

ENGINEERING PRACTICE STUDY

PROJECT NUMBER: 5961-2024-045

TITLE:

MIL-STD-750-2, TEST METHOD 2071

"VISUAL AND MECHANICAL EXAMINATION"

PROPOSAL TO DEVELOP A DRAFT TO ADD NEW FIGURES,
UPDATE CURRENT FIGURES, STANDARDIZE FORMAT, AND
LANGUAGE USAGE FOR CLARITY AND CONSISTENCY

20 NOVEMBER 2024

FINAL RERORT

STUDY CONDUCTED BY

DLA LAND AND MARITIME
Document Standardization Division (VA)
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ATTACHMENTS 2

I. OBJECTIVES: The objective of this Engineering Practice (EP) Study was to obtain input from users (military services, device manufacturers, laboratories, and user community) concerning a proposed revision to test method 2071 of MIL-STD-750-2.

II. BACKGROUND: The preparing activity for MIL-STD-750 (DLA-VAC) received a request from a qualified manufacturer to revise the terminal to ceramic eyelet braze acceptability requirements. Since DLA-VAC was currently working on a proposed draft of 2071.11 to address the editorial, format and lack of consistency in term usage issues within the method, the manufacturer requested change was included the initial draft of the proposed revision. The proposed revision of the test method also includes additional new figures, modifies current figures, corrects editorial issues, and reorganizes the test method structure to reflect the format being implemented in recent series 2000 visual acceptance method updates.

III. RESULTS: An EP Study project was opened and an initial draft was posted on the DLA Land and Maritime website and brought up during the September 2024 JEDEC JC-13.1 meetings. The draft method was distributed for review and comment during the time period of August 12, 2024 through September 26, 2024. Input was solicited from interested parties using all FSC 5961 email distribution lists, that included the military services, certified laboratories, discrete semiconductor manufacturers, original equipment manufacturers, and the user community, concerning the proposed changes.

Comments and concerns were received and compiled for review and consideration regarding the proposed changes in the initial draft. All received comments were compiled and discussed internally within DLA-VAC. From the feedback received, all comments from the military were accepted and incorporated into the proposed draft for the final report (see attachment 1). One comment submitted by industry will be considered in the next standardization action. One of the military services had concerns and questions regarding the changes to the discontinuous braze metallization requirements that will need further discussion and will be addressed in a future standardization effort.

Both a clean reader draft (see attachment 1) and mark-up source draft (see attachment 2, which contains both additions and deletions) have been included for comparison, reviewing, and documenting the results of this study. A key that identifies the changes that were made in the initial draft versus the changes that were made in the final report draft has been included at the top of the first page of each attachment.

IV. CONCLUSIONS: The highlighted changes to the test method (see attachment 1) should be proposed for incorporation into the next standardization document change action to MIL-STD-750-2.

V. RECOMMENDATIONS: The findings of this EP study are sufficient to support the updating the method. Prepare an initial draft of MIL-STD-750-2 using the results of this study for the draft of test method 2071.11. In addition, discuss at a future JEDEC 13.1 meetings the concerns and questions submitted by the military concerning the changes to the discontinuous braze metallization requirements.

The point of contact for this final report is Mr. David Corbett, DLA Land and Maritime – VAC, P. O. Box 3990, Columbus, OH 43218-3990. Mr. Corbett can also be reached at 614-692-0526 / DSN 850-0526, or by electronic mail at: 750.TestMethods@dla.mil.

KEY to changes:

For the Initial Draft (ID), text highlighted in yellow was added and have black vertical bars in the left hand margin. For the Final Report, text highlighted in green and green vertical bars are the results from comments to the ID.

ATTACHMENT 1 to Project 5961–2024–045

METHOD 2071.11

EXTERNAL VISUAL AND MECHANICAL EXAMINATION

1. Purpose. The purpose of this test method is to verify the design, construction, markings, materials, and workmanship of hermetically packaged semiconductor devices (hereafter referred to as devices) are in compliance with the requirements described herein and the applicable acquisition document. This test method is normally employed at outgoing inspection within the device manufacturer's facility or as an incoming inspection of the assembled device. This test method can also be utilized to inspect for damage due to handling, assembly, and test of the packaged device.

2. Apparatus. Apparatus used in this test method shall be capable of demonstrating device conformance to the applicable requirements of the individual specification sheet and those specified herein. The apparatus for this test method shall consist of the following:

- a. Optical equipment, with sufficient lighting, capable of the magnifications as specified herein. The preferred instrument is a binocular or stereo microscope with 10X eyepieces and applicable objective lenses to meet the specified magnifications.
- b. Adequate fixturing for handling the devices being inspected without causing damage.
- c. Adequate covered storage and transportation containers to protect devices from mechanical damage and environmental contamination.
- d. Any visual standards (e.g., drawings, photographs) necessary to enable the inspector to make objective decisions as to the acceptability of devices being inspected.

3. Definitions. The definitions for all terms used herein shall be as specified in MIL-PRF-19500 and those contained herein. The following definitions shall apply for this test method.

3.1 "c" cracks. Small cracks or micro-cracks in glass surface.

3.2 Glass meniscus. The glass meniscus is defined as that area of glass that wicks up or down the lead or terminal.

3.3 Examples of foreign material. Examples of terms used to describe foreign material that are used in this test method include the following: lead carbonate formations, solder filler metal, braze filler metal, other metallization.

4. Procedure.

4.1 Magnification. Unless otherwise specified, the device shall be examined under a magnification of 20X minimum. The field of view shall be sufficiently large to contain the entire device or area of interest and allow inspection to the criteria listed in 5 herein. Where inspection at a lower magnification reveals an anomaly, then inspection at a higher magnification (40X maximum, unless otherwise specified) may be performed to determine acceptability. Higher magnification may be used to further examine and characterize observed anomalies.

When a disposition is in doubt for any dimensional criteria, that dimension may be measured for verification.

4.2 Foreign material adherence. When foreign material is present, and its adherence is in question, the device may be subjected to a clean filtered gas stream of approximately 20 psig (138 kPa) or an isopropyl alcohol wash and then re-inspected.

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5. Failure criteria. Devices which exhibit any of the following conditions shall be considered rejects.

5.1 General defects.

- a. Evidence of any nonconformance with the applicable procurement document or absence of any required feature.
- b. Presence of secondary coating material that visually obscures a seal area(s) (i.e., any hermetic interfaces).
- c. Visual evidence of corrosion or contamination. Discoloration shall not be sufficient cause for rejection. The presence of lead carbonate formations in the form of a white/yellow crystalline shall be considered evidence of contamination.
- d. Gaps, separations, or other openings that are not part of the normal design configuration.
- e. Workmanship not in accordance with the applicable procurement document.

5.2 Displaced or foreign material.

- a. Foreign material (including solder filler metal, braze filler metal, or other metallization) bridging leads or terminals or otherwise interfering with the normal application of the device.
- b. Foreign material that reduces the isolation between leads or terminals to less than 50 percent of the leads or terminal separation.
- c. Foreign material such as ink, paint or other adherent deposits on leads or terminals that exceeds 5 percent of the solderable area.

5.3 Construction defects.

- a. Protrusions beyond seating plane that will interfere with proper seating of the device.
- b. Protrusions on any other package surface that exceeds the lead thickness in height (leadless packages).
- c. Protrusions on the lid or cover, or extending beyond the surface plane of solder pads, that exceed 25 percent of the terminal width in height (leadless packages).
- d. Metallization not intended by design between solder pads, seal ring or cover to metallized castellations that reduce the isolation to less than 50 percent of solder pad separation (leadless packages).
- e. Any misalignment of device component parts to the extent that the package outline drawing dimensions are exceeded.
- f. Damage causing distortion of a flange beyond its normal configuration.

5.4 Finish of package body and cover defects.

- a. Evidence of blistering, corrosion, flaking, non-adhesion, peeling, or pitting of the finish which exposes underplate or base metal. Any discoloration that does not exhibit these conditions shall be acceptable.
- b. Indentations, mars or scratches, either due to damage or processing, that exposes underplate or base metal.

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5.5 Terminal (leads, pads, pins, studs, etc.) defects.

- a. Broken leads or terminals.
- b. Damaged or bent leads or terminals which precludes their use in the intended application.
- c. Burrs that will cause lead or terminal dimensions to be exceeded.
- d. Damage to a stud (thread damage or bending) which restricts normal mounting.
- e. Scratches that expose underplate or base metal over more than 5 percent of the lead or terminal surface area affected. Exposed base material on the cut lead or terminal ends shall be acceptable and does not count towards the 5 percent allowance.
- f. Leads or terminals that are not intact or aligned in their design location, free of sharp or unspecified lead bends, or twisted more than 5 degrees from the design seating plane.
- g. Leads or terminals with pits and/or depressions that exceed 25 percent of the width (diameter for round leads) and are greater than 50 percent of the lead or terminal thickness in depth.
- h. Leads or terminals with burrs exceeding a height greater than 50 percent of the lead or terminal thickness.

5.6 Crimped or welded seal defects of hermetic (metal) packages.

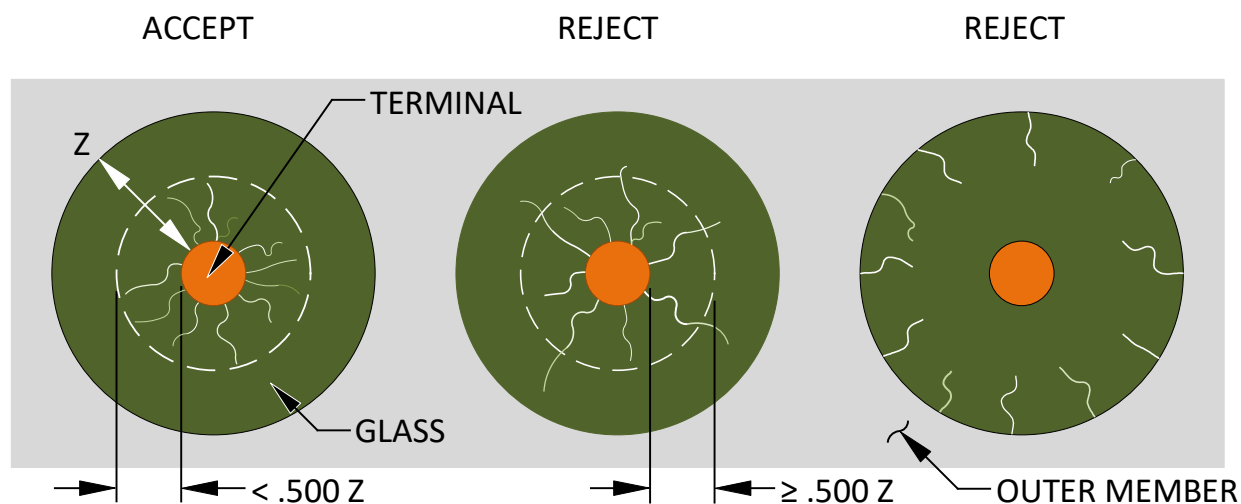
- a. Any fracture or split in the tubulation weld.
- b. Base weld mating surfaces not parallel, or that precludes intended use.
- c. Damage causing distortion of a weld flange beyond its normal configuration.
- d. Dents in metal covers that precludes their use in the intended application.
- e. Missing welds or crimps.

5.7 Glass seal area defects of hermetic (metal) packages.

- a. Radial cracks (except meniscus cracks) that extend more than one-half of the distance from the terminal to the outer member (see figure 2071-1). Radial cracks that originate from the outer member.
- b. Circumferential cracks (except meniscus cracks) that extend more than 90 degrees around the seal center (see figure 2071-2).
- c. Crazeing of the glass seal surface (see figure 2071-3).
- d. Open surface bubble(s) in strings or clusters that exceed two-thirds of the distance between the lead or terminal and the outer member (see figure 2071-4).

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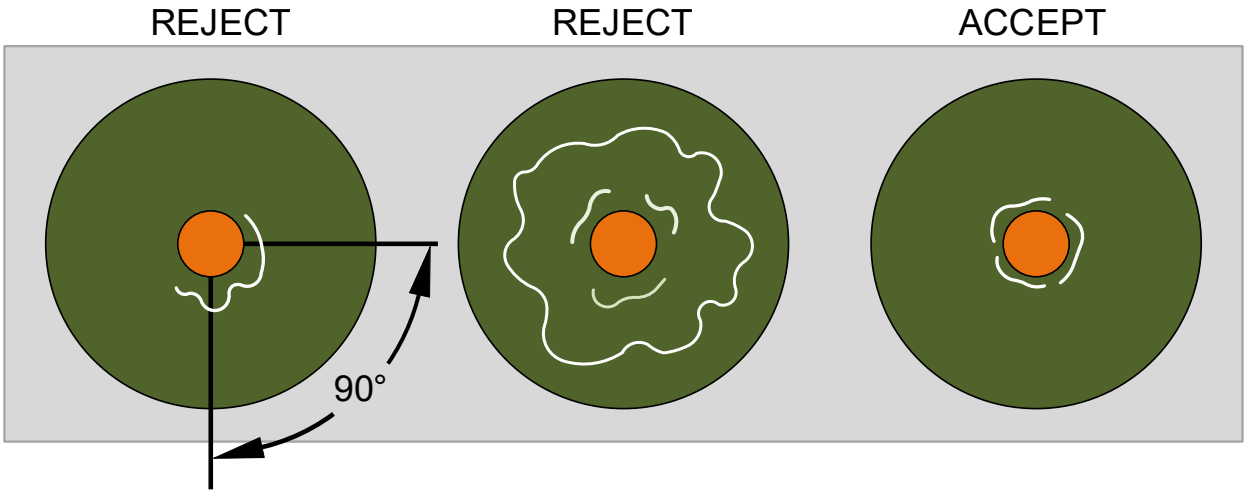
- e. Visible subsurface bubbles that exceed the following:
- (1) Large bubbles or voids that exceed one-third of the glass sealing area (see figure 2071-5a).
 - (2) Single bubble or void that is larger than two-thirds of the distance between the lead or terminal and the outer member at the site of the inclusion and extends more than one-third of the glass seal depth (see figure 2071-5b).
 - (3) Two bubbles in a line totaling more than two-thirds of the distance from lead or terminal to outer member (see figure 2071-5c).
 - (4) Interconnecting bubbles greater than two-thirds of the distance between lead or terminal and outer member (see figure 2071-5d).
- f. Except as designed, re-entrant seals which exhibit non-uniform wicking or negative wicking (i.e., negative meniscus) at the lead or outer member interface (see figure 2071-6).
- g. Glass meniscus cracks that are not located within one-half of the distance between the lead or terminal to the outer member (see figure 2071-7).
- h. Any chip-out of sealing glass that penetrates deeper than the glass meniscus plane.
- i. Exposed base metal as a result of meniscus chip-outs shall be acceptable if the exposed area is no deeper than .010 inch (0.25 mm) or 50 percent of lead diameter, whichever is greater (see figure 2071-8).



