass, fibers, and other nonmetallic materials within the enclosure shall not exceed 0.125 millimeters (.005 inches) in their major dimension.

18.6.3.2 Residue. There shall be no visible laser trim residue at 50X magnification within the enclosure.

18.6.3.3 Metallization defects. Any of the following anomalies in the active circuit metallization shall be cause for rejection.

a. Metallization scratches: A scratch is defined as any tearing defect that disturbs the original surface of the metallization.

   (1) Any scratch in metallization through which the underlying resistor material also appears to be scratched.

   (2) Any scratch in the interconnecting metallization which exposes resistive material or oxide anywhere along its length and reduces the width of the scratch-free metallization strip to less than 50 percent of its original width.

b. Metallization voids: Any void in the interconnecting metallization that leaves less than 50 percent of the original width undisturbed. A void is defined as any region in the interconnecting metallization where the underlying resistive material or oxide is visible which is not caused by a scratch.

c. Metallization adherence: Any evidence of metallization lifting, peeling, or blistering.

d. Metallization probing: Probe marks on the interconnecting metallization other than the bonding pads that violate the scratch or void criteria.

e. Metallization bridging:

   (1) Metallization defect that reduces the distance between any two metallization areas to less than 0.008 millimeters (.0003 inches).

   (2) Bridging between metallization and resistor pattern, not intended by design, which reduces the distance between the two to less than 0.0025 millimeters (.0001 inches).

f. Metallization alignment: Any misalignment between the resistor pattern and the metallization such that more than 0.0125 millimeters (.0005 inches) of resistor on a side is exposed.

g. Metallization corrosion: Any evidence of localized heavy stains, metallization corrosion, discoloration or mottled metallization.

18.6.3.4 Resistor defects. The active area of a resistor is that part of the resistance pattern that remains in series connection between resistor terminals and is not shorted by metallization. Any of the following anomalies within the active resistor area shall be cause for rejection:

a. Resistor scratches: Any scratch within the active resistor area.

b. Resistor voids:

(1) Any void or neckdown in the active resistor path that reduces the width of the stripe by more than 50 percent of the original width.

(2) Any void or necking down in the active resistor path for a line width design of less than 0.005 millimeters (.0002 inches) which reduces its original width by 25 percent or more

(3) Any void or chain of voids in the resistor element at the gold termination.

c. Resistor adherence: Any evidence of resistor film lifting, peeling, or blistering.

d. Probe marks: Any probe mark on the resistor material.

e. Resistor material corrosion: Any evidence of localized heavy stains or corrosion of resistor material in the active resistor path. However, discoloration of tantalum-based resistors due to thermal stabilization is not a cause for rejection.

f. Resistor bridging defects:

(1) Continuous bridging: Any conductive continuous bridging between active resistance stripes.

(2) Partial bridging defect that reduces the distance between adjacent active resistance stripes to less than 0.0025 millimeters (.0001 inches) or 50 percent of the design separation, whichever is less, when caused by smears, photolithographic defects, or other causes.

Exception. For a partial bridge within lines and spacing of 0.0025 millimeters (0.0001 inches) design width, visual separation (evident at 400X magnification) is sufficient for acceptance.

18.6.3.5 Laser trim faults.

a. A partial cut, or bridged trim link.

b. Remaining width in fine-trim area after laser cut is less than the width of the narrowest line within the same resistor pattern.

(1) Uncut material is remaining after a laser scribe due to "skipping" of laser beam.

(2) If laser cut is not in straight lines, the narrowest remaining width must be equal to or greater than the width of the narrowest lines within the same resistor pattern.

c. Oxide voids, cracking, or similar damage caused to the $Si0_2$ underlayer by laser beam where such damage touches active interconnects or resistor path.

d. Laser trim cut where edge of cut touches the active resistor path.

e. Any discoloration or change in surface finish of a resistor stripe by the direct laser beam or by spurious reflections caused by optics of the system.

f. Any chip intended to be laser-trimmed that is not laser-trimmed.

