

ENGINEERING PRACTICE STUDY

PROJECT NUMBER: 5961-2022-005

TITLE:

MIL-STD-750-2, TEST METHOD 2074:
"INTERNAL VISUAL INSPECTION (DISCRETE SEMICONDUCTOR DIODES)"

PROPOSAL TO DEVELOP A DRAFT TO
CORRECT SELECT FIGURES AND REVISE REQUIREMENTS
FOR CLARITY AND CONSISTENCY

4 MARCH 2022

FINAL REPORT

STUDY CONDUCTED BY

DLA LAND AND MARITIME
Document Standardization Division (VA)
Active Device Branch (VAC)

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Attachments: 2

I. OBJECTIVES: The objective of this Engineering Practice (EP) Study was to obtain input from the military services, device manufacturers, laboratories, and user community concerning a proposed revision to test method 2074 of MIL-STD-750-2.

II. BACKGROUND: DLA received input from both users and manufacturers regarding various errors and interpretations of a few select figures and requirements of the current revision of test method 2074.6. The draft revision contained both editorial and technical changes that addressed those problems. The changes include correcting errors on those figures and mitigating differences between the paragraph requirements and their associated figures. Also, the requirements related to die alignment, foreign material and the inspection procedure were modified to increase clarity and reduce inconsistency.

III. RESULTS: All comments received regarding the proposed content and format changes were accepted and have been incorporated into the drafts for the final report except for one requesting that DLA develop a new figure. That request for a new figure will be pursued in a future revision. Both a clean reader draft (see attachment 1) and mark-up source draft (see attachment 2) have been included for comparison and reviewing.

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: Prepare an initial draft of MIL-STD-750-2 using the results of this study for the draft of test method 2074.7.

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 modifications:

Modifications included in the initial draft: New text is black with yellow highlighting.

Modifications as a result of comments to the initial draft: New text is black with green highlighting.

Deleted items are not shown in this attachment. Deleted items are shown in attachment 2.

METHOD 2074.7

INTERNAL VISUAL INSPECTION (DISCRETE SEMICONDUCTOR DIODES)

1. Purpose. The purpose of this test method is to verify that the internal materials, design, construction, and workmanship of discrete semiconductor diodes and other two-terminal semiconductor devices (hereafter referred to as "device") are in compliance with the requirements described herein and the applicable acquisition document.

1.1 Application. All examinations and inspections shall be performed to identify and reject those devices with defects that could lead to device failures. The following details apply:

- a. Opaque glass construction devices shall be examined before encapsulation. After encapsulation, the requirements of test method 2068 of this standard apply.
- b. Metal can construction devices using soldered contact style construction (e.g. DO, TO, etc.) shall be examined before capping or sealing.
- c. Transparent glass construction devices shall be examined after encapsulation.
- d. Internal cavity construction devices using bonded wire or ribbon style construction (e.g. DIP, LCC, UB, etc.) are inspected to the requirements of test method 2078.

1.2 Exclusions and limitations. The inspections of this test method excludes microwave and RF devices.

2. Apparatus. The apparatus for this test method shall consist of the following.

- a. Optical equipment (a monocular, binocular, or stereo microscope) capable of the specified magnification.
- b. Light sources of sufficient intensity to adequately illuminate the devices being inspected.
- c. Adequate fixturing for handling the devices during examination to promote efficient operation without causing contamination or damage.
- d. Adequate covered storage and transportation containers to protect devices from mechanical damage and environmental contamination.
- e. Visual standards (e.g., gauges, drawings, photographs) necessary to perform an effective examination and enable the inspector to make objective decisions as to the acceptability of the devices being examined.

3. Definitions. The following definitions shall apply:

3.1 Controlled environment. A controlled environment is an environment which controls airborne particle count and relative humidity.

3.2 Examples of foreign material. Examples of terms used to describe foreign material that are used in this test method include the following: chips, conductive contaminants, extraneous matter, flaked plating, foreign matter, foreign stains, opaque material, particulate matter, semiconductor material, and unattached solder balls.

4. General requirements.

4.1 Procedure.

4.1.1 **General.** The devices or die shall be examined in a suitable sequence of operations and at the specified magnifications to determine compliance with the requirements of the applicable acquisition document and the criteria specified herein and in the appendices of this test method based on device design and construction.

4.1.2 **Sequence of inspection.** The order in which acceptability criteria are presented herein is not a required order of examination and may be varied at the discretion of the manufacturer. The following details apply:

- a. Examinations for transparent glass body devices may be performed anytime prior to body coating or painting.
- b. Axial construction devices shall be viewed at approximate right angles to their major axis while being rotated through 360 degrees.

4.2 **Control of environment.** Within the time interval, if any, between visual inspection and package sealing, devices shall be stored, handled, and processed in a controlled environment to avoid contamination and in a manner to preserve the integrity of the devices as inspected. The use of an inert gas environment, such as dry nitrogen, shall satisfy the requirements for storing in a controlled environment.

4.3 **Magnification.** Unless otherwise specified, examinations shall be performed at magnification ranges between 20X minimum and 30X maximum.

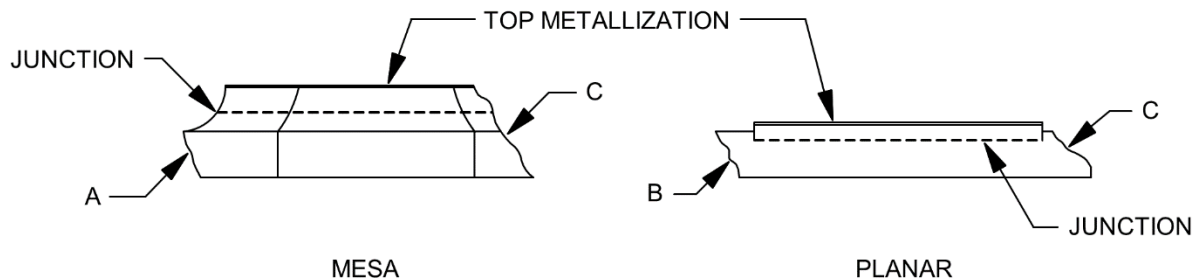
4.4 **Illumination.** The visual inspection shall be performed under suitable illumination.

5. Detailed requirements.

5.1 **Examinations of die for acceptability (accept and reject criteria).** The following die criteria are applicable to the die of all body styles (see 5.2) listed herein. Any die that exhibits any of the following defects shall be rejected.

- a. Chipouts (see figure 2074-1). Reject die for chipouts that extend more than 50 percent of the way up the moat area (mesa devices) or that extend to within .002 inch (0.051 mm) of the junction.

NOTE: Actual junction location will vary depending on specific die characteristics.



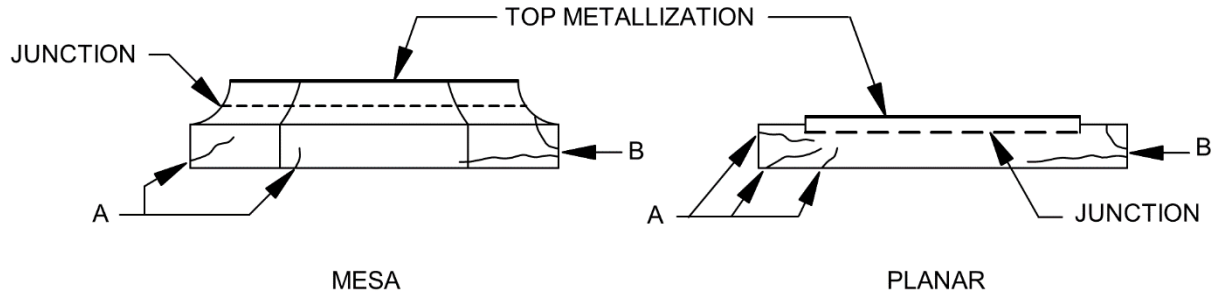
Accept: "A" chipouts $\leq$ 50 percent up moat and $\geq$.002 inch (0.051 mm) from junction.
 Accept: "B" chipouts $\geq$.002 inch (0.051 mm) from junction.
 Reject: "C" chipouts $\leq$.002 inch (0.051 mm) from junction.

FIGURE 2074-1. Die chipouts.

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- b. Cracks (see figure 2074-2). Reject die for cracks that extend to within .002 inch (0.051 mm) of the junction or propagate in the direction of the junction.

NOTE: The junction may be in a different place than shown depending on specific die characteristics.