NOTES:

1. Accept: Radial glass cracks less than one-half the distance from the lead or terminal to outer member.
2. Reject: Radial glass cracks extending more than one-half the distance from the lead or terminal to outer member.
3. Reject: Radial cracks that originate from the outer member.

FIGURE 2071-1. Radial glass cracks in the terminal sealing area.



NOTES:

1. Reject: Circumferential cracks that extend more than 90 degrees around the seal center.
2. Reject: Circumferential glass cracks in the sealing area.
3. Accept: Circumferential glass cracks in the meniscus area.

FIGURE 2071-2. Circumferential glass cracks in the terminal sealing area.

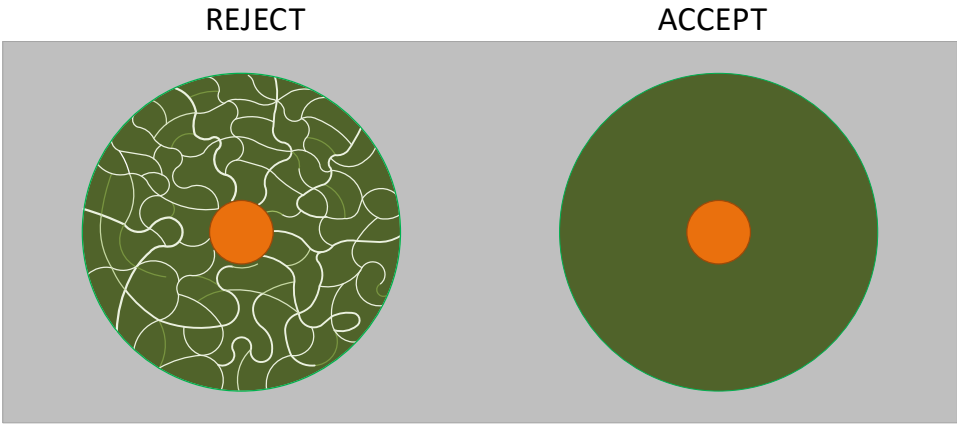
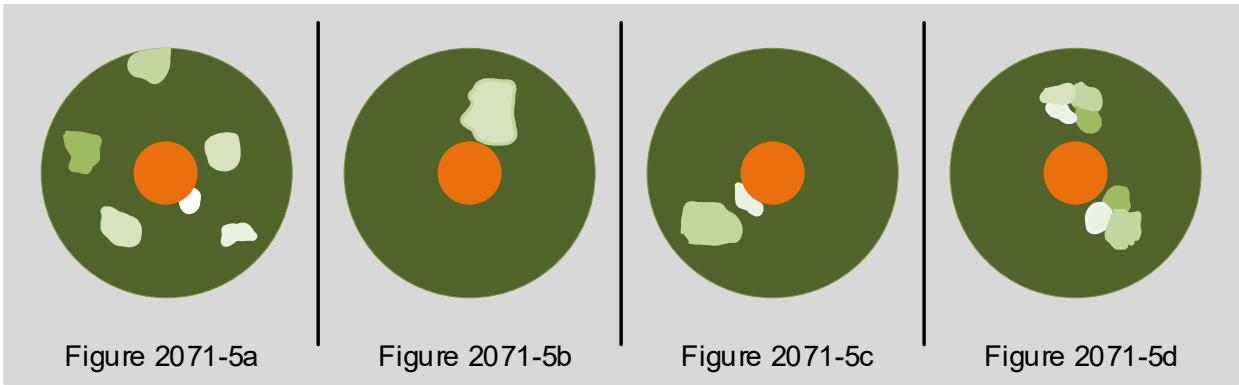


FIGURE 2071-3. Craze of the glass seal surface.



FIGURE 2071-4. Open surface bubble(s) in the glass seal surface.



NOTES:

1. 5a, Reject: Bubbles in glass exceeding one-third of the glass sealing area (see 5.7.e.1).
2. 5b, Reject: Single bubble or void in the glass of the sealing area (see 5.7.e.2).
3. 5c, Reject: Two bubbles in a line in the glass of the sealing area (see 5.7.e.3).
4. 5d, Reject: Interconnecting bubbles in the glass of the sealing area (see 5.7.e.4).

FIGURE 2071-5. Subsurface bubbles.

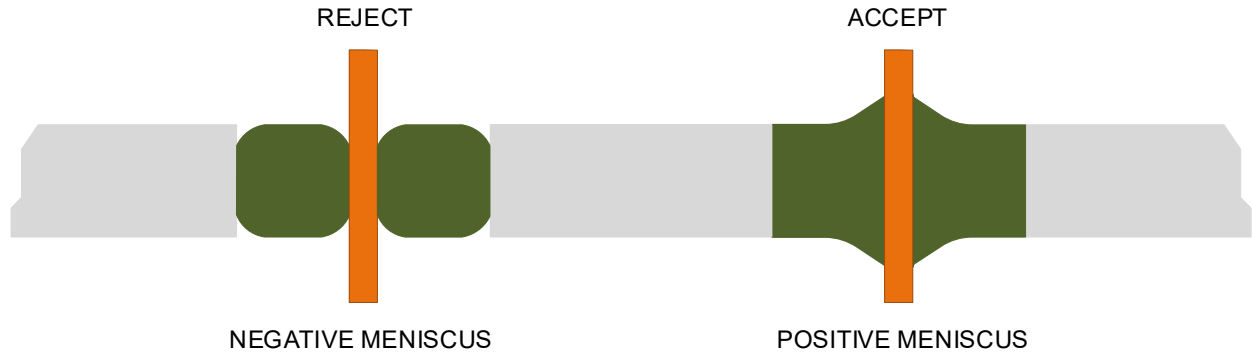
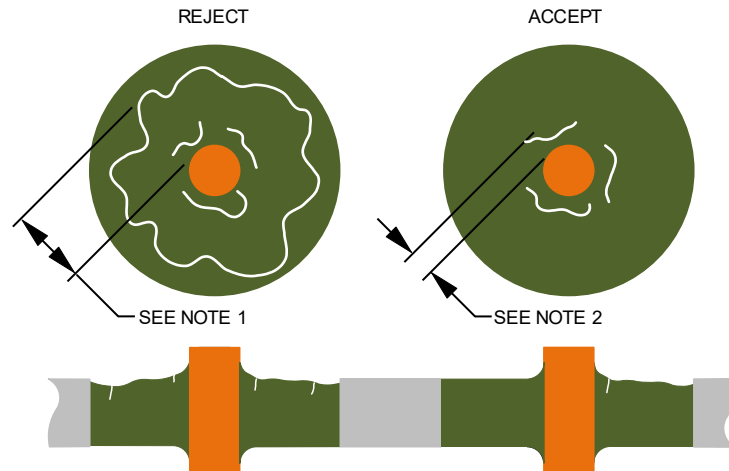


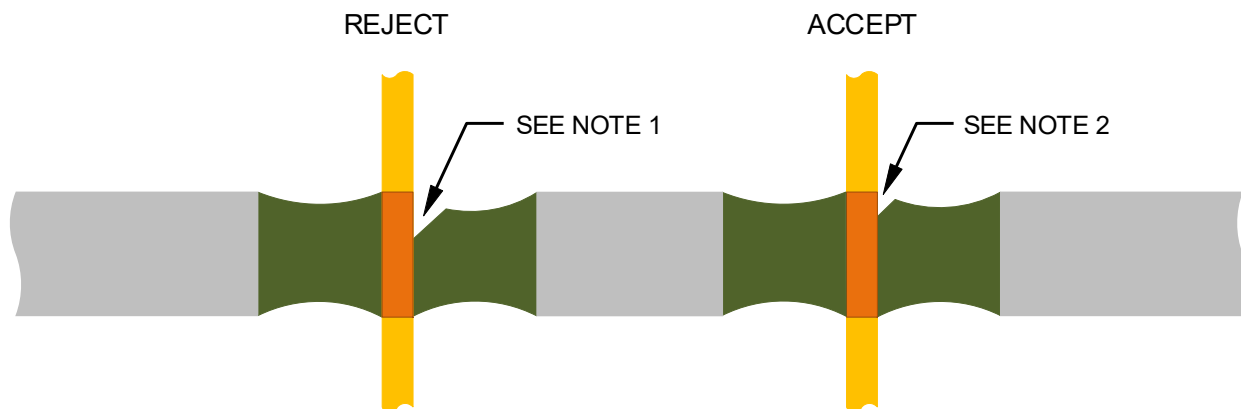
FIGURE 2071-6. Re-entrant seals.



NOTES:

1. Reject: Crack is located at or extending into region greater than one-half the distance between terminal and outer member.
2. Accept: Crack is located in region less than one-half the distance between terminal and outer member.

FIGURE 2071-7. Meniscus cracks in the glass of the sealing area.

**NOTES:**

1. Reject: Exposed base (unplated) metal greater than .010 inch (0.25 mm) deep or 50 percent of lead or terminal diameter, whichever is greater.
2. Accept: Exposed base (unplated) metal no greater than .010 inch (0.25 mm) deep.

FIGURE 2071-8. Exposed base (unplated) metal due to meniscus chip-outs.

5.8 Opaque glass body device defects. The failure criteria for opaque glass body devices shall be in accordance with test method 2068 of this standard.

5.9 Transparent glass diodes, double plug construction defects.

- a. Any evidence of a crack, fracture, or a chip-out closer to the die than 50 percent of the designed seal length shall be rejected. Area of examination shall be as shown on figure 2071-9.
- b. Any crack that terminates in the axial direction is cause for rejection.
- c. Meniscus cracks are not cause for rejection.
- d. Any chip-out that exposes base metal shall be rejected.
- e. Small surface impact marks, "c" cracks, and microcracks are acceptable if they are confined to the glass surface with no other cracks radiating from them.
- f. Terminals that are not brazed (or soldered) to the plug around at least 90 percent of the terminal perimeter are cause for rejection.

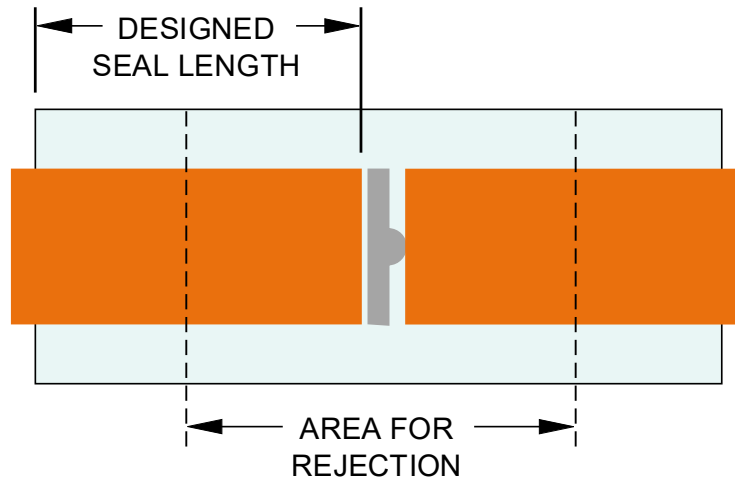


FIGURE 2071-9. Area of examination for transparent glass diode (double plug construction).

5.10 Transparent glass diodes, large cavity (i.e. S-bend, C-bend, or straight-through constructions) defects.

- a. Any crack or fracture in the glass over the area of the device cavity shall be rejected.
- b. Any chip-out that exposes base metal shall be rejected (this does not apply to chip-outs at either end of device where glass joins external lead).
- c. Any crack that terminates in the axial direction shall be cause for rejection.
- d. Meniscus cracks shall not be cause for rejection.
- e. Small surface impact marks, "c" cracks, and microcracks are acceptable if they are confined to the glass surface with no other cracks radiating from them.

5.11 Ceramic package defects. The failure criteria for ceramic packages shall be in accordance with test method 2009 of MIL-STD-883-2.

5.12 Ceramic eyelet feedthrough defects of hermetic packages. The following defects shall not be acceptable. See figure 2071-10 for identification of features.

- a. Any delamination or separation of the braze metallization from the inner diameter (ID) or outer diameter (OD) of the ceramic eyelet (see figure 2071-11).
- b. Any cracks or separation in the braze between the ceramic eyelet ID and the lead or terminal or the ceramic eyelet OD and the package (see figure 2071-12). Any voids, depressions, or pinholes the bottom of which cannot be seen at 30X maximum magnification in the braze between the ceramic eyelet ID and the lead or terminal or the ceramic eyelet OD and the package.

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- c. Any discontinuation in the braze from the ceramic eyelet ID to the lead or the ceramic eyelet OD to the package exposing unplated metallization or bare ceramic (see figure 2071-13).
- d. Any conductive material attached to the ceramic eyelet that reduces the designed isolation width by more than one-third unless it is demonstrated that the device voltage isolation requirement can be met with less than two-thirds of the width of the ceramic eyelet (see figures 2071-10 and 2071-14).
- e. Any metallization that extends beyond the height of the ceramic eyelet that is not adhered to the ceramic eyelet.
- f. Cracks in the ceramic eyelet. Chip-outs greater than .005 inch (0.127 mm) in any direction.

5.13 Identification markings (content, legibility, and placement) defects.

- a. Marking content, illegible marking, or marking placement not in accordance with the applicable acquisition document.
- b. Defective laser marking; evidence of gouges or deep holes where the bottom of the laser marking cannot be observed (applicable to both plated and non-plated packages).

5.14 Glass diode plug to terminal interface. The plug to terminal interface of glass body diodes shall be in accordance with figures 2071-14 and 2071-15.