18.6.3.6 Resistor bonding pad defects: Any resistor containing one or more bonding pads with one or more of the following anomalies shall be rejected.

a. Globules: A globule is defined as any material with a smooth perimeter extending out from the bonding pad onto the resistor or substrate material. Such globules are usually featureless and of low reflectivity and therefore difficult to focus upon.

b. Missing metallization: Any indications of missing metallization whether at the perimeter or totally within the bonding pad. Resistor material may be visible in the areas of missing metallization.

c. Metallization corrosion:

(1) Any evidence of localized heavy, diffused stains, discolored material, or low-density material either on the pad's perimeter or totally within the bonding pad.

(2) Any evidence of stains or discoloration extending out onto the resistor or substrate material.

18.6.3.7 Oxide defects: Any resistor having the following oxide, scribing, or die anomalies shall be rejected.

a. Oxide void: An oxide void is defined as a fault in the oxide evidenced by localized double- or triple-colored fringes at the edges of the defect visible at 100X magnification. The following shall be cause for rejection:

(1) Any oxide void that bridges any two resistor or metal areas not intended by design.

(2) Any oxide void under metallization or resistor geometry.

b. Scribing and die defects. The following shall be cause for rejection:

(1) Less than 0.125 millimeters (.005 inches) oxide visible between active metallization and edge of a die. Excluded from this are any inactive metallization lines.

(2) Any chipout or crack in the active resistor or metal area.

(3) Any crack that exceeds 0.125 millimeters (.005 inches) in length or comes closer than 0.025 millimeters (.001 inches) to an active area on the die.

(4) Any crack in a die that exceeds 0.025 millimeters (.001 inches) in length and points towards the active circuit area.

(5) A die having an attached portion of an adjacent die which contains metallization or resistor material.

(6) A crack or chip in the backside of a die that leaves less than 75 percent of area intact or a crack or chip under a bonding pad.

18.7 Resistors, wirewound, accurate (MIL-PRF-39005). A typical configuration is shown on figure 18-5.

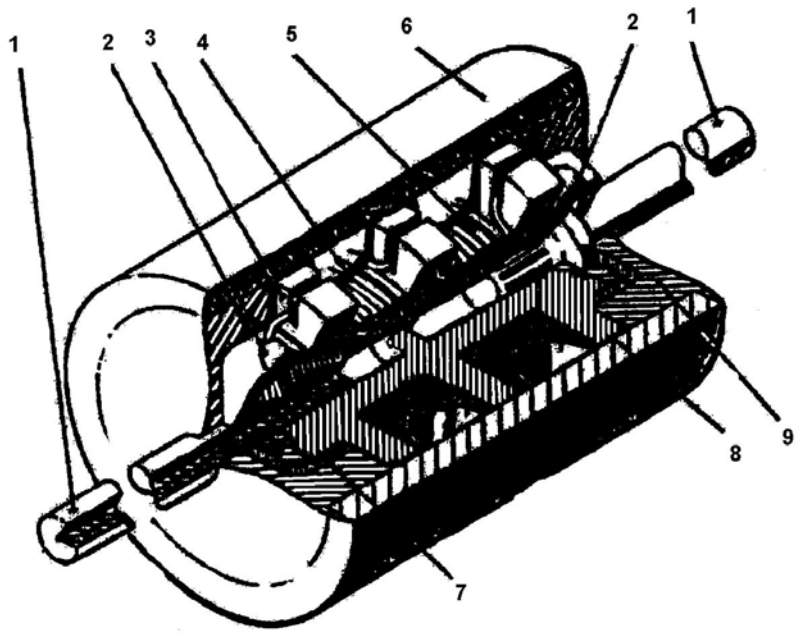
18.7.1 Method.

18.7.1.1 External visual. Conduct visual examination at 20X minimum magnification of terminals, leads, external coating, markings, all surfaces, and dimensions.

18.7.1.2 Sample preparation. Each group of samples shall be prepared as detailed below.

18.7.1.2.1 One half (round up). One half of the samples shall be encapsulated and sectioned in a plane parallel to the longitudinal axis to a depth exposing the core and terminal leads. The manner of sectioning shall be such that minimal damage is done to the device. An example to minimize internal damage to cavity or fragile devices is to backfill with potting material.