Reject: "A" Cracks $\leq$.002 inch (0.051 mm) from junction or propagating toward junction.
 Accept: "B" Cracks $\geq$.002 inch (0.051 mm) from junction and propagating away from junction.

FIGURE 2074-2. Die cracks.

5.2 Applicable body styles. The devices shall be examined in accordance with the following appendixes as applicable for the design and construction of the body style involved.

- Appendix A: Glass body (transparent), axial lead, pressure contact design.
- Appendix B: Glass body (transparent), axial lead, straight through lead to die contact design.
- Appendix C: Glass body (transparent), axial lead and surface mount, double plug (Dumet plug, round end-cap, soft glass) design.
- Appendix D: Glass body (transparent), axial lead and surface mount, double plug (tungsten or molybdenum plug, square end-cap, hard glass) design.
- Appendix E: Glass body (transparent), axial lead, point contact design.
- Appendix F: Glass body (opaque), axial lead and surface mount, double plug (power rectifier and regulator) design.
- Appendix G: Metal body, axial lead, solder contact design.
- Appendix H: Metal body, stud mounted, solder contact design.
- Appendix I: Metal body, diamond base regulators, solder contact design.

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

- a. Detailed requirements for materials, design, construction, and workmanship.
- b. Magnification requirements, if other than specified herein.

GLASS BODY (TRANSPARENT), AXIAL LEAD, PRESSURE CONTACT DESIGN

A.1 **General.** This appendix contains the acceptance criteria for devices of the transparent glass body, axial lead, pressure contact connection (C and S bend whisker) design. The following examinations shall be made after encapsulation. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

A.1.1 **Glass cracks and chips (see figure 2074-A1).** No cracks shall be allowed in the vicinity of the cavity. Any crack originating at either end of the package or crack that extends into the body of the glass toward the cavity more than 25 percent of the glass-to-glass or glass-to-metal seal length shall be cause for rejection. Any glass chip deep enough to expose the plug or lead surface and extending longitudinally into the glass-to-metal seal toward the cavity to reduce the effective seal length to less than one external lead diameter shall be cause for rejection.

A.1.2 **Incomplete seal.** All devices shall be inspected for glass-to-metal seal or glass-to-glass seal. Both seals shall be a minimum of one external lead diameter over the entire sealed portion (sealed interface).

A.1.3 **Bubbles in seal.** All devices shall be inspected for bubbles in the glass-to-metal or glass-to-glass seal. A series of bubbles that reduce the effective seal length to less than one external lead diameter shall be cause for rejection. Bubbles in the glass, but not affecting the glass-to-glass or glass-to-metal seal area, are not cause for rejection.

A.1.4 **Glass package deformities (see figure 2074-A2).** Any glass envelope deformity equal to or greater than 75 percent of the external lead diameter shall be cause for rejection.

A.1.5 **Foreign material.** A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.

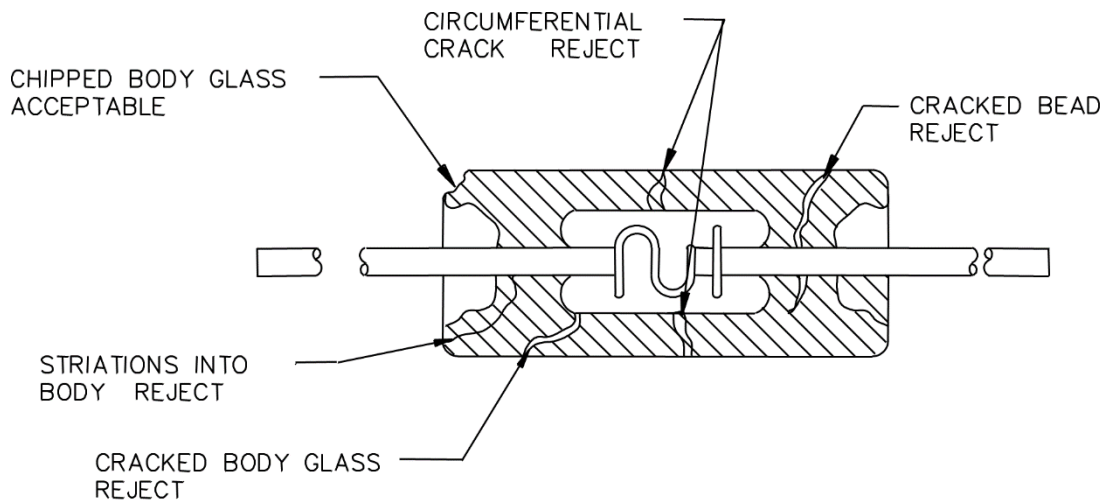
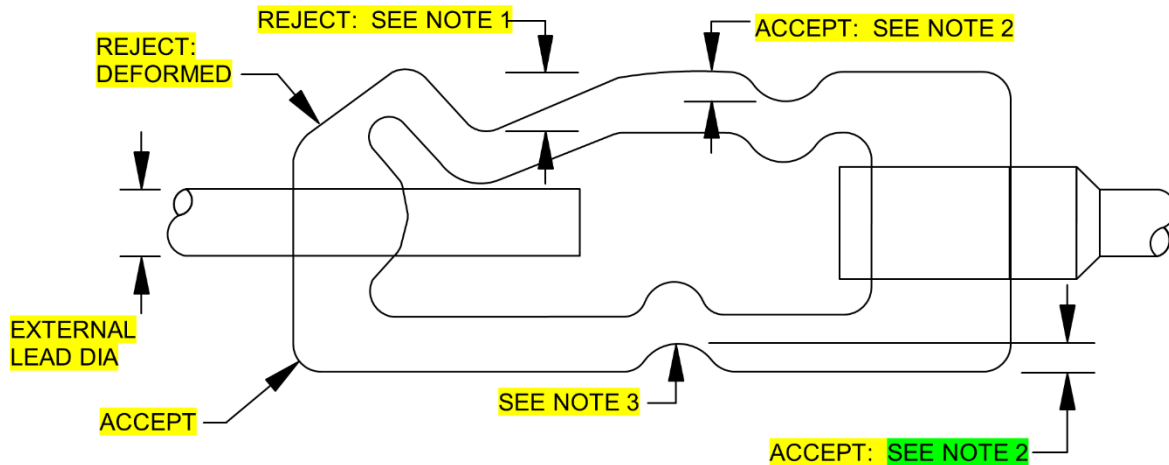


FIGURE 2074-A1. Glass cracks and chips.



NOTES:

1. Reject if deformity is greater than or equal to 75 percent of external lead diameter.
2. Accept when deformity/indentation is less than 75 percent of external lead diameter.
3. Any indentation in the center of the device by design is not to be considered a deformity.

FIGURE 2074-A2. Package deformities.

A.1.6 Solder protrusions (see figure 2074-A3). Any device with a **solder** protrusion that extends more than twice the smallest width **of the protrusion** shall be rejected.

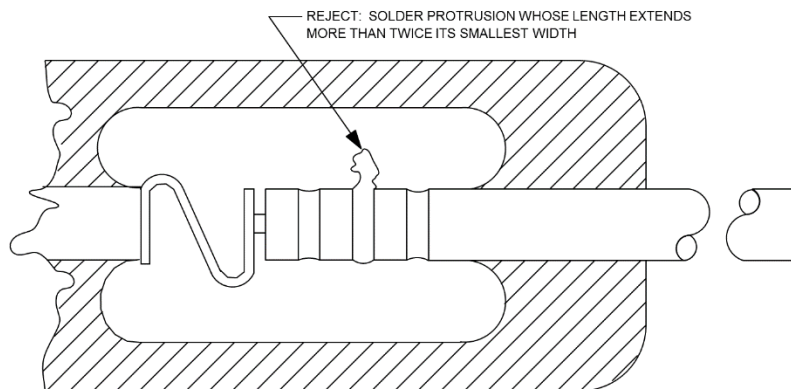


FIGURE 2074-A3. Solder protrusions.

APPENDIX A

A.1.7 Pressure contact defects. The following misalignments or deformations shall be cause for rejection:

- a. Whisker embedded within glass body wall (see figure 2074-A4).