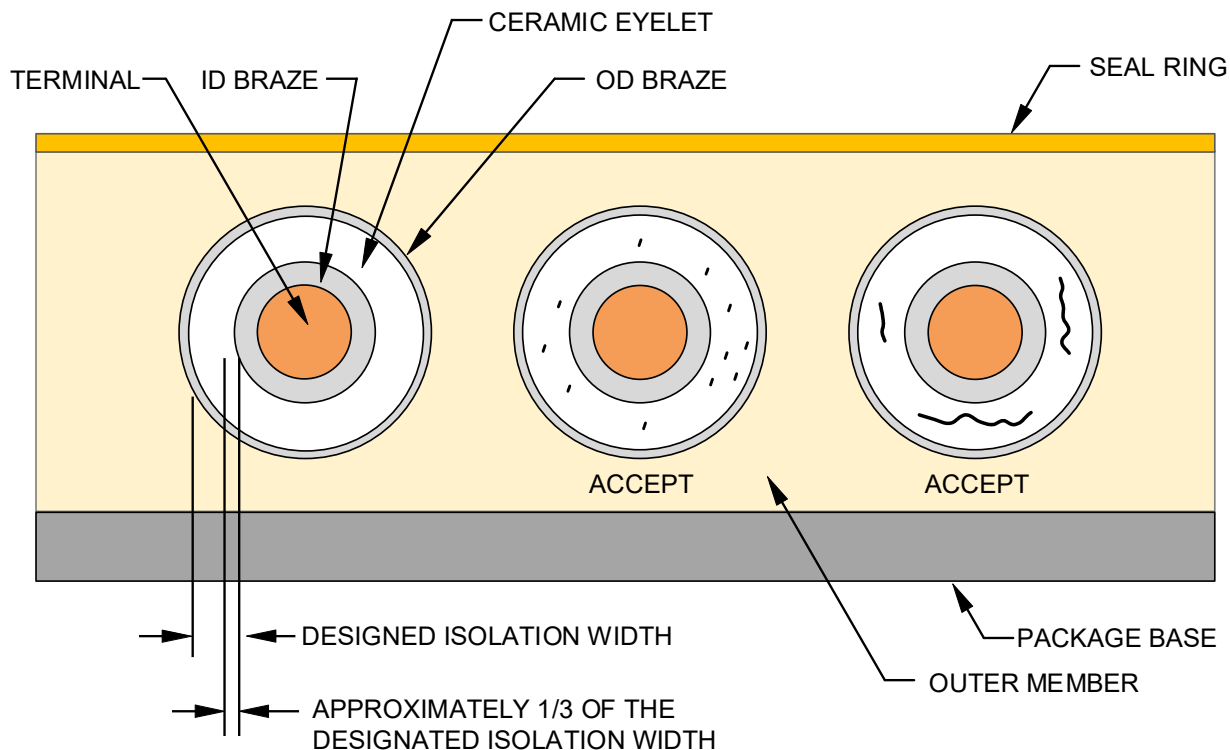
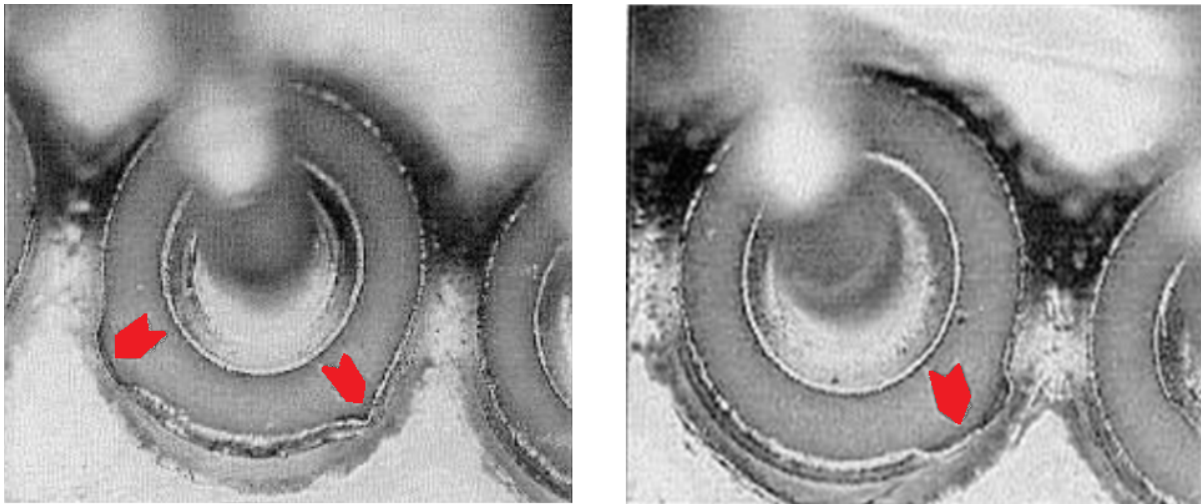


FIGURE 2071-10. Ceramic eyelet feedthrough visual inspection criteria.

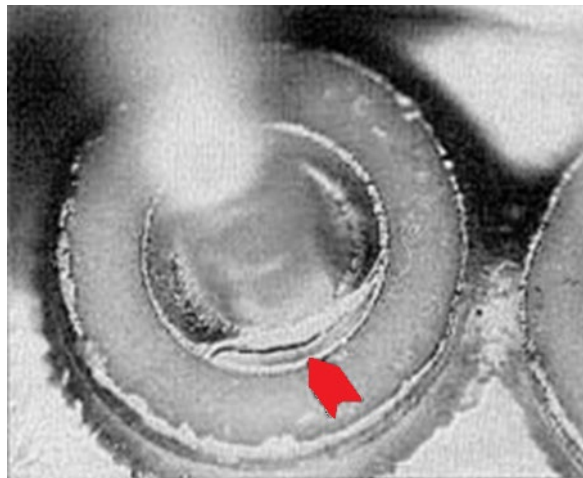
6. Summary. The following conditions must be specified in the applicable performance specification sheet or acquisition document:

- a. Requirements for markings and the lead or terminal identification.
- b. Detailed requirements for materials, design, construction, and workmanship.
- c. Magnification requirements, if other than specified.



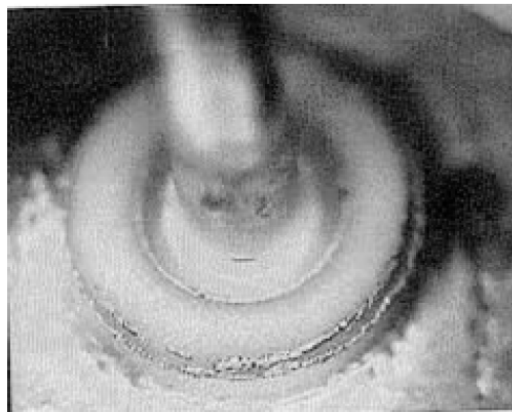
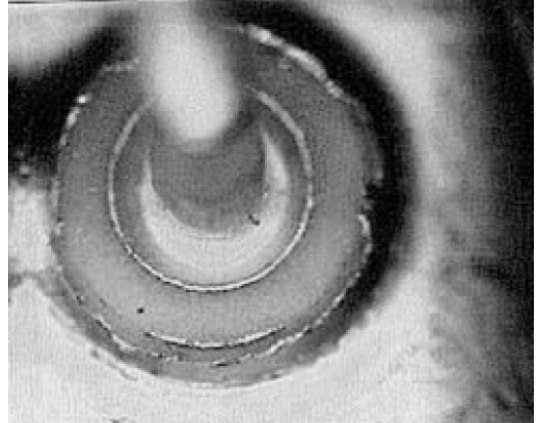
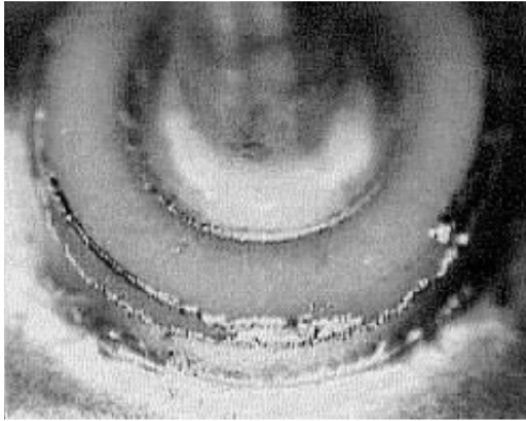
NOTE: Arrows on both pictures illustrate rejectable conditions of braze metallization delamination or separation.

FIGURE 2071-11. Braze metallization delamination or separation.



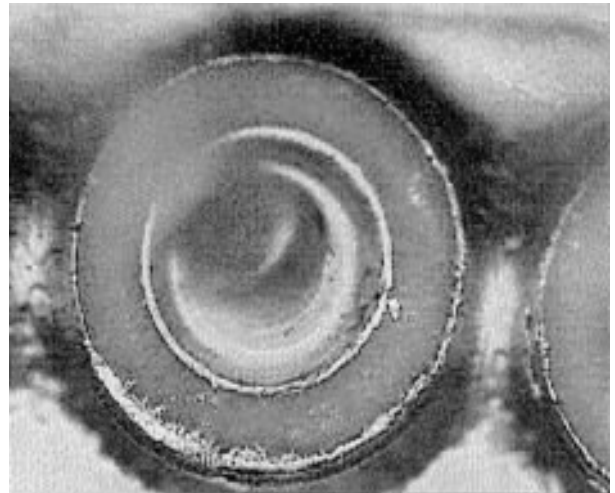
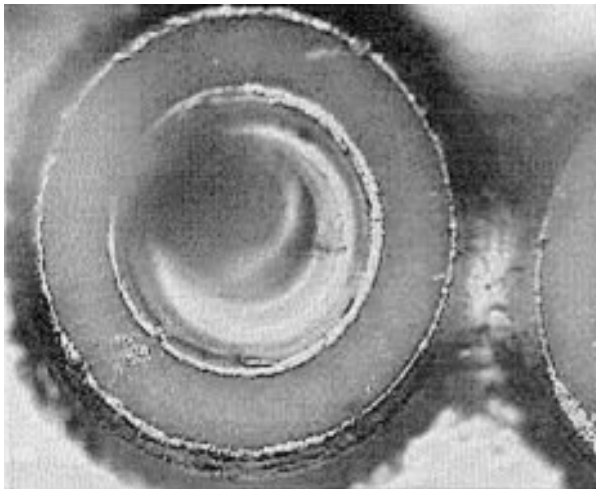
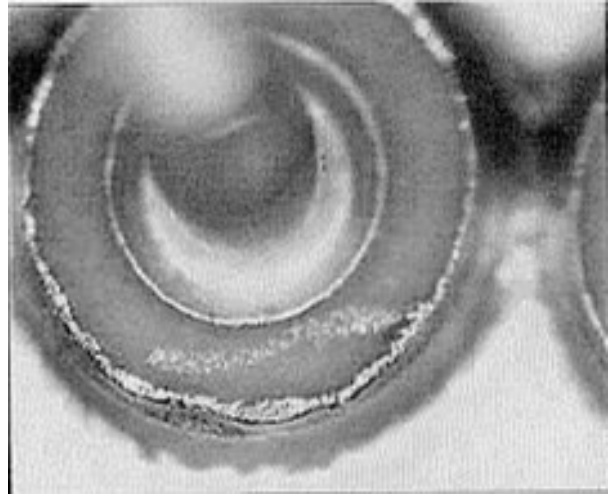
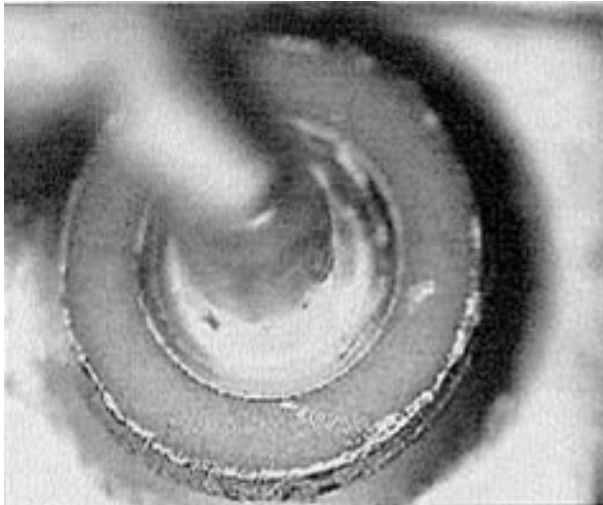
Reject: Arrow indicates a crack on the inner diameter braze metallization of the ceramic eyelet.

FIGURE 2071-12. Crack in the ceramic eyelet braze metallization.



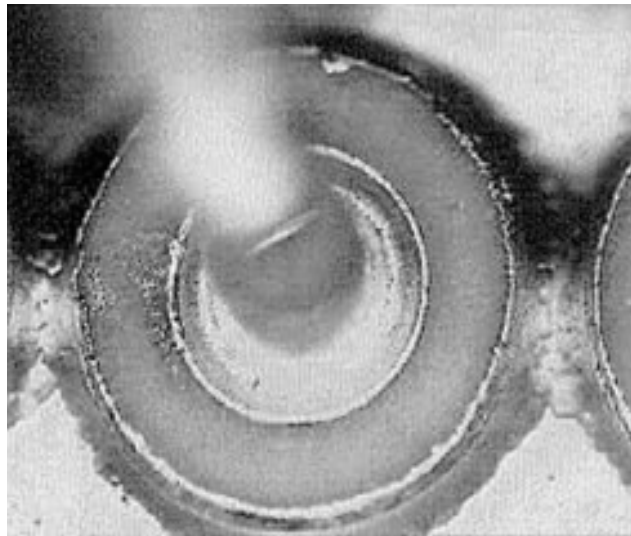
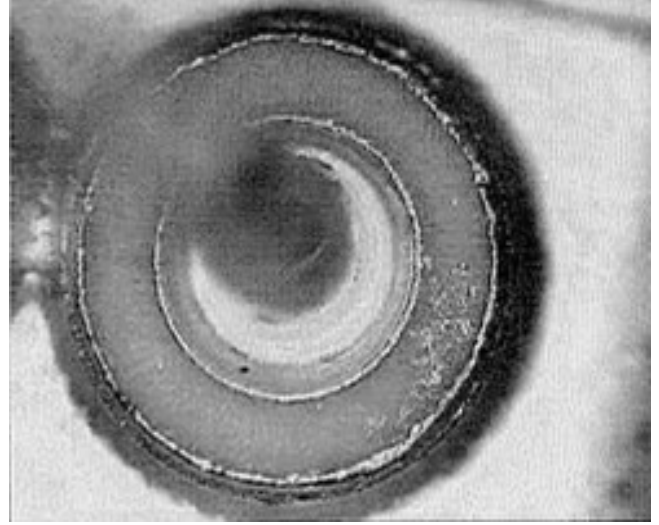
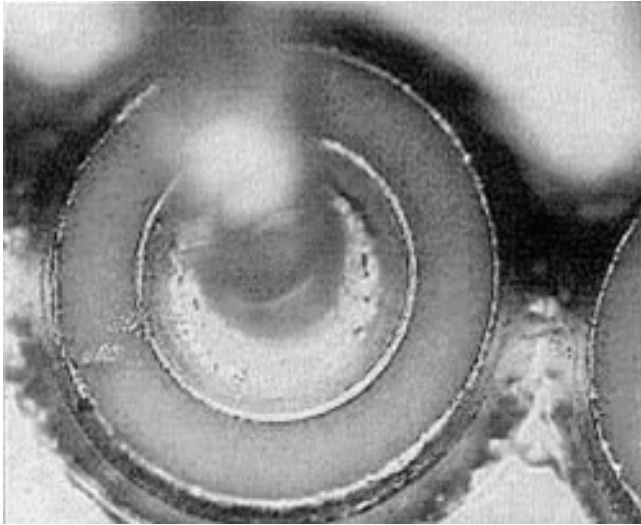
Reject: All three figures illustrate discontinuous braze metallization on the outer diameter of the ceramic eyelet.