18.7.1.2.2 Remaining samples. The remaining samples shall be gently submerged in a suitable solution that dissolves the external coating and exposes but not attacks the resistance wire, core, terminations, and welded connections.



1	Lead
2	Weld Tab
3, 8	Bobbin
4	Cushion Coat
5	Resistance Wire
6	Enclosure shell
7	End Cap
9	Epoxy Fill

FIGURE 18-5. Typical wirewound Resistor (MIL PRF-39005).

18.7.1.3 Internal visual examination. All exposed surfaces of each resistor shall be examined at 30X minimum magnification. All anomalies shall be noted and photographed.

18.7.2 Data records. DPA findings that indicate deviation from specified configuration or other requirements or the existence of defects shall be documented.

18.7.3 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 exhibit any of the defects listed below.

a. Wire kinks, abrupt bends, or overlaps.

b. Cracks or lifting in tab welds.

c. Cracks or distortion in bobbin or core.

d. Damage or discolored portion of encapsulant.

e. No evidence of weld tip indentation at welds.

f. Burning at weld greater than one-half tab width.

g. Absence of soft cushion coating over wire winding and beneath encapsulant.

h. Less than 0.60 millimeters (.025 inches) gap between leads (see item 10 in figure 18-5).

18.8 Resistors, fixed, wirewound, power, (MIL-PRF-39007) and wirewound power, chassis-mounted (MIL-PRF-39009). Typical configurations are shown on figure 18-6 and figure 18-7.

18.8.1 Methods.

18.8.1.1 External visual. Conduct visual examination at 20X minimum magnification, and examine terminals, leads, marking, general dimensions, and appearance for any evidence of defective workmanship.

18.8.1.2 Radiographic examination. Radiographic examination will be performed in accordance with method 209 of MIL-STD-202, (2 views rotated 90 degrees apart). The radiographs shall be inspected for the following conditions noted in 18.8.3.

18.8.1.3 Sample preparation. When resistors contain beryllium-oxide ceramic cores, there shall be no machining, grinding, filling, or polishing performed on the cores. Beryllium-oxide dust is highly toxic. Preparation of the samples shall be done as follows:

18.8.1.3.1 For MIL-PRF-39007 resistors:

a. Dissolve external coating in a suitable solution that exposes but does not attack the resistance wire, core, terminals, and caps and welded connections. The solvent shall not discolor or stain any surface.

b. When the resistor core is the only element left, to be examined, cut resistance wire from caps at locations sufficiently distant from weld connections or terminations such that the connections are not disturbed. This procedure facilitates core examination.

18.8.1.3.2 For MIL-PRF-39009 resistors:

a. Make two saw cuts (180 degrees apart) along the horizontal axis, deep enough to just penetrate the internal potting material.

b. Immerse resistor in a suitable solution to dissolve the potting material and remove the housing in order to expose the internal element. Solvent shall not damage the resistance wire, core, terminals, end caps and welded connections, or discolor or stain any surface.

c. When the resistor core is the only element left, to be examined, cut resistance wire from caps at locations sufficiently distant from weld connections or terminations such that the connections are not disturbed. This procedure facilitates core examination.

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

18.8.3 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 defects listed below. All exposed inner surfaces shall be examined at 30X minimum magnification during each phase of the DPA for the following characteristics:

a. End cap misalignment greater than 10 degrees.

b. End cap showing corrosion, lifted or missing plating.

c. Weld splatter at lead-to-cap termination, or cracked or partially lifted weld.

d. Split, cracks, or holes on the end caps.

e. Sudden kinks, bends, or sharp distortion on the resistance wire that reduces the wire diameter to 5/6ths or less of the initial value.

f. Loose windings on active portion of the resistor.

g. Wire not secure at weld on end cap.

h. Number of wire turns different between samples having similar resistance values, up to 5 percent or one turn, whichever is greater.

i. Space between wire turns more than five times the wire diameter except for values less than 1 ohm, or space between turns of less than the wire diameter except for high-value resistors using insulated wires.