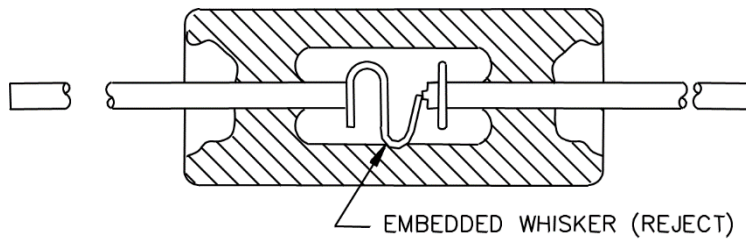


FIGURE 2074-A4. Embedded whisker.

- b. Toe contact between base of C or S bend whisker and top surface of die caused by insufficient loading (see figure 2074-A5).

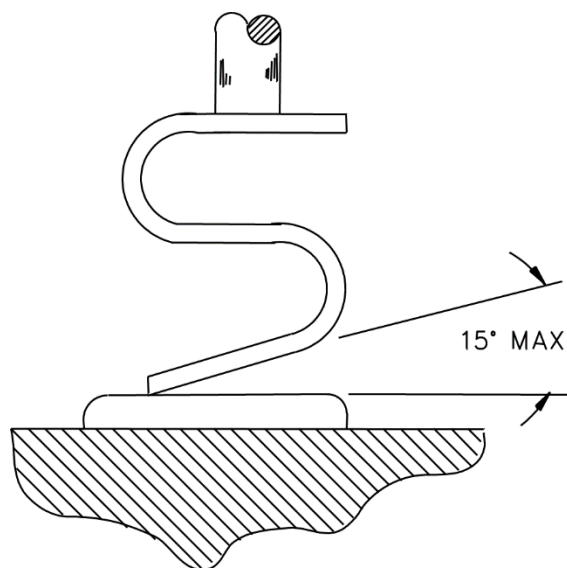


FIGURE 2074-A5. Whisker toe contact.

- c. Toe contact on top surface of die (see figure 2074-A6).

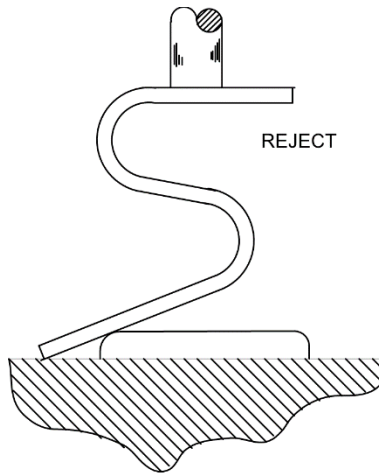


FIGURE 2074-A6. Whisker toe contact on top surface of die.

- d. Heel contact between base of C or S bend whisker and top surface of die (see figure 2074-A7).

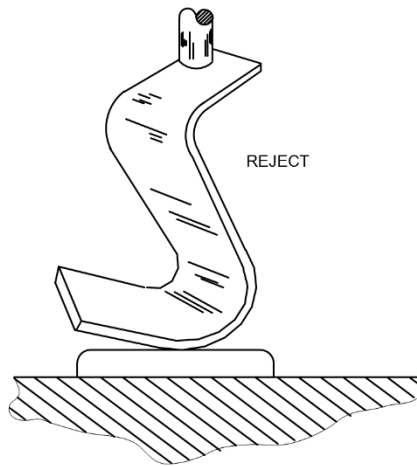


FIGURE 2074-A7. Whisker heel contact.

- e. Point contact between base of C or S bend whisker and top surface of die except by design (deformed or twisted whisker) (see figure 2074-A8).

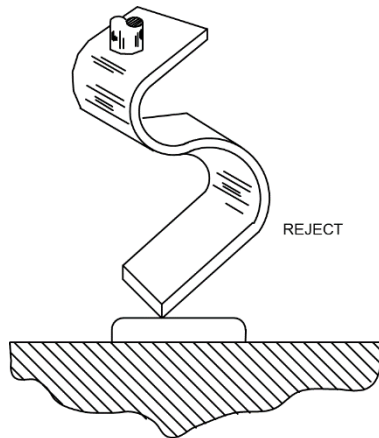


FIGURE 2074-A8. Whisker point contact.

- f. Design compressed height (see figures 2074-A9 and 2074-10). Either half of an S or a C bend whisker that is compressed so that any dimension is reduced to less than 50 percent of its design compressed height shall be rejected.

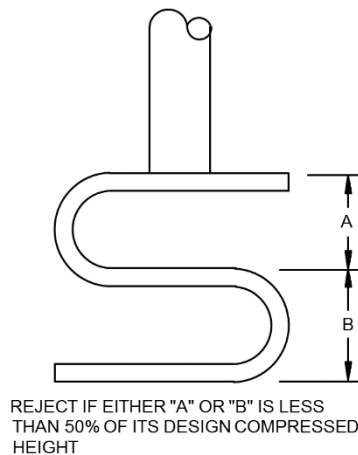


FIGURE 2074-A9. S bend whisker compressed height.

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APPENDIX A

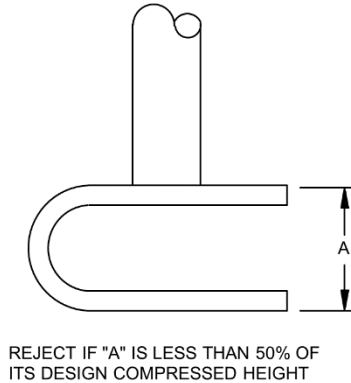


FIGURE 2074-A10. C bend whisker compressed height.

A.1.8 Whisker weld to post. Any device that exhibits weld splash or splatter (teardrop or balled) between whisker and post shall be rejected when it exceeds 25 percent of nominal lead diameter. The profile of the whisker weld to post shall not allow light penetration by more than 50 percent of lead diameter when using back lighting techniques.

A.1.9 Die-to-post or die-to-die contact area. Solder shall not be rough in appearance and shall be fused to a minimum of one-half the available bonding perimeter. Any solder overflow that touches the opposite surface of the die or dice shall be cause for rejection.

A.1.10 Die alignment (see figure 2074-A11). A device shall be rejected if the die surface is not within 15 degrees of being normal to the centerline of the mounting post.

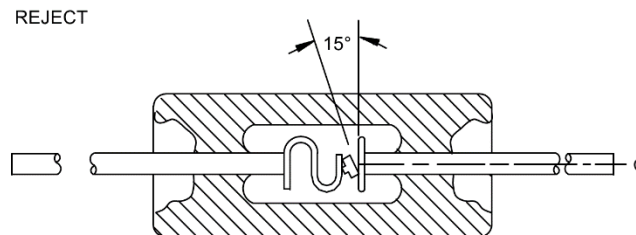


FIGURE 2074-A11. Die alignment.

A.1.11 Lead alignment defects (applicable to that portion of each lead within the glass envelope). A device lead which is either misaligned or bent so that it makes an angle with the principle device axis greater than 10 degrees shall be rejected.

A.1.12 Multiple die attachment defects. A multiple die stack that tilts more than 10 degrees from the principle axis of the device shall be cause for rejection.

GLASS BODY (TRANSPARENT), AXIAL LEAD, STRAIGHT THROUGH LEAD TO DIE CONTACT DESIGN

B.1 General. This appendix contains the acceptance criteria for devices of the axial lead, transparent body, straight through lead to die contact design (see figure 2074-B1). The following examinations shall be performed after encapsulation but before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

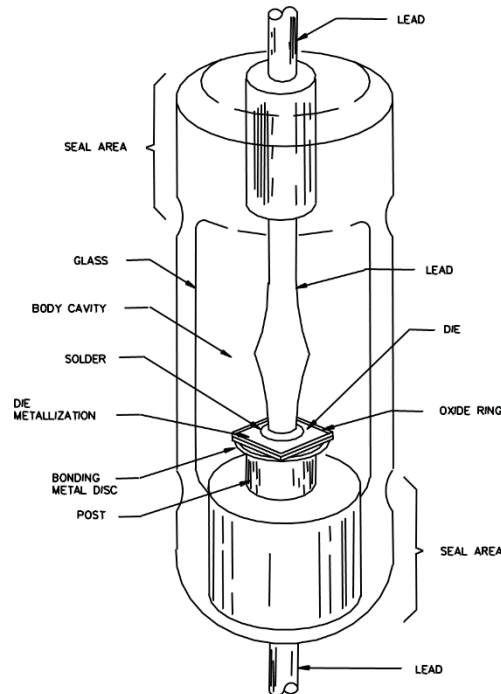


FIGURE 2074-B1. Straight through internal construction.