FIGURE 2071-13. Discontinuous braze metallization.



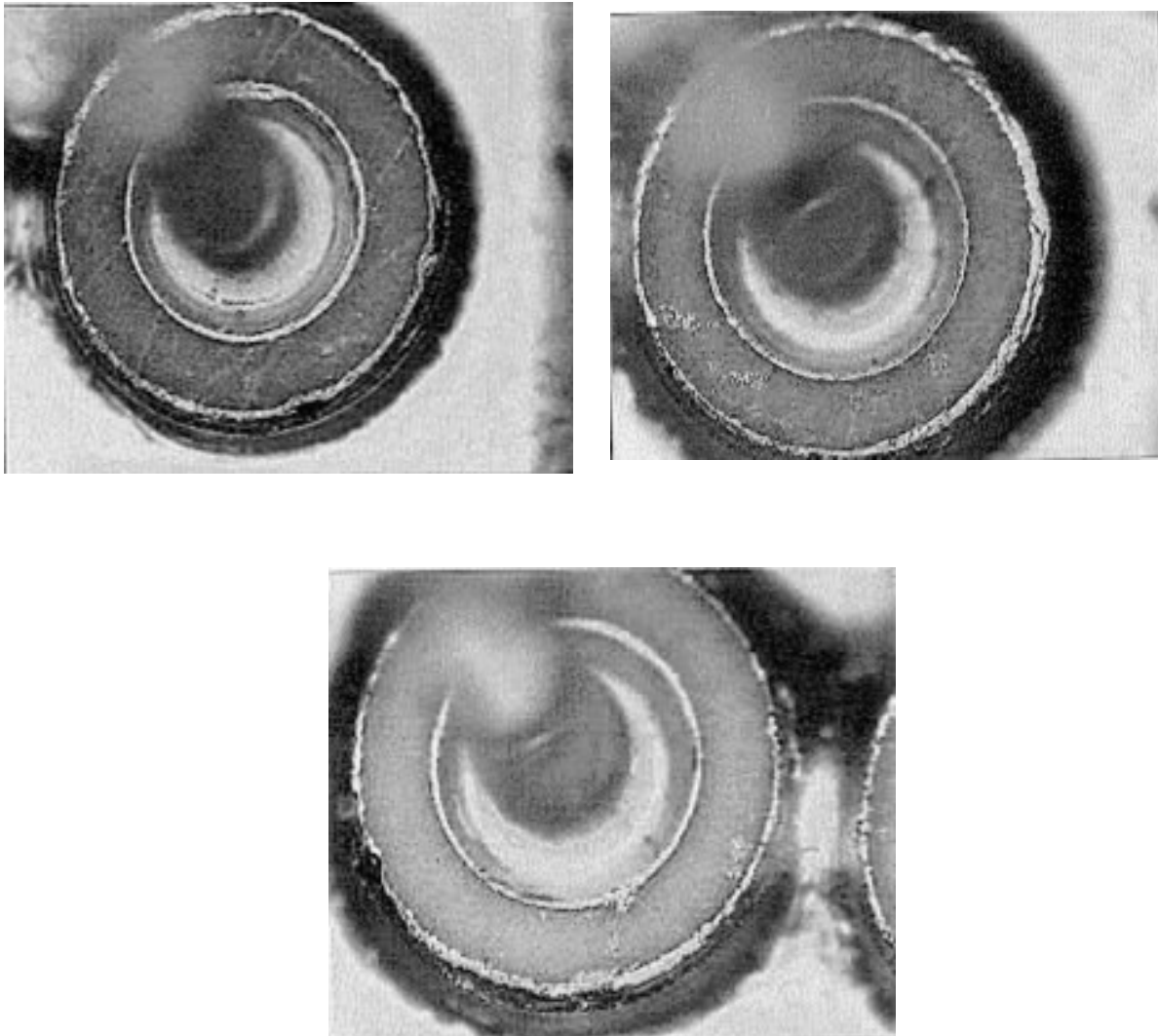
Reject: All figures indicate rejectable foreign material conditions.

FIGURE 2071-14. Rejectable foreign material conditions.



Reject: All figures indicate rejectable foreign material conditions.

FIGURE 2071-14. Rejectable foreign material conditions – Continued.



Reject: All figures indicate rejectable foreign material conditions.

FIGURE 2071-14. Rejectable foreign material conditions – Continued.

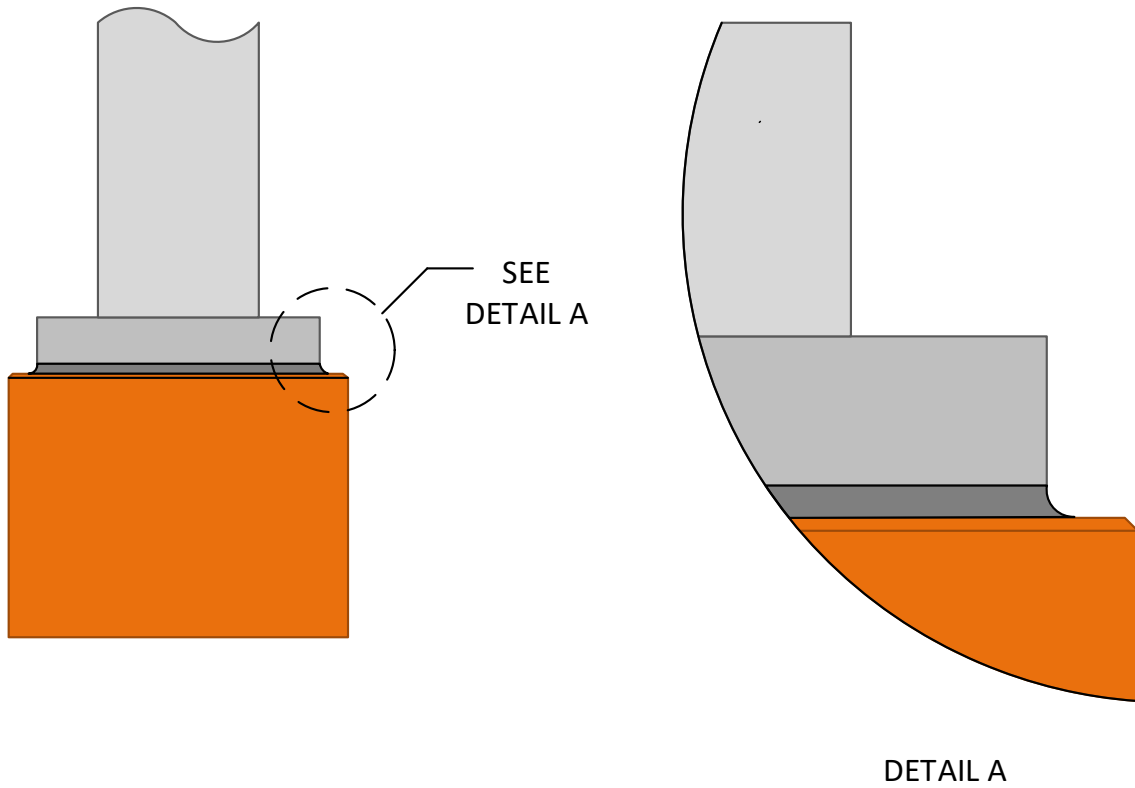


FIGURE 2071-15. Plug to terminal interface depicting acceptable filler metal "wetting" with fillet.

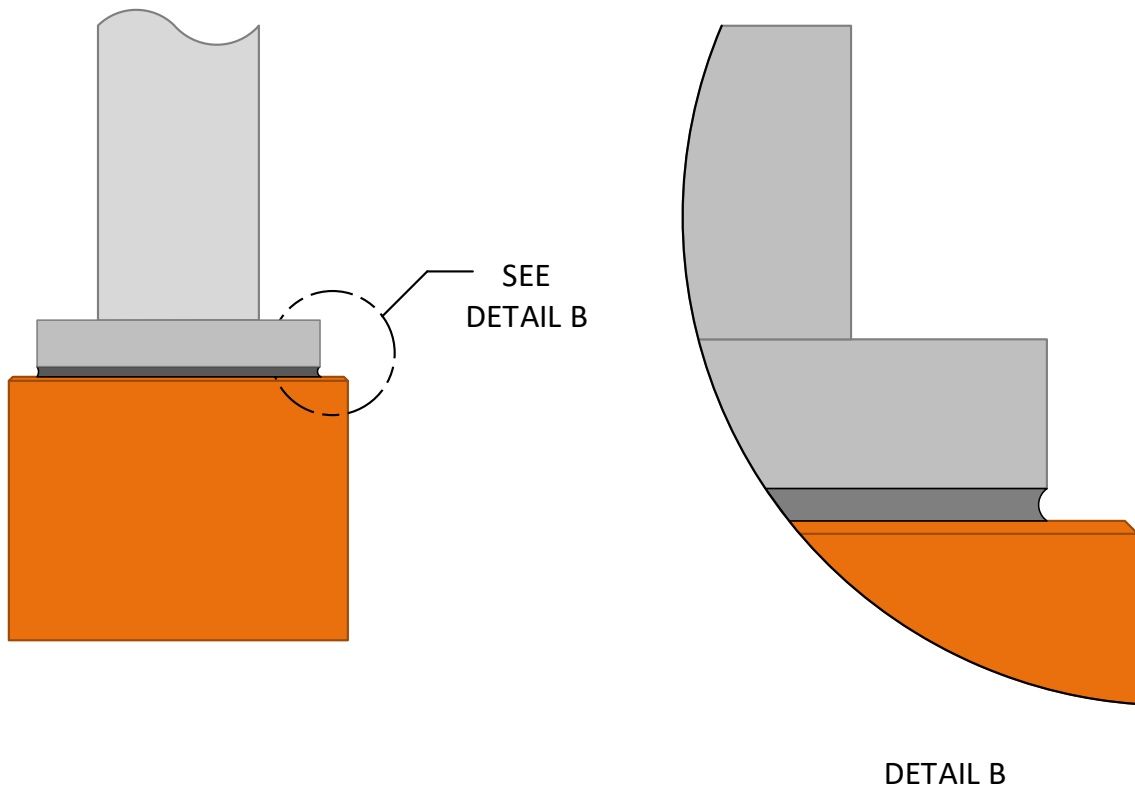


FIGURE 2071-16. Plug to terminal interface depicting acceptable filler metal "wetting" without fillet.

KEY to changes:

For the Initial Draft, added text is highlighted in yellow and text to be deleted is highlighted in red with strike-out. For the Final Report as a result of accepted comments to the Initial Draft, added changes are highlighted in green and marked with green vertical bars and text to be deleted is highlighted in maroon with strike-out and bars.

ATTACHMENT 2 to Project 5961-2024-045

METHOD 2071.40 11

EXTERNAL VISUAL AND MECHANICAL EXAMINATION

1. **Purpose.** The purpose of this test method is to verify the design, construction, markings, materials, and workmanship of hermetically packaged semiconductor devices (hereafter referred to as devices) are in compliance with the requirements described herein and the applicable acquisition document. This test method is normally employed at outgoing inspection within the device manufacturer's facility or as an incoming inspection of the assembled device. This test method shall can also be utilized to inspect for damage due to handling, assembly, and test of the packaged device.

2. **Apparatus.** Apparatus used in this test method shall be capable of demonstrating device conformance to the applicable requirements of the individual specification sheet and those specified herein. The apparatus for this test method shall consist of the following:

- a. Optical equipment, with sufficient lighting. This includes optical equipment capable of the magnifications of 20X minimum as specified herein, which shows the entire area of interest at once in the field of view. The preferred instrument is a binocular or stereo microscope with 10X eyepieces and 4.0X applicable objective lenses to meet the specified having a magnifications range between 20X and 40X.
- b. Adequate fixturing for handling the devices being inspected without causing damage.
- c. Adequate covered storage and transportation containers to protect devices from mechanical damage and environmental contamination.
- d. Any visual standards (e.g., drawings, photographs) necessary to enable the inspector to make objective decisions as to the acceptability of devices being inspected.

3. **Definitions.** The definitions for all terms used herein shall be as specified in MIL-PRF-19500 and those contained herein. The following definitions shall apply for this test method.

3.1 **"c" cracks.** Small cracks or micro-cracks in glass surface.

3.2 **Glass meniscus.** The glass meniscus is defined as that area of glass that wicks up or down the lead or terminal.

3.3 **Examples of foreign material.** Examples of terms used to describe foreign material that are used in this test method include the following: lead carbonate formations, solder filler metal, braze filler metal, other metallization.

4. **Procedure.**

4.1 **Magnification.** Unless otherwise specified, the device shall be examined under a magnification of 20X minimum. The field of view shall be sufficiently large to contain the entire device or area of interest and allow inspection to the criteria listed in 4.5 herein. Where inspection at a lower magnification reveals an anomaly, then inspection at a higher magnification (40X maximum, unless otherwise specified) may be performed to determine acceptability. Higher magnification may be used to further examine and characterize observed anomalies.

When a disposition is in doubt for any dimensional criteria, that dimension may be measured for verification.

4.2 **Foreign displaced material adherence.** When foreign material is present, and its Where adherence of foreign material is in question, the device may be subjected to a clean filtered air gas stream (suction or expulsion or vacuum) of approximately 20 psig (138 kPa) or an isopropyl alcohol wash and then re-inspected.

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5.4. Failure criteria. Devices which exhibit any of the following conditions shall be considered rejects.

5.1 4.4 General rejects defects. Device construction (package outline), lead (terminal), identification markings (content, placement, and legibility), and workmanship not in accordance with the applicable performance specification sheet shall be rejected. This includes the following:

a. Illegible marking, marking content or placement not in accordance with the applicable specification. Evidence of any nonconformance with the applicable procurement document or absence of any required feature.

b. Presence of secondary coating material that visually obscures a seal area(s) (i.e., any hermetic interfaces).

c. Any misalignment of device component parts to the extent that the package outline drawing dimensions are exceeded.

c 4. Visual evidence of corrosion or contamination. Discoloration is shall not be sufficient cause for rejection. The presence of lead carbonate formations in the form of a white/yellow crystalline shall be considered evidence of contamination.

e. Missing welds or crimps.

f. Tabulation weld: Any fracture or split in the tabulation weld.

g. Weld alignment: Base weld mating surfaces not parallel, or that precludes intended use.

h. Damage causing distortion of a flange beyond its normal configuration.

i. Dents in metal lids that precludes their use in the intended application or causing a defect in the finish (see 4.4).

d 1. Gaps, separations, or other openings that are not part of the normal design configuration.

e. Workmanship not in accordance with the applicable procurement document.