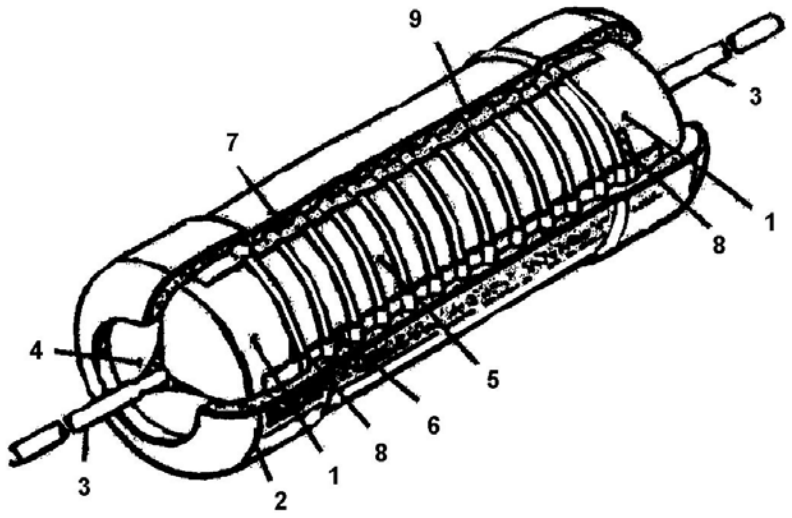
j. Cracks, spalls, or surface holes on the core that exceed 0.60 millimeters (.025 inches) in the greatest dimension.

k. No extraneous particles 0.05 mm (.002 inches) or more in the maximum dimension located in the encapsulation between the two end caps.

l. Molded units shall show no evidence of voids or bubbles that reduce the total insulation area by more than 10 percent. Also, no single void or bubble shall have a major dimension greater than 0.60 mm (.025 inches). The lead end cap interface shall not extend beyond the encapsulant edge.

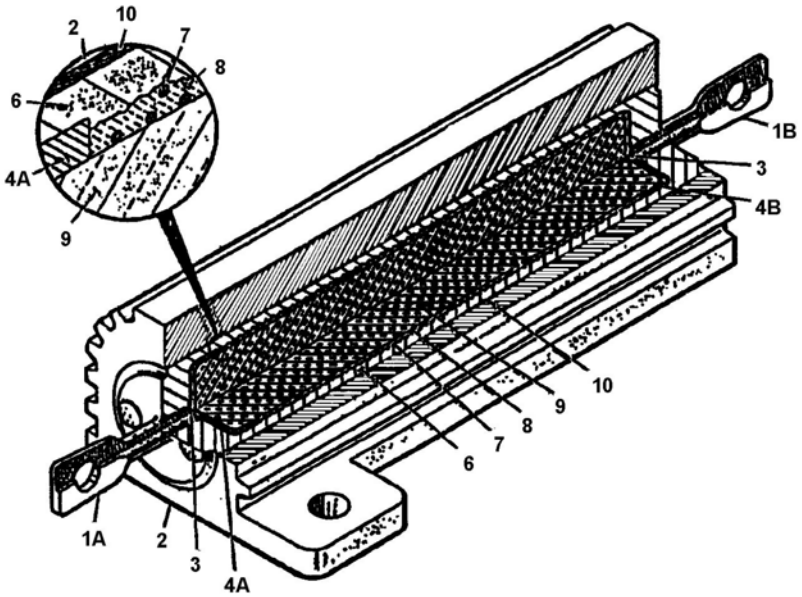
m. Welds shall be well positioned with no excess wire projecting beyond the weld junction or poking through the resistor coating.

n. Wire showing evidence of corrosion.



1 End Gap
2 Sleeving
3 Lead
4 Butt Weld
5 Core
6 Undercoating Under Wire
7 Wire
8 Resistance Weld
9 Outer Coating

FIGURE 18.6. Typical Wirewound Power Resistor (MIL-PRF-39007).



1 Terminal
2 Housing
3 Butt Weld (Cap-to-Terminal)
4 Cap
6 Molding Compound
7 Resistance Wire
8 Coating
9 Core
10 Tape

FIGURE 18-7. Typical Wirewound Chassis-Mounted Power Resistors.