B.1.1 Glass cracks and chips (see [figure 2074-A1](#)). No cracks shall be allowed in the vicinity of the cavity. Any crack originating at either end of the package or crack that extends into the body of the glass toward the cavity more than 25 percent of the glass-to-glass or glass-to-metal seal length shall be cause for rejection. Any glass chip deep enough to expose the plug or lead surface and extending longitudinally into the glass-to-metal seal toward the cavity to reduce the effective seal length to less than one external lead diameter shall be cause for rejection.

B.1.2 Incomplete seal. All devices shall be inspected for glass-to-metal seal or glass-to-glass seal. Both seals shall be a minimum of one external lead diameter over the entire sealed portion (sealed interface).

B.1.3 Bubbles in seal. All devices shall be inspected for bubbles in the glass-to-metal or glass-to-glass seal. A series of bubbles that reduce the effective seal length to less than one external lead diameter shall be cause for rejection. Bubbles in the glass, but not affecting the glass-to-glass or glass-to-metal seal area, are not cause for rejection.

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APPENDIX B

B.1.4 Glass package deformities (see [figure 2074-A2](#)). Any glass envelope deformity equal to or greater than 75 percent of the external lead diameter shall be cause for rejection.

B.1.5 **Foreign material**. A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.

B.1.6 Die to post solder connection.

- a. Solder voids (see figure 2074-B2). A device shall be rejected if solder flow is less than 50 percent of the perimeter of the minimum available contact area of the post.

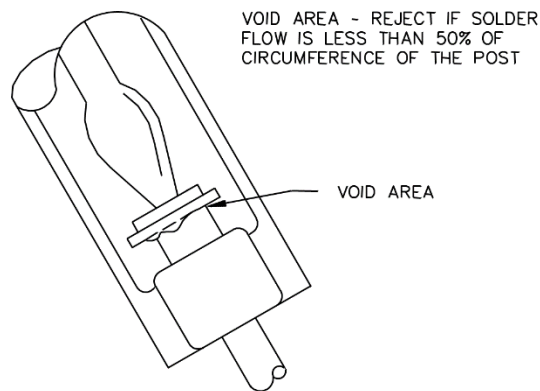


FIGURE 2074-B2. Solder voids.

- b. Solder overflow (see figure 2074-B3). A device shall be rejected if any solder flow touches the opposite surface of the die.

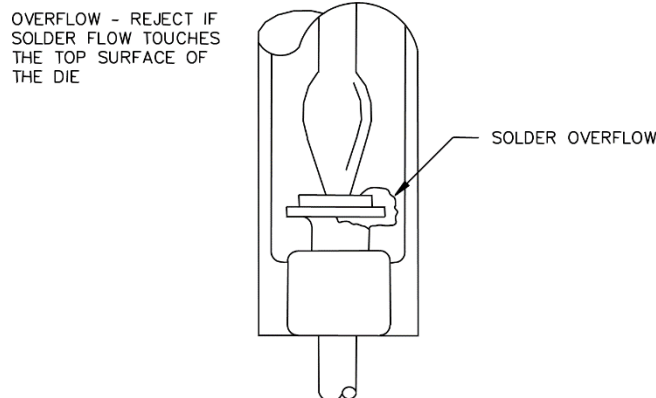


FIGURE 2074-B3. Solder bridge.

B.1.7 Lead to die solder connection (see figure 2074-B4). A device shall be rejected if more than 50 percent of the perimeter of the available contact area of the lead is void of solder.

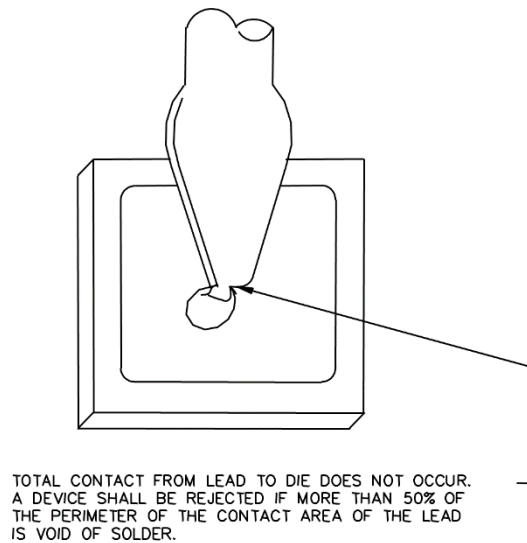


FIGURE 2074-B4. Lead to die solder voids.

- a. Solder overflow (see figure 2074-B5). A device shall be rejected if solder flow extends beyond 50 percent of the distance from the metal to the outer edge of the oxide.

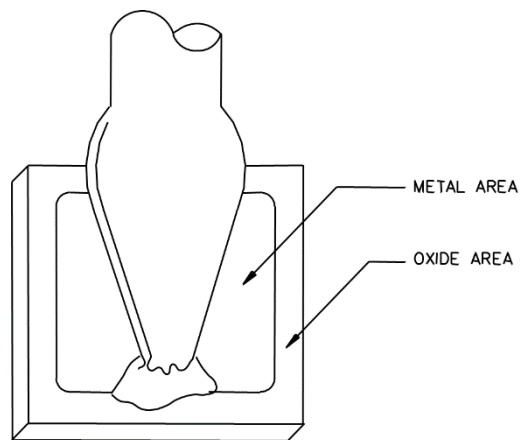


FIGURE 2074-B5. Solder overflow onto oxide area.

- b. Solder protrusion, slivers, and spikes (see figure 2074-B6). A device shall be rejected if solder slivers and spikes are not securely attached to the main body. A securely attached sliver or spike is one having a cross sectional area greater at the area of attachment than anywhere else on the solder protrusion and having no necked down areas. Solder protrusions, slivers, and spikes whose length exceeds twice the smallest width of attachment shall be rejected.

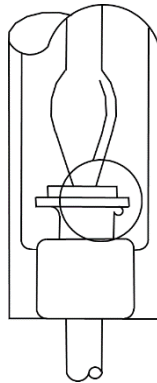


FIGURE 2074-B6. Solder slivers and spikes.

- c. Solder balls. A device shall be rejected if there are any insecurely attached solder balls. An insecurely attached solder ball is one whose major cross sectional area is more than twice the cross sectional area of the attachment.

B.1.8 Die-to-die solder connection (see figure 2074-B7). A device shall be rejected if more than 50 percent of the perimeter of the available contact area of the die is void of solder.

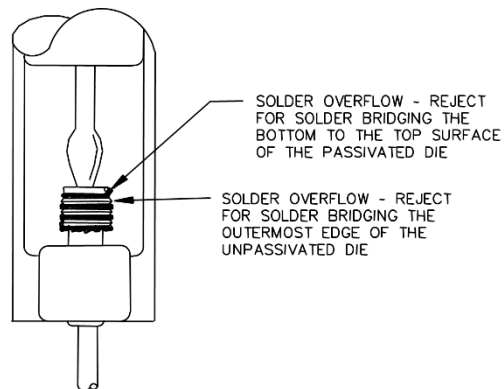


FIGURE 2074-B7. Die-to-die solder connection.

**GLASS BODY (TRANSPARENT), AXIAL LEAD AND SURFACE MOUNT, DOUBLE PLUG,
(DUMET PLUG, ROUND END-CAP, SOFT GLASS) DESIGN**

C.1 General. This appendix contains the acceptance criteria for devices of the transparent glass body, axial lead and surface mount, double plug, soft glass design. The following inspections shall be performed after encapsulation and before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

C.1.1 Glass cracking (see figure 2074-C1). Spiral or longitudinal cracks of any length originating at either end that propagate in the direction of the die are cause for rejection. Reject for cracks that are not confined to the glass surface or the outer 25 percent of the seal length. 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. Cracks confined to the outer 25 percent of the designed seal length that propagate back toward the starting edge (away from the die area) are acceptable.