5.2 4.2 Foreign/displaced material. Where adherence of foreign material is in question, devices may be subjected to a clean filtered air stream (suction or expulsion) or an isopropyl alcohol wash and then re-inspected.

a. Foreign material (including solder filler metal, braze material, filler metal, or other metallization) bridging leads or terminals or otherwise interfering with the normal application of the device.

b. Foreign material that reduces the isolation between leads/leads or terminals to less than 50 percent of the leads or terminal separation.

c. Foreign material such as ink, paint or other adherent deposits on leads or terminals that exceeds 5 percent of the solderable area.

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5.3 ~~4.3~~ Construction defects.

- a. Protrusions beyond seating plane that will interfere with proper seating of the device.
- b. Protrusions on any other package surface that exceeds the lead thickness in height (leadless packages).
- c. Protrusions on the lid or cover, or extending beyond the surface plane of solder pads, that exceed 25% ~~percent~~ of the terminal width in height (leadless packages).
- d. Metallization not intended by design between solder pads, seal ring or ~~the~~ cover to metallized castellations that reduce the isolation to less than 50% ~~percent~~ of solder pad separation (leadless packages).
- e. ~~4.1.c~~ Any misalignment of device component parts to the extent that the package outline drawing dimensions are exceeded.
- f. ~~4.1.h~~ Damage causing distortion of a flange beyond its normal configuration.

5.4 ~~4.4~~ Finish of package body and ~~the~~ cover defects.

- a. Evidence of blistering, corrosion, flaking, non-adhesion, peeling, or ~~flaking~~ pitting of the finish which exposes underplate or base metal. Any discoloration that does not exhibit these conditions shall be acceptable.
- b. Indentations, mars or scratches, either due to damage or processing, that exposes underplate or base metal.

5.5 Terminal (leads, pads, pins, studs, etc.) defects. ~~4.5~~ Leads/terminals

- a. Broken leads or terminals.
- b. Damaged or bent leads or terminals which precludes their use in the intended application.
- c. Burrs that will cause lead or terminal dimensions to be exceeded.
- d. Damage to a stud (thread damage or bending) which restricts normal mounting.
- e. Scratches that expose underplate or base metal over more than 5 percent of the lead or terminal surface area affected. Exposed base material on the cut lead or terminal ends ~~is~~ shall be acceptable and does not count towards the 5 percent allowance.
- f. Leads or terminals that are not intact or aligned in their design location, free of sharp or unspecified lead bends, or twisted more than 5 degrees from the design ~~lead~~ seating plane.
- g. Leads or terminals with pits and/or depressions that exceed 25 percent of the width (diameter for round leads) and are greater than 50 percent of the lead or terminal thickness in depth.
- h. Leads or terminals with burrs exceeding a height greater than 50 percent of the lead or terminal thickness.

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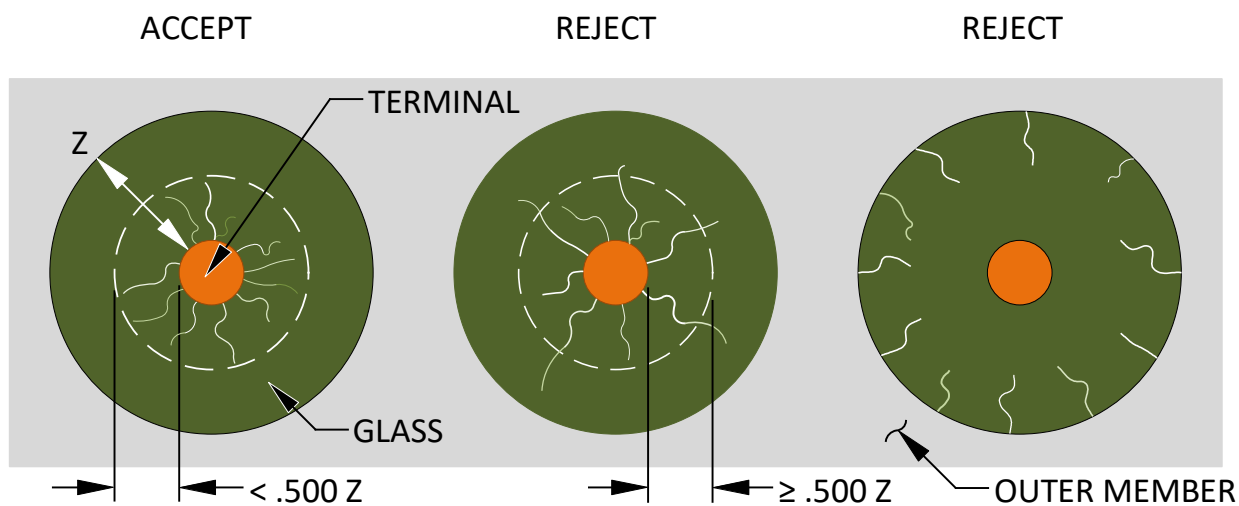
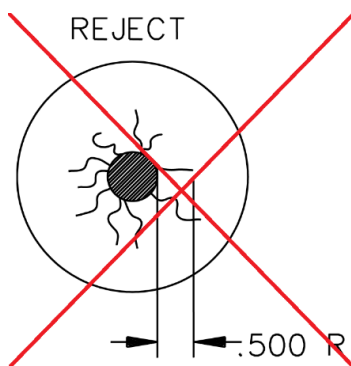
5.6 Crimped or welded seal defects of hermetic (metal) packages.

- a 4.1.f. Tubulation weld: Any fracture or split in the tubulation weld.
- b 4.1.g. Weld alignment: Base weld mating surfaces not parallel, or that precludes intended use.
- c 4.1.h. Damage causing distortion of a weld flange beyond its normal configuration.
- d 4.1.i. Dents in metal covers that precludes their use in the intended application or causing a defect in the finish (see 4.4).
- e 4.1.e. Missing welds or crimps.

5.7 Glass seal areas defects of hermetic (metal) packages. 4.6 Failure criteria for lead/terminal seal area of metal can devices.

- a. Radial cracks (except meniscus cracks) that extend more than one-half of the distance from the pin terminal to the outer member (see figure 2071-1). Radial cracks that originate from the outer member.
- b. Circumferential cracks (except meniscus cracks) that extend more than 90 degrees around the seal center (see figure 2071-2).
- c. Crazeing of the glass seal surface (see figure 2071-3).
- d. Open surface bubble(s) in strings or clusters that exceed two-thirds of the distance between the lead or terminal and the package wall outer member (see figure 2071-4).
- e. Visible subsurface bubbles that exceed the following:
 - (1) Large bubbles or voids that exceed one-third of the glass sealing area (see figure 2071-3 figure 2071-5a).
 - (2) Single bubble or void that is larger than two-thirds of the distance between the lead or terminal and the package wall outer member at the site of the inclusion and extends more than one-third of the glass seal depth (see figure 2071-4 figure 2071-5b).
 - (3) Two bubbles in a line totaling more than two-thirds of the distance from pin lead or terminal to case outer member (see figure 2071-5 figure 2071-5c).
 - (4) Interconnecting bubbles greater than two-thirds of the distance between pin lead or terminal and case outer member (see figure 2071-6 figure 2071-5d).
- f. Except as designed, re-entrant seals which exhibit non-uniform wicking or negative wicking (i.e., negative meniscus) at the lead or outer member interface (see figure 2071-6).
- g. Twenty five percent or greater of the radius length from the center of the feedthrough lead or terminal to the edge of the glass eyelet.
- h. Glass meniscus cracks that are not located within one-half of the distance between the lead or terminal to the case outer member (see figure 2071-7). The glass meniscus is defined as that area of glass that wicks up the lead or terminal.
- i. Any chip-out of ceramic or sealing glass that penetrates the sealing glass deeper than the glass meniscus plane.
- j. Exposed base metal as a result of meniscus chip-outs are shall be acceptable if the exposed area is no deeper than .010 inch (0.25 mm) or 50 percent of lead diameter, whichever is greater (see figure 2071-8).

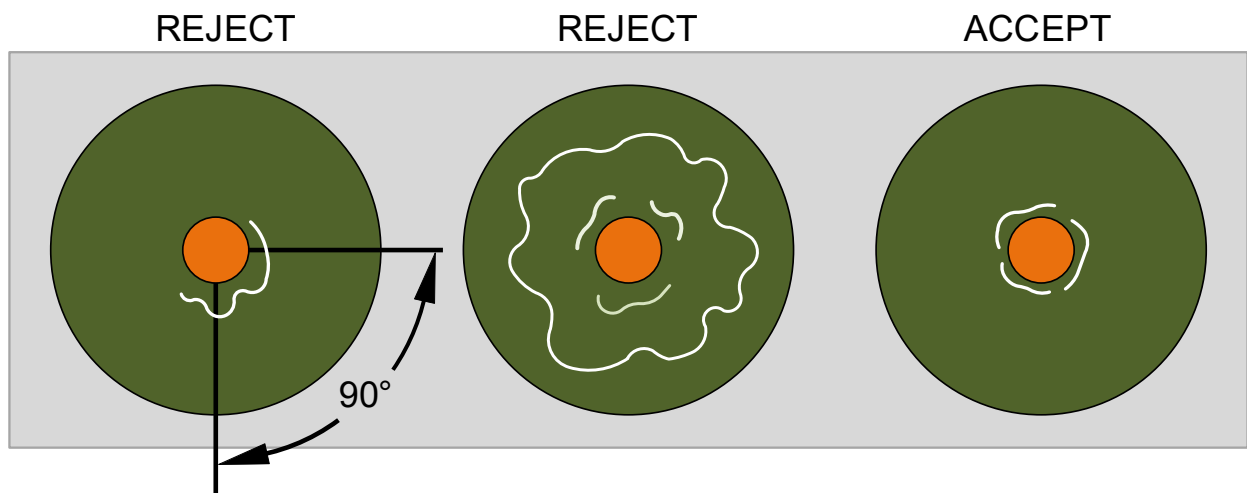
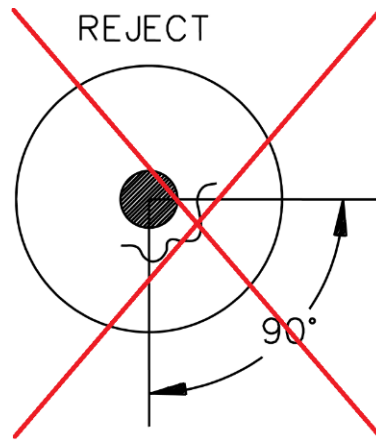
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NOTES:

1. Accept: Radial glass cracks less than one-half the distance from the lead or terminal to outer member.
2. Reject: Radial glass cracks extending more than one-half the distance from the lead or terminal to outer member.
3. Reject: Radial cracks that originate from the outer member.

FIGURE 2071-1. Radial glass cracks in the terminal sealing area extending more than one-half the distance from pin to outer member.



NOTES:

1. Reject: Circumferential cracks that extend more than 90 degrees around the seal center.
2. Reject: Circumferential glass cracks in the sealing area.
3. Accept: Circumferential glass cracks in the meniscus area.

FIGURE 2071-2. Circumferential glass cracks in the terminal sealing area.

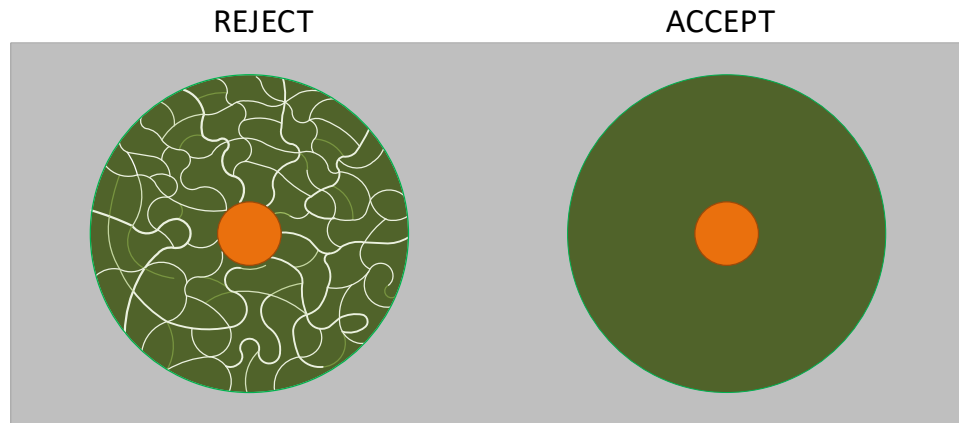


FIGURE 2071-3. Crazing of the glass seal surface.



FIGURE 2071-4. Open surface bubble(s) in the glass seal surface.

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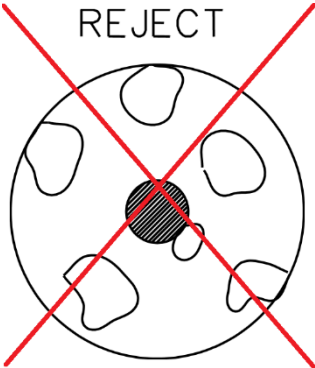


FIGURE 2071-3. Bubbles in glass exceeding one third of the sealing area.

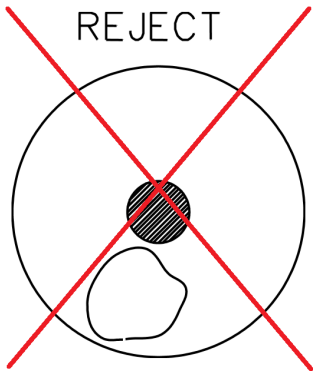


FIGURE 2071-4. Single bubble or void.

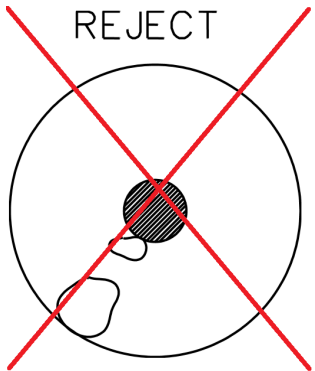
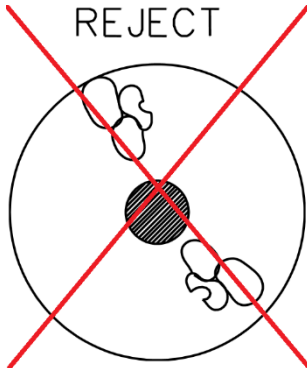


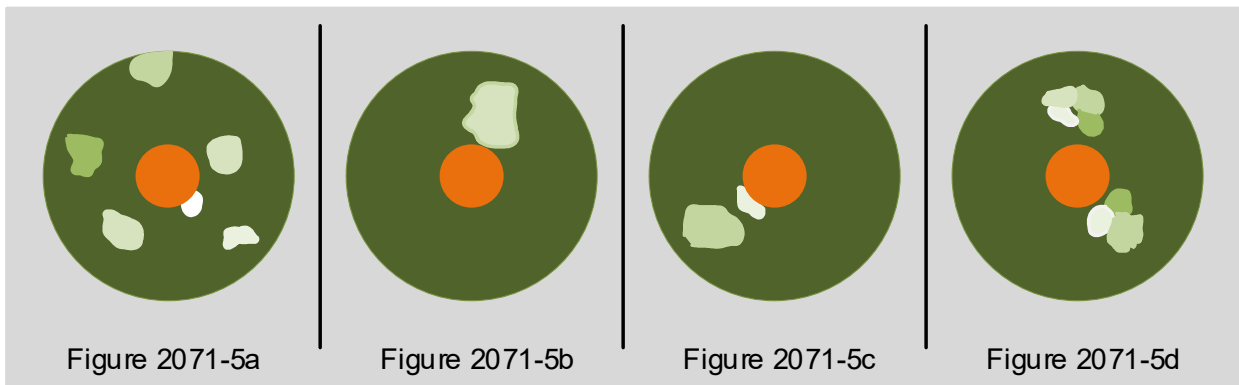
FIGURE 2071-5. Two bubbles in a line.

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REJECT



~~FIGURE 2071-6. Interconnecting bubbles.~~



NOTES:

1. 5a, Reject: Bubbles in glass exceeding one-third of the glass sealing area (see 5.7.e.1).
2. 5b, Reject: Single bubble or void in the glass of the sealing area (see 5.7.e.2).
3. 5c, Reject: Two bubbles in a line in the glass of the sealing area (see 5.7.e.3).
4. 5d, Reject: Interconnecting bubbles in the glass of the sealing area (see 5.7.e.4).

FIGURE 2071-5. Subsurface bubbles.

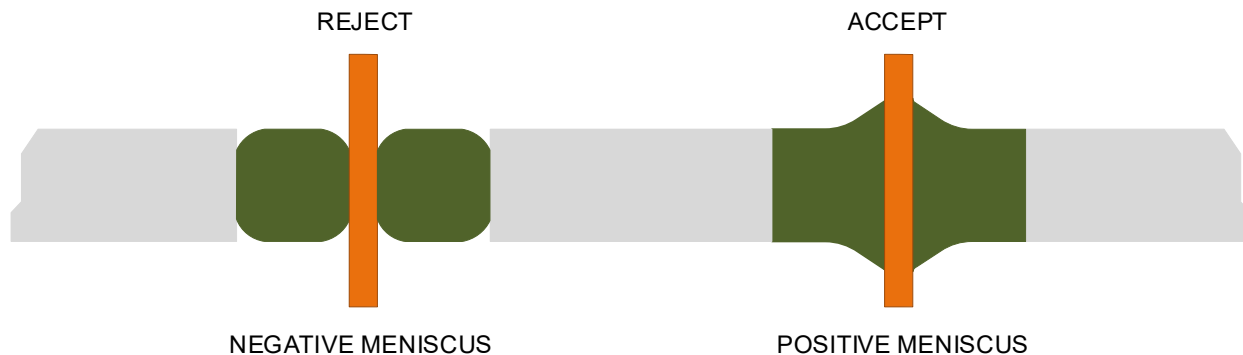
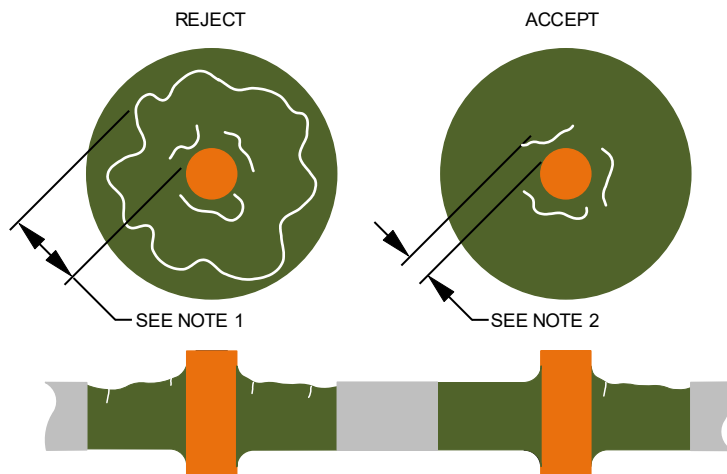
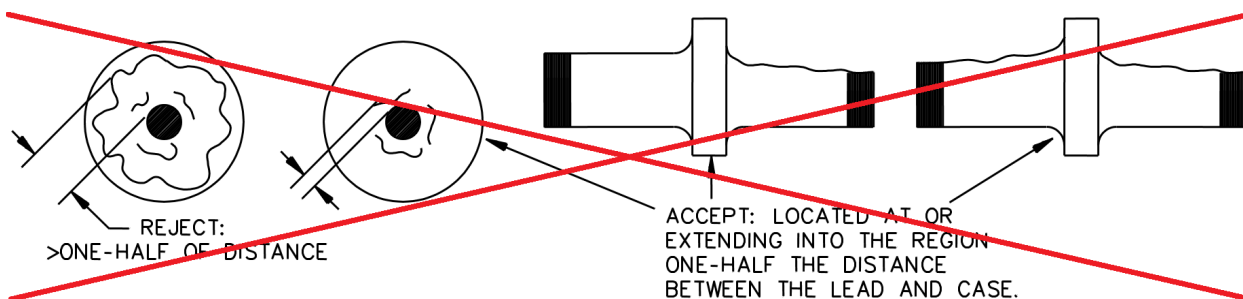


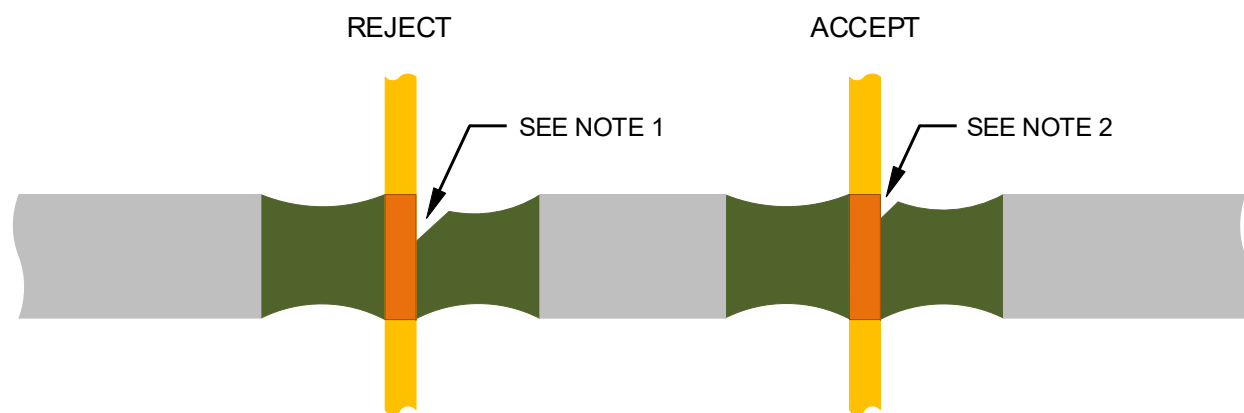
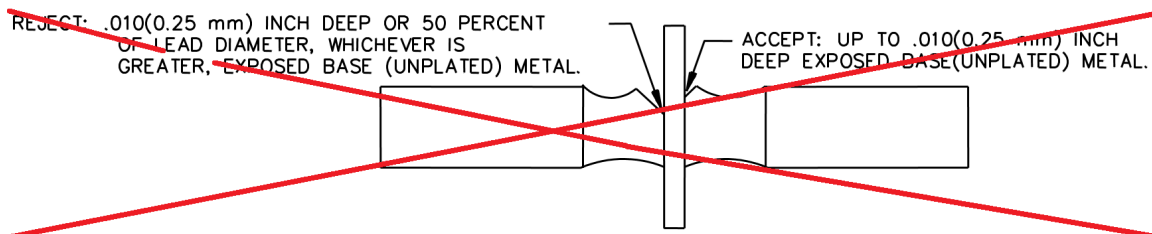
FIGURE 2071-6. Re-entrant seals.



NOTES:

1. Reject: Crack is located at or extending into region greater than one-half the distance between terminal and outer member.
2. Accept: Crack is located in region less than one-half the distance between terminal and outer member.

FIGURE 2071-7. Meniscus cracks in the glass of the sealing area.



NOTES:

1. Reject: Exposed base (unplated) metal greater than .010 inch (0.25 mm) deep or 50 percent of lead or terminal diameter, whichever is greater, exposed base (unplated) metal.
2. Accept: Exposed base (unplated) metal no greater than .010 inch (0.25 mm) deep exposed base (unplated) metal.

FIGURE 2071-8. Exposed base (unplated) metal due to meniscus chip-outs.

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5.8 4.8 Failure criteria for Opaque glass body devices defects. The failure criteria for opaque glass body devices shall be in accordance with [test method 2068](#) of this standard.

5.9 4.9 Transparent glass diodes, double plug construction defects.

- a. Any evidence of a crack, fracture, or a chip-out closer to the die than 50 percent of the designed seal length shall be rejected. Area of examination shall be as shown on [figure 2071-9](#).
- b. Any crack that terminates in the axial direction is cause for rejection.
- c. Meniscus cracks are not cause for rejection.
- d. Any chip-out that exposes base metal shall be rejected.
- e. Small surface impact marks, "c" cracks, and microcracks are acceptable if they are confined to the glass surface with no other cracks radiating from them.
- f. Terminals that are not brazed (or soldered) to the plug around at least 90 percent of the terminal perimeter are cause for rejection. ~~See figure 2071-9 and figure 2071-9.~~

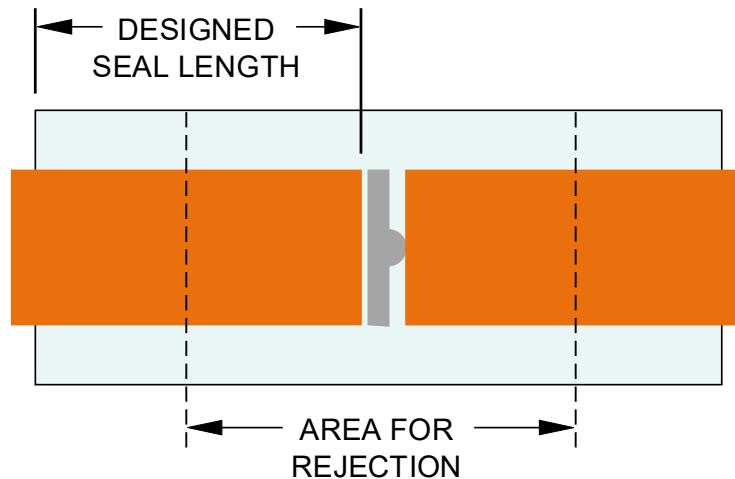


FIGURE 2071-9. **Area of examination for** transparent glass diode (double plug construction).

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5.10 4.10 Transparent glass diodes, large cavity (i.e. S-bend, C-bend, or straight-through constructions) defects.

- a. Any crack or fracture in the glass over the area of the device cavity shall be rejected.
- b. Any chip~~out~~ that exposes base metal shall be rejected (this does not apply to chip~~outs~~ at either end of device where glass joins external lead).
- c. Any crack that terminates in the axial direction ~~is~~ shall be cause for rejection.
- d. Meniscus cracks ~~are~~ shall not be cause for rejection.
- e. Small surface impact marks, "c" cracks, and microcracks are acceptable if they are confined to the glass surface with no other cracks radiating from them.

5.11 4.7 Failure criteria for Ceramic packages defects. The failure criteria for ceramic packages shall be in accordance with test method 2009 of MIL-STD-883-2.

5.12 4.11 Failure criteria for Hermetic packages with Ceramic eyelet feedthroughs defects of hermetic packages. The following defects shall not be acceptable. See figure 2071-10 for identification of features.

- a. Any delamination or separation ~~or delamination~~ of the braze metallization from the inner diameter (ID) or outer diameter (OD) of the ceramic eyelet (see ~~figures 2071-10 and~~ figure 2071-11).
- b. Any cracks or separation in the braze between the ceramic eyelet ID and the lead ~~or terminal~~ or the ceramic eyelet OD and the package (see figure 2071-12). Any voids, depressions, or pinholes the bottom of which cannot be seen at 30X maximum magnification in the braze between the ceramic eyelet ID and the lead ~~or terminal~~ or the ceramic eyelet OD and the package.
- c. Any discontinuation in the braze from the ceramic eyelet ID to the lead or the ceramic eyelet OD to the package exposing unplated metallization or bare ceramic (see ~~figure 2071-12~~ figure 2071-13).
- d. Any conductive material attached to the ceramic eyelet that reduces the designed isolation width by more than one-third unless it is demonstrated that the device voltage isolation requirement can be met with less than two-thirds of the width of the ceramic eyelet (see ~~figures 2071-13 through 2071-14~~ figures 2071-10 and 2071-14).
- e. Any metallization that extends beyond the height of the ceramic eyelet that is not adhered to the ceramic eyelet.
- f. ~~No Cracks are allowed in the ceramic eyelet.~~ Chip~~outs~~ greater than .005 inch (0.127 mm) in any direction are not allowed.

5.13 4.12 Failure criteria for laser marked packages. Identification markings (content, legibility, and placement) defects.

- a. Marking content, illegible marking, or marking placement not in accordance with the applicable acquisition document ~~specification sheet~~.
- b. Defective laser marking; evidence of gouges or deep holes where the bottom of the laser marking cannot be observed (applicable to both plated and non-plated packages).

5.14 Glass diode plug to terminal interface. The plug to terminal interface of glass body diodes shall be in accordance with figures 2071-14 and 2071-15.