REJECT: CRACKS NOT CONFINED TO SURFACE OR OUTER 25% OF SEAL LENGTH - "A"

REJECT: CRACKS OF ANY LENGTH THAT PROPAGATE TOWARD DIE - "B"

REJECT: SPIRAL CRACKS PROPAGATING TOWARD DIE - "C"

ACCEPT: SMALL C-CRACKS OR MICRO CRACKS IN GLASS SURFACE - "D"

ACCEPT: CRACKS IN OUTER 25% OF SEAL LENGTH THAT PROPAGATE AWAY FROM DIE - "E"

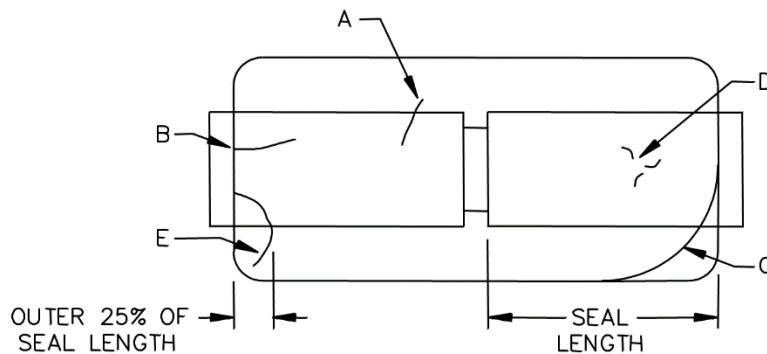


FIGURE 2074-C1. Glass cracks.

C.1.2 High seal (see figure 2074-C2). Any device which displays a glass case off center condition reducing the seal band of either plug by more than 25 percent of its designed length shall be cause for rejection.

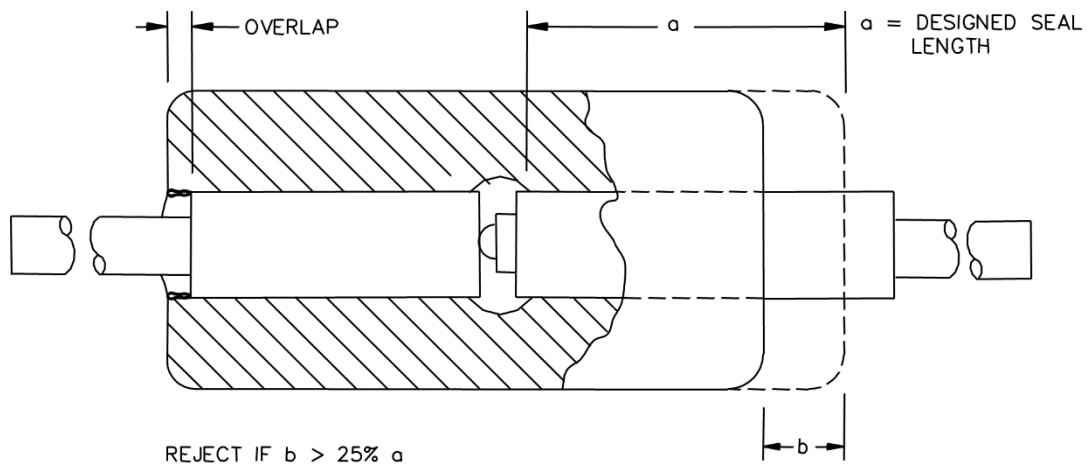
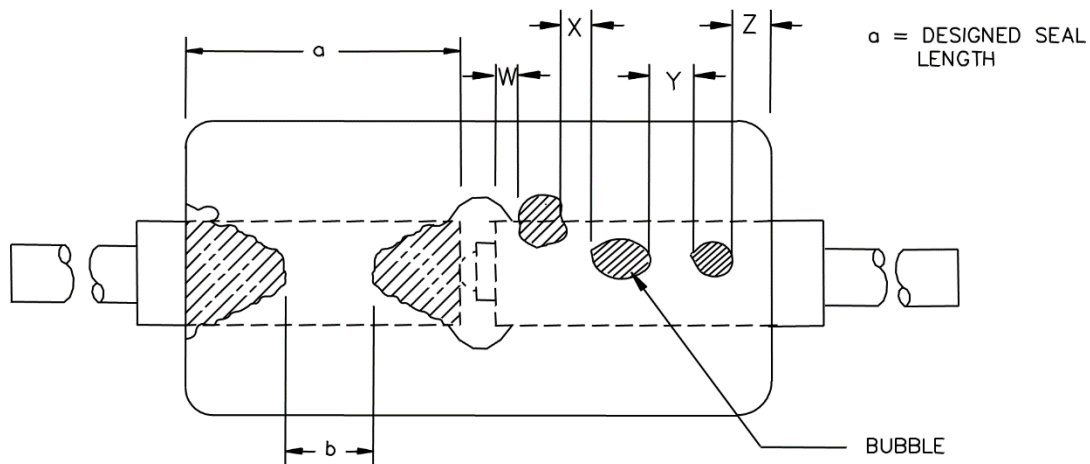


FIGURE 2074-C2. High seal.

C.1.3 Insufficient seal (see 2074-C3). Any anomaly such as bubbles, plug blisters, separations, leaching, or undersealing that affects the combined seal length of either plug by reducing the a sealing band to less than 50 percent of the designed seal length on any package type shall be cause for rejection.



REJECT IF $b < 50\% a$

REJECT IF $W + X + Y + Z < 50\% a$

FIGURE 2074-C3. Insufficient seal.

C.1.4 Plug alignment and displacement (see figure 2074-C4 and 2074-C5). A plug-to-plug displacement distance (offset) greater than 25 percent of the diameter of the plug shall be cause for rejection. The plug shall not tilt to the degree that it touches the chip or is misaligned from the other plug axis more than 5 degrees.

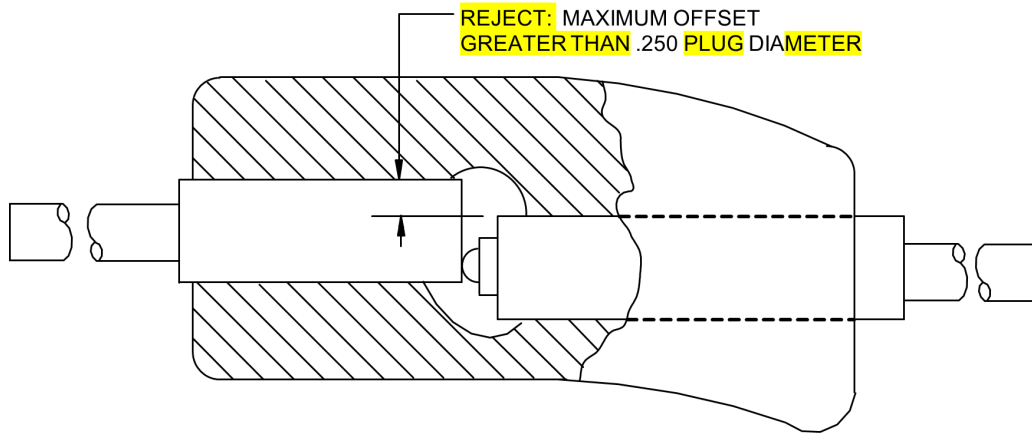


FIGURE 2074-C4. Plug-to-plug offset alignment.

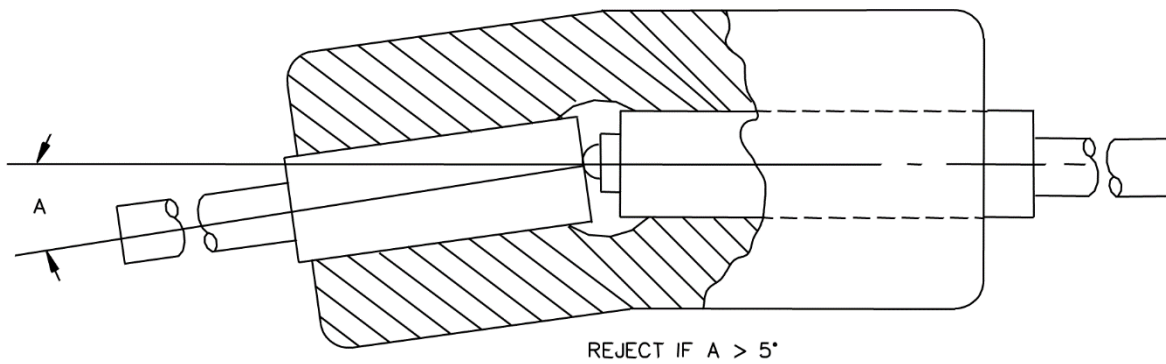


FIGURE 2074-C5. Plug tilt angle.

C.1.5 Foreign material. A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas (die cavity area). Extraneous materials between the glass seal and the plug is considered attached and shall not be cause for rejection.

C.1.6 Lead connections (see figure 2074-C6). Lead to plug connections shall be inspected for incomplete welds. Any partial welds less than 75 percent of total weld area shall be cause for rejection.

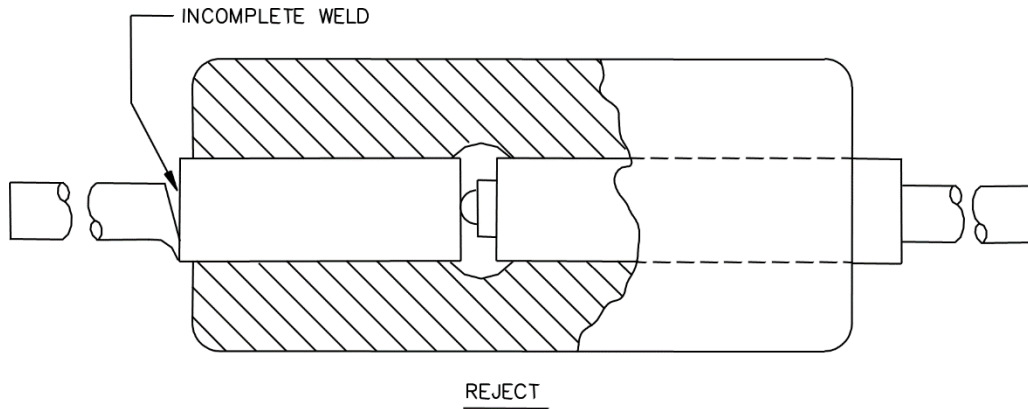


FIGURE 2074-C6. Incomplete weld.

C.1.7 Die defects. The following die defects shall be cause for rejection.

C.1.7.1 Tilt. Die tilt greater than 5 degrees, or **plug**, or preform makes contact to **die** on bump side.

C.1.7.2 Chipouts or cracks. Die chipouts or die cracks shall use the criteria detailed in **5.1** of this test method and figures 2074-1 and 2074-2.

C.1.8 Criteria for round end-cap surface mount devices. The following criteria shall apply for end-cap surface mount devices:

- Glass-to-metal seal shall be .015 inch (0.381 mm) **minimum** for DO-213AA and .020 inch (0.508 mm) **minimum** for DO-213AB, around the diameter of each **plug**.
- Plug** exposure shall not exceed 30 percent of the **plug** length .014 inch (0.3556 mm) min for DO-213AA and .022 inch (0.5588 mm) **minimum** for DO-213AB.
- There shall be no cracks in the device within .010 inch (0.254 mm) of the die.
- There shall be no cracks in the glass that are pointed towards the die.
- There shall be no conductive contaminants in the die cavity area.
- For plug alignment, including end-caps, see C.1.4.
- For end-cap connections, see C.1.6.

GLASS BODY (TRANSPARENT), AXIAL LEAD AND SURFACE MOUNT, DOUBLE PLUG, (TUNGSTEN OR MOLYBDENUM PLUG, SQUARE END-CAP, HARD GLASS) DESIGN

D.1 General. This appendix contains the acceptance criteria for devices of the transparent glass body, axial lead and surface mount, double plug, hard glass design. The following inspections shall be performed after encapsulation and before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

D.1.1 Glass.

- a. Cracks. No cracks allowed except cracks confined to the outer 25 percent of the designed seal length that propagate back toward the starting edge (away from the die area) are acceptable. 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.
- b. Chipouts (see figure 2074-D1). Edge chipouts that expose a plug and are not confined to the outer 25 percent of the designed seal length are cause for rejection. Edge chipouts (regardless of size) that expose a plug and create a sharp angle or "V" shape that points toward the die area are rejects.

REJECT: CHIPOUTS NOT CONFINED TO OUTER 25% OF SEAL LENGTH -

REJECT: CHIPOUTS OF ANY SIZE WITH SHARP POINT - "B"

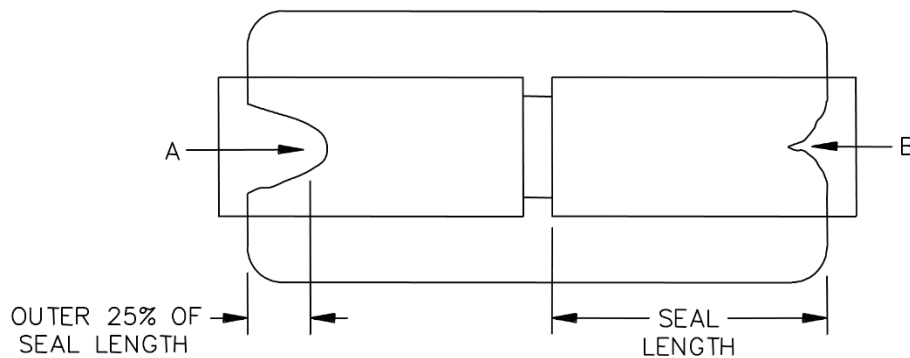


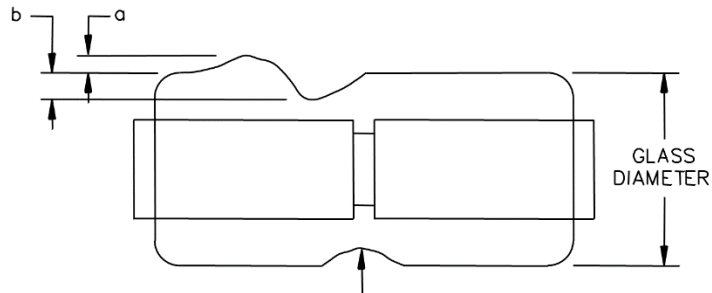
FIGURE 2074-D1. Chipouts.

- c. Holes. Any hole over the die or plug area greater than 50 percent of the glass thickness in depth is cause for rejection, except that holes of any depth are acceptable in the outer 25 percent of the designed seal length.
- d. Deformities (see figure 2074-D2). Any glass surface deformity that causes the glass surface to be displaced by more than 10 percent of the designed glass diameter, or that results in the device not meeting a dimensional requirement, is cause for rejection.

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APPENDIX D

REJECT: AMOUNT OF SURFACE GLASS DISPLACEMENT "a" OR "b FROM A DEFORMITY" IS $\geq 10\%$ OF DESIGNED GLASS DIAMETER



NOTE: INDENTATIONS AT CENTER OF DEVICE BY DESIGN ARE NOT CONSIDERED DEFORMITIES

FIGURE 2074-D2. Deformity.

- e. Surface damage and discoloration. Any device with surface abrasions, chips, scratches, rough or discolored (darkened) glass over the die area that result in the die not being clearly visible, is a reject. Using liquid immersion to improve die visibility is acceptable.

D.1.2 Seal.

- a. Glass positioning and missing glass (see figure 2074-D3). Off center glass and portions of missing glass that reduce the seal length on either plug by more than 25 percent of the designed seal length is cause for rejection.

REJECT: GLASS OFF CENTER AND/OR MISSING GLASS THAT REDUCES SEAL LENGTH BY $\geq 25\%$ - "A"

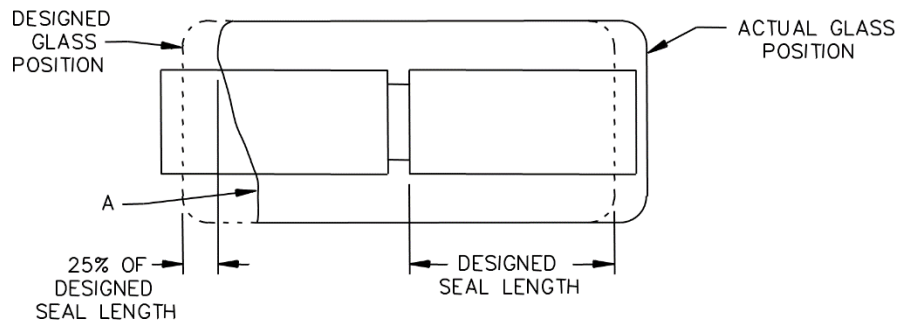


FIGURE 2074-D3. Positioning.

- b. Insufficient seal (see figure 2074–D4). Seal surface anomalies such as undercut, separations, plug blisters, scratches or cracks, bubbles, silicon chips, fibers, or missing plating which, when combined, reduce the sealing length along any linear path to less than 50 percent of the designed seal length are cause for rejection.

NOTE: Lines or "strings" of small bubbles are considered to be seal anomalies for the entire length of the line.