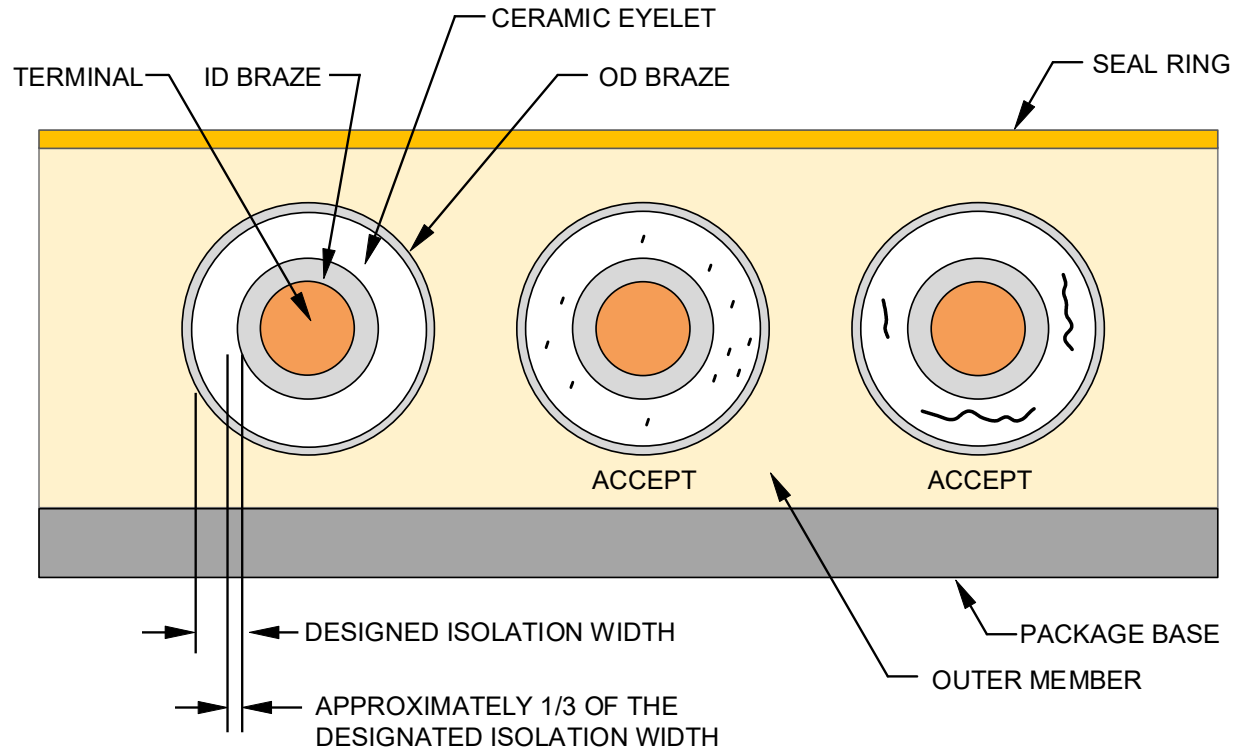
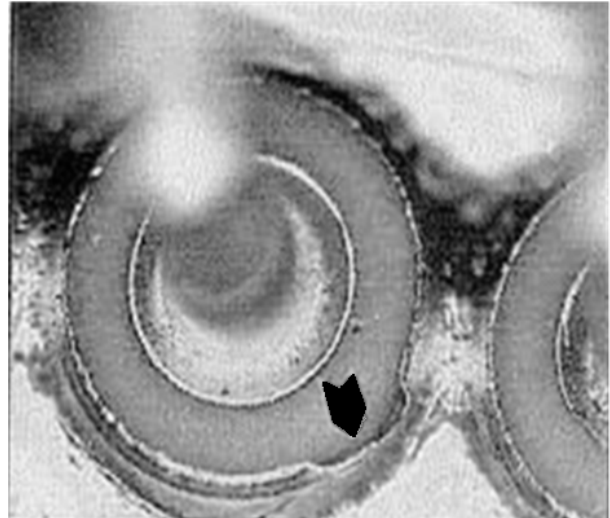
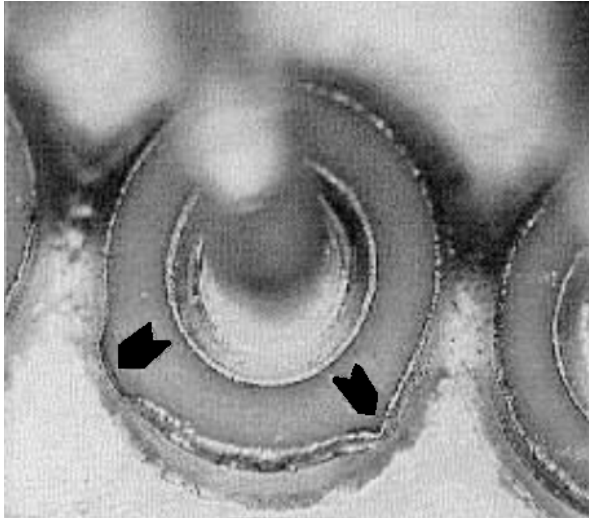


FIGURE 2071-10. Ceramic eyelet feedthrough visual inspection criteria.

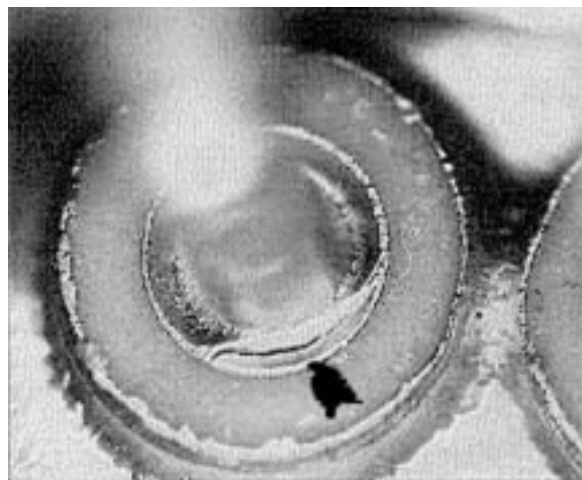
6. **5** Summary. The following conditions must be specified in the applicable performance specification sheet or acquisition document:

- a. Requirements for markings and the lead **or** terminal **or** pin identification.
- b. Detailed requirements for materials, design, construction, and workmanship.
- c. Magnification requirements, if other than specified.



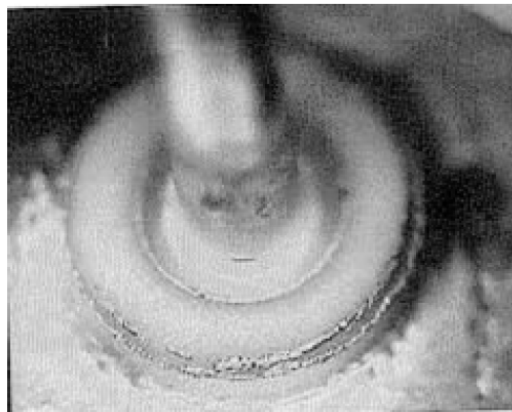
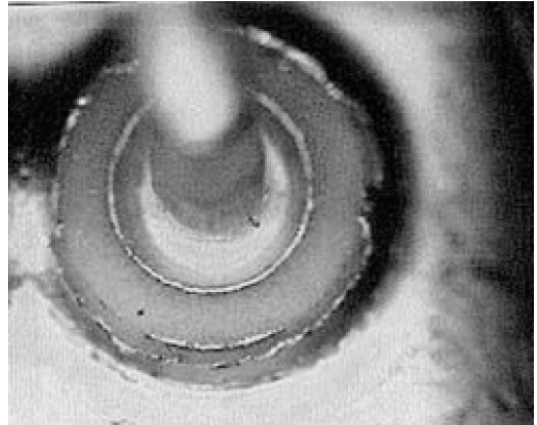
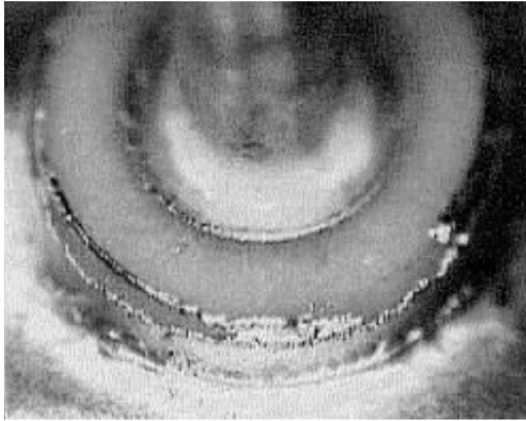
NOTE: Arrows on both pictures illustrate rejectable conditions of braze metallization delamination or separation.

FIGURE 2071-11 2071-40. Braze metallization delamination or separation.



Reject: Arrow indicates a crack on the inner diameter braze metallization of the ceramic eyelet.

FIGURE 2071-12 2071-14. Crack in the ceramic eyelet braze metallization.



Reject: All three figures illustrate discontinuous braze metallization on the outer diameter of the ceramic eyelet.

FIGURE 2071-13 ~~2074-12~~. Discontinuous braze metallization.

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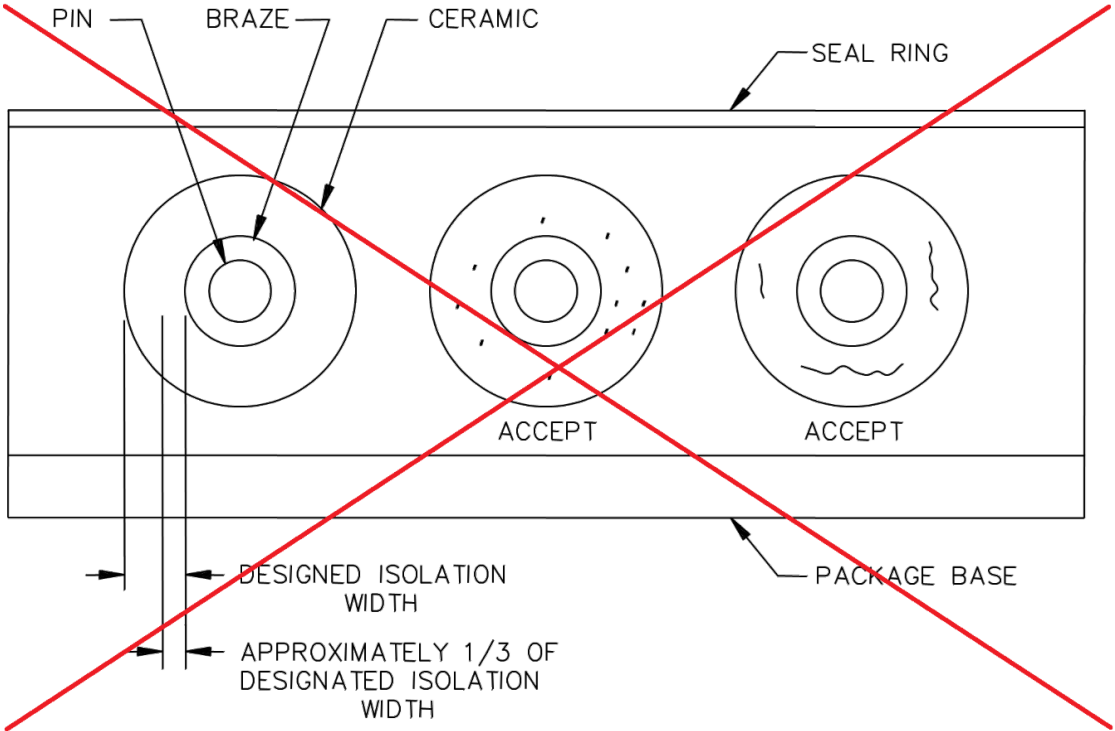
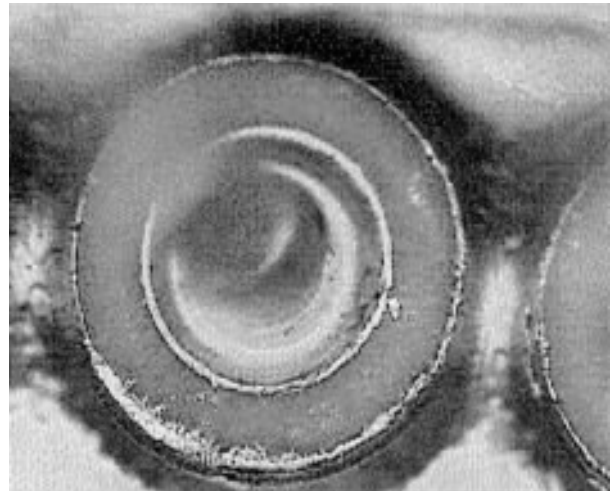
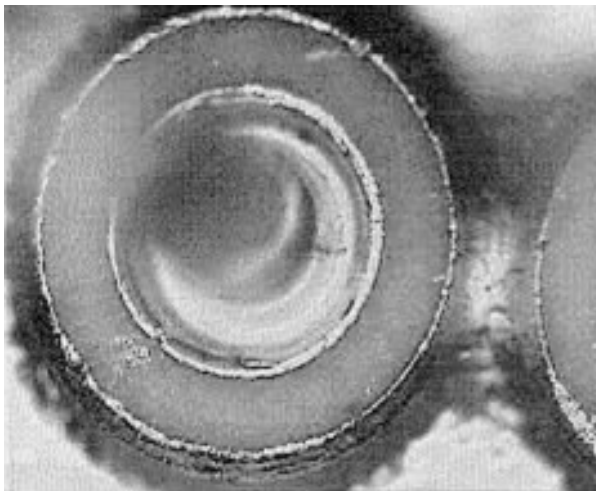
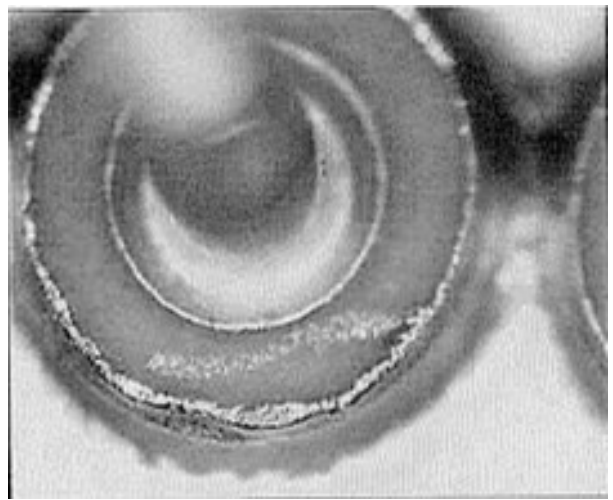
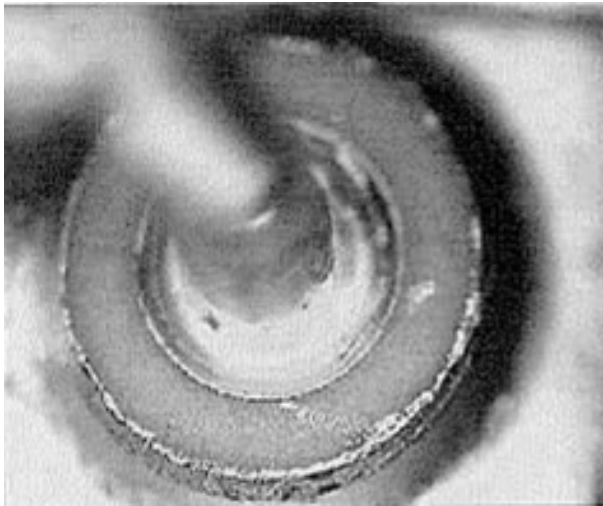
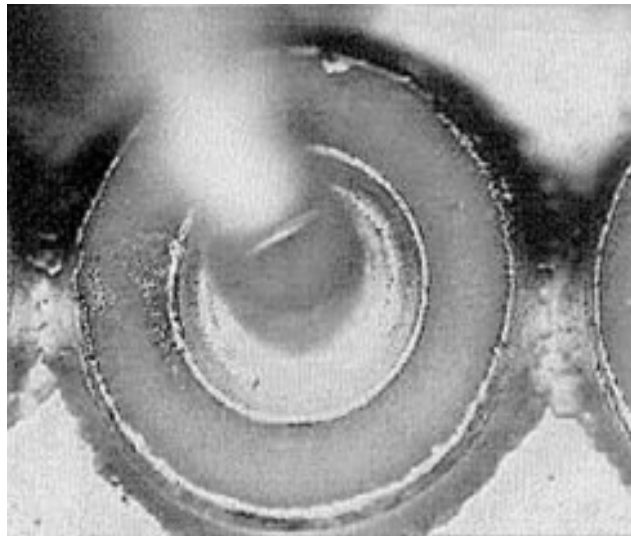
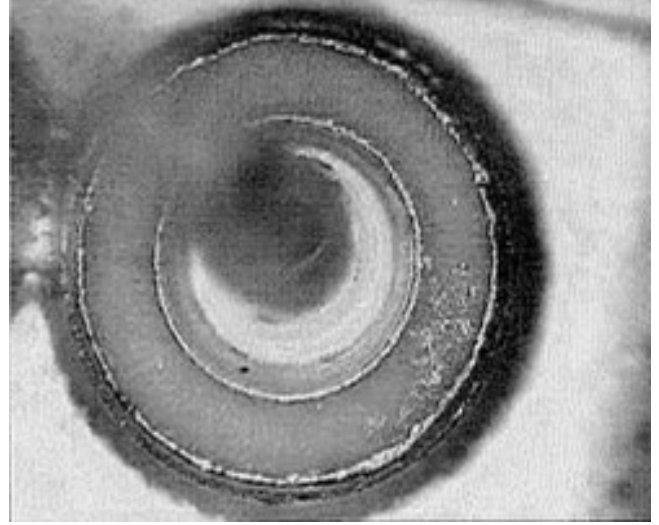
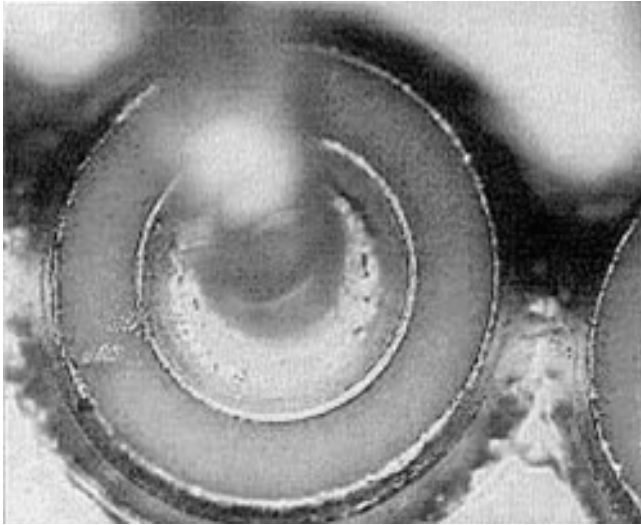