REJECT: SEAL LENGTH "a" REDUCED TO $\leq 50\%$ OF DESIGNED SEAL LENGTH

REJECT: COMBINED SEAL LENGTHS "x"+"y"+"z" ALONG ANY LINE $\leq 50\%$ OF DESIGNED SEAL LENGTH

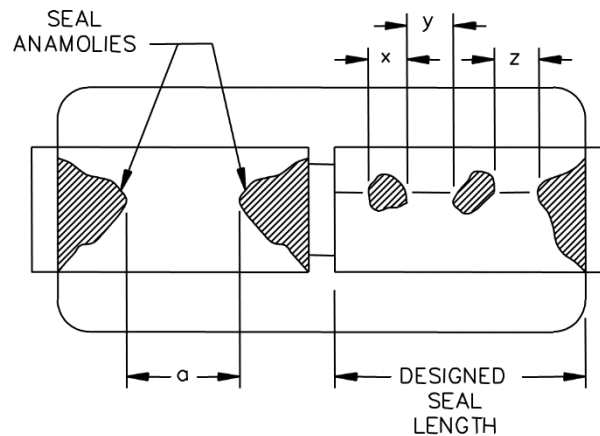


FIGURE 2074–D4. Insufficient seal.

- c. **Foreign material.** A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas (die cavity area). Extraneous materials between the glass seal and the **plug** are considered attached and shall not be cause for rejection.

D.1.3 Alignment. NOTE: Any die to plug non-contact that occurs as a result of die or plug misalignment is most accurately evaluated by thermal impedance testing. In cases where pass/fail status of a device is unclear based on the alignment requirements presented herein, thermal impedance testing may be used to determine the acceptability of the device.

- a. Die alignment. Any die that tilts more than 5 degrees with respect to the surface of either plug or that tilts sufficiently to make any unintended contact with the plug is cause for rejection (see figure 2074–D5). Any die that is out of axial alignment such that it extends beyond the **plug** more than 20 percent of its length or width is cause for rejection (see figure 2074–D6).

REJECT: DIE TILT "A" $> 5^\circ$

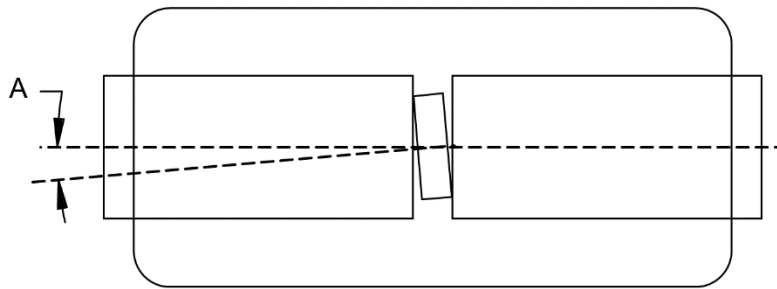


FIGURE 2074-D5. Die tilt.

REJECT: LENGTH OF DIE NON-CONTACT "a" $\geq 20\%$ OF DIE LENGTH

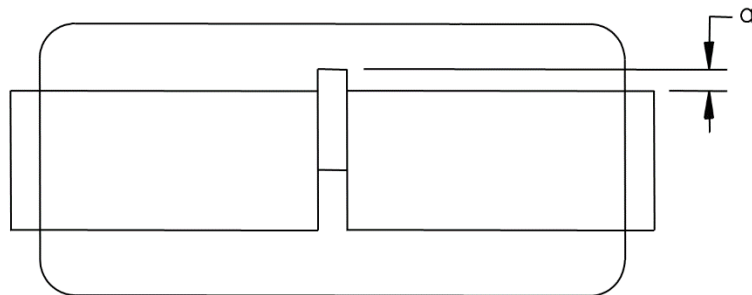


FIGURE 2074-D6. Die non-contract.

- b. Plug alignment. A plug-to-plug displacement distance (offset) greater than 12.5 percent of the diameter of the plug shall be cause for rejection (see figure 2074-D7). Any plug that tilts more than 5 degrees with respect to the other or that tilts sufficiently to make any unintended contact with the die is cause for rejection (see figure 2074-D8).

REJECT: PLUG OFFSET "A" IS GREATER THAN 12.5% OF PLUG DIAMETER

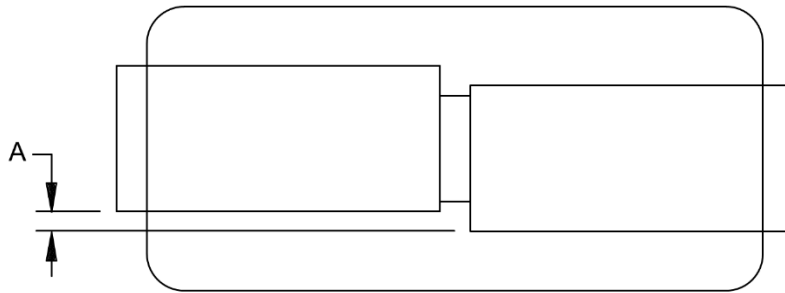


FIGURE 2074-D7. Plug-to-plug offset alignment.

REJECT: PLUG TILT ANGLE "α" IS $\geq 5^\circ$

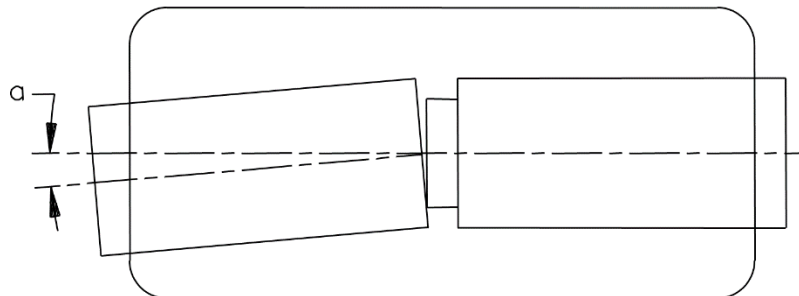


FIGURE 2074-D8. Plug tilt angle.

D.1.4 Lead and end-cap attach.

- a. Lead alignment (lead devices). Leads that are not axially aligned to within one lead diameter, or leads that are not contained completely within the diameter of the plug, are cause for rejection (see [figure 2074-D9](#)).

REJECT: LEAD OFFSET "a" IS GREATER THAN ONE LEAD DIAMETER
 REJECT: LEAD IS NOT COMPLETELY CONTAINED WITHIN PLUG DIAMETER "B"

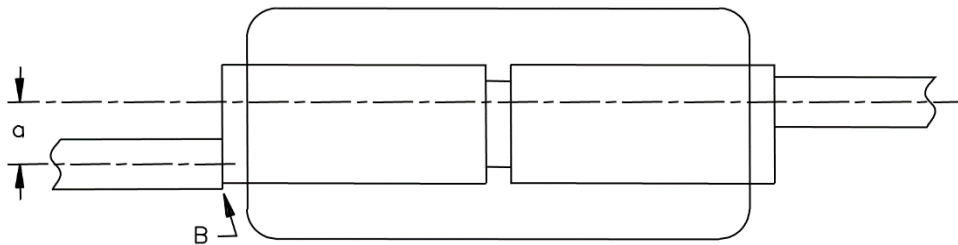


FIGURE 2074-D9. Lead offset.

- b. Braze. Terminals that are not brazed to the plug around at least 90 percent of the terminal perimeter are cause for rejection. Any cracks or fissures in the braze are cause for rejection. Pin holes in the braze are acceptable.
- c. End-caps (surface mount). Reject for end-caps that do not allow at least **.003 inch** (0.076 mm) clearance from the glass body to the mounting surface on all four sides (see [figure 2074-D10](#)). Reject for end-caps that are not perpendicular to the plugs to within 5 degrees (see [figure 2074-D11](#)). Reject for end-caps that are bent sufficiently to cause the device to exceed any specified diode or end-cap dimension (see [figure 2074-D12](#)). Reject for end-cap rotation where mounting surfaces are not co-planar to each other to within 5 degrees (see [figure 2074-D13](#)). Reject for tabs that have indentations, holes, or other damage affecting more than 25 percent of any mounting surface (see [figure 2074-D14](#)). Reject for end-caps that exhibit flaking, blistering, or peeling.