FIGURE 2071-13. Ceramic feedthrough visual inspection criteria.



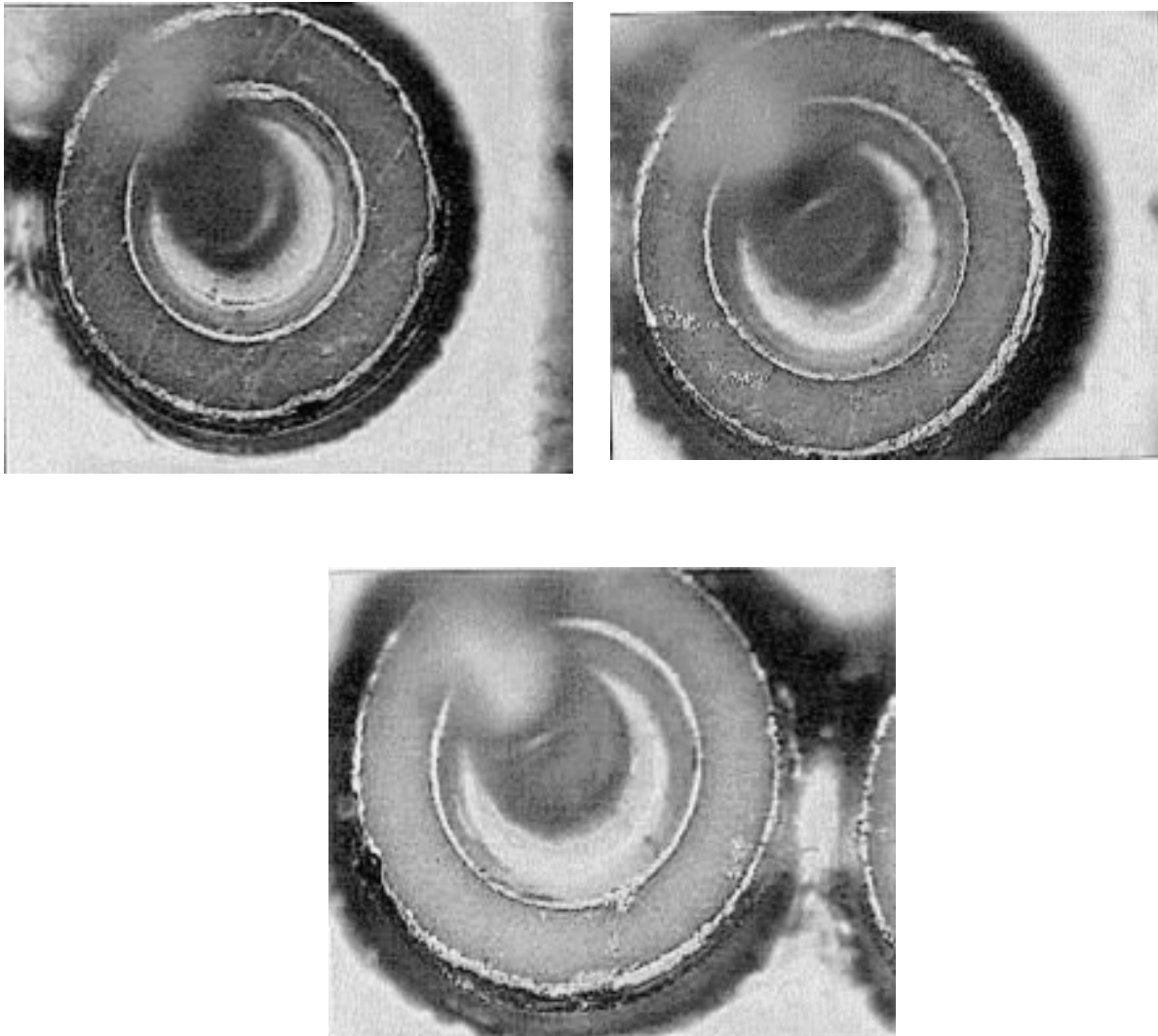
Reject: All figures indicate rejectable foreign material conditions.

FIGURE 2071-14. Rejectable foreign material conditions.



Reject: All figures indicate rejectable foreign material conditions.

FIGURE 2071-14. Rejectable foreign material conditions – Continued.



Reject: All figures indicate rejectable foreign material conditions.

FIGURE 2071-14. Rejectable foreign material conditions – Continued.

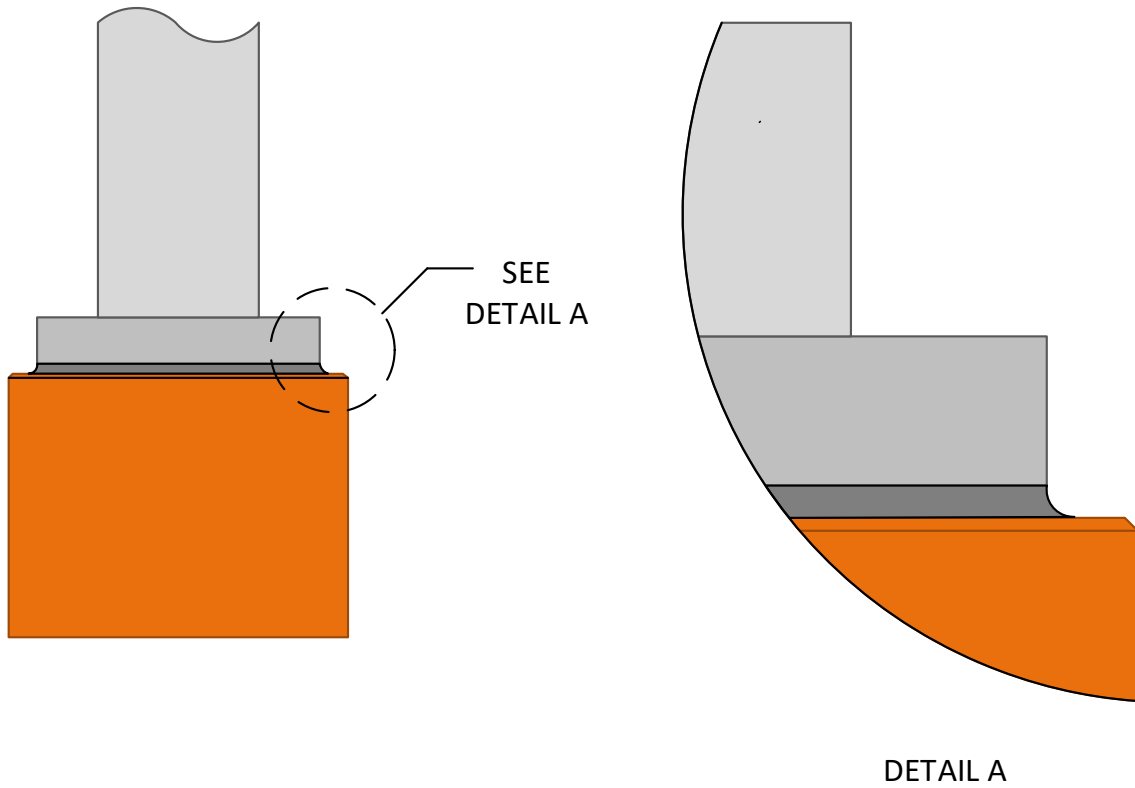


FIGURE 2071-15. Plug to terminal interface depicting acceptable filler metal "wetting" with fillet.

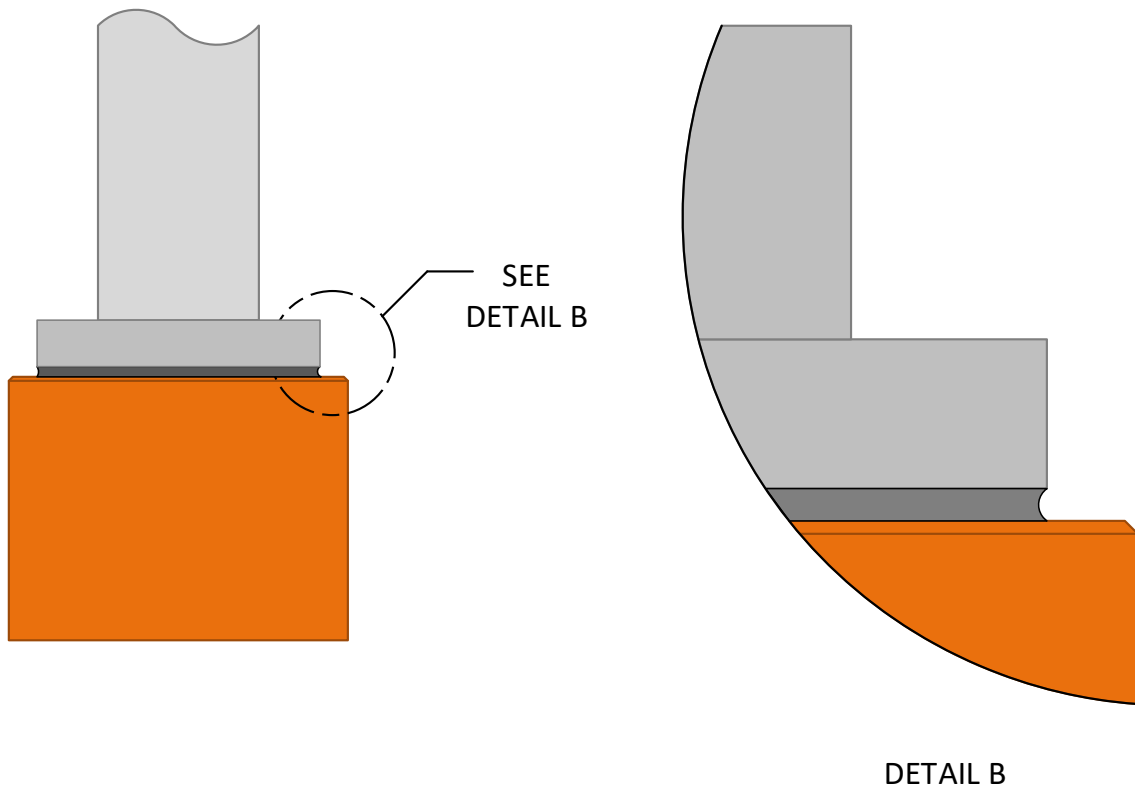


FIGURE 2071-16. Plug to terminal interface depicting acceptable filler metal "wetting" without fillet.