REJECT: GLASS BODY TO END CAP CLEARANCE "A" IS $\leq$.003 INCH (0.076 mm)

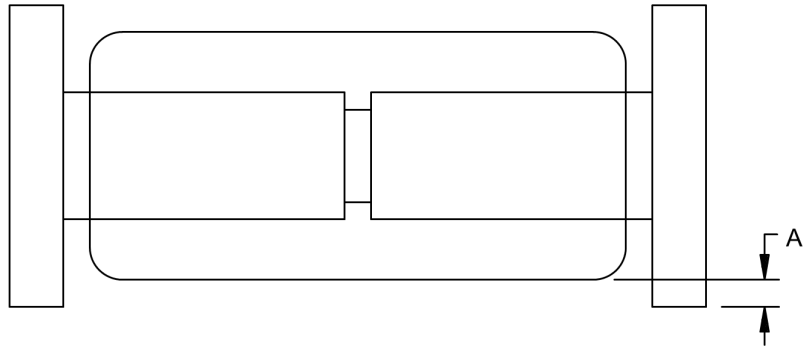


FIGURE 2074-D10. End-cap clearance.

REJECT: END CAP TILT "α" IS $\geq 5^\circ$

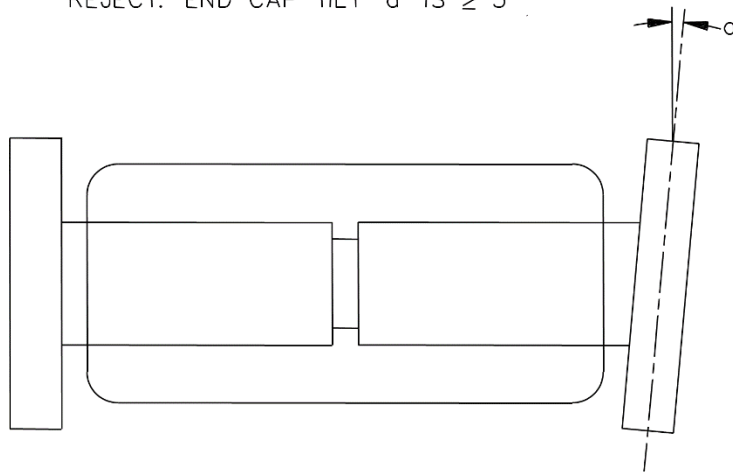


FIGURE 2074-D11. End-cap tilt.

REJECT: DEVICE WITH END CAP DEFORMATION THAT
EXCEEDS ANY SPEIFIED DEMENSION - "A"

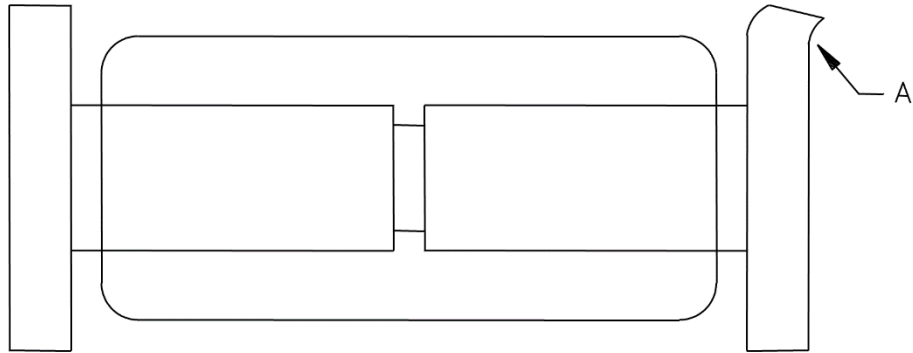


FIGURE 2074-D12. End-cap deformation.

REJECT: END CAP ROTATION " α " $\geq 5^\circ$

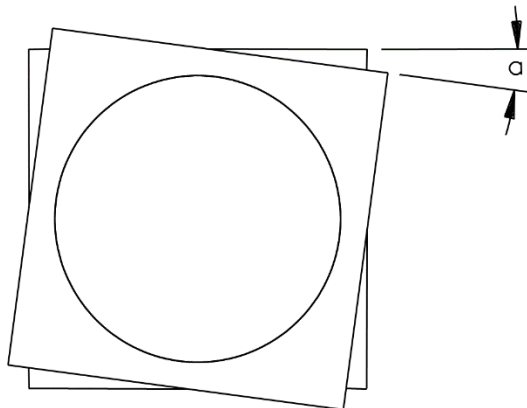


FIGURE 2074-D13. End-cap rotation.

REJECT: ANY MOUNTING SURFACE REDUCED TO $\leq 75\%$
OF IT'S DESIGNED AREA DUE TO NICKS("A"), PITS("B"), ECT.

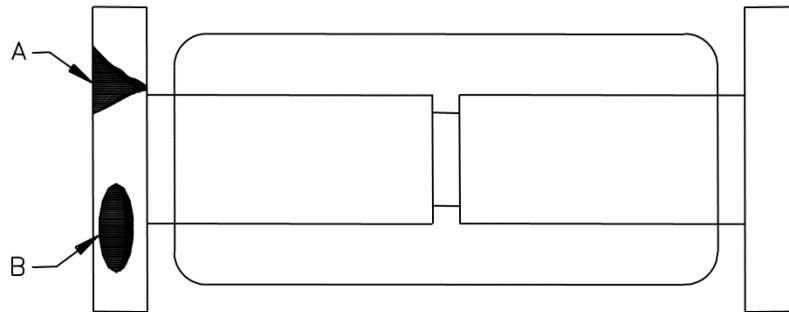


FIGURE 2074-D14. Mounting surface nicks and pits.

D.1.5 Die defects.

- a. Chipouts or cracks. Die chipouts or die cracks shall use the criteria detailed in paragraph 5.1 of this test method and figures 2074-1 and 2074-2.
- b. Conductive contaminants. There shall be no conductive contaminants in the die cavity area.

GLASS BODY (TRANSPARENT), AXIAL LEAD, POINT CONTACT DESIGN

E.1 **General.** This appendix contains the acceptance criteria for devices of the transparent glass body, axial lead, point contact design. The following examinations shall be made after encapsulation but before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

E.1.1 **Glass cracks and chips** (see figure 2074-A1). No cracks shall be allowed in the vicinity of the cavity. Any crack originating at either end of the package or crack that extends into the body of the glass toward the cavity more than 25 percent of the glass-to-glass or glass-to-metal seal length shall be cause for rejection. Any glass chip deep enough to expose the plug or lead surface and extending longitudinally into the glass-to-metal seal toward the cavity to reduce the effective seal length to less than one external lead diameter shall be cause for rejection.

E.1.2 **Incomplete seal.** All devices shall be inspected for glass-to-metal seal or glass-to-glass seal. Both seals shall be a minimum of one external lead diameter over the entire sealed portion (sealed interface).

E.1.3 **Bubbles in seal.** All devices shall be inspected for bubbles in the glass-to-metal or glass-to-glass seal. A series of bubbles that reduce the effective seal length to less than one external lead diameter shall be cause for rejection. Bubbles in the glass, but not effecting the glass-to-glass or glass-to-metal seal area, are not cause for rejection.

E.1.4 **Glass package deformities** (see figure 2074-A2). Any glass envelope deformity equal to or greater than 75 percent of the external lead diameter shall be cause for rejection.

E.1.5 **Foreign material.** A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.

E.1.6 **Pressure contact defects.** The following misalignments or deformities shall be cause for rejection.

- a. Whisker touches glass body wall (see figure 2074-E1).

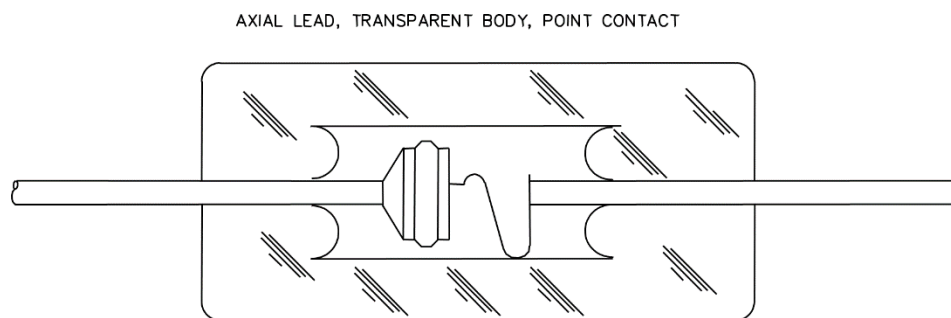


FIGURE 2074-E1. Whisker touches glass body wall (reject).

- b. Whisker loops touch one another (see figure 2074-E2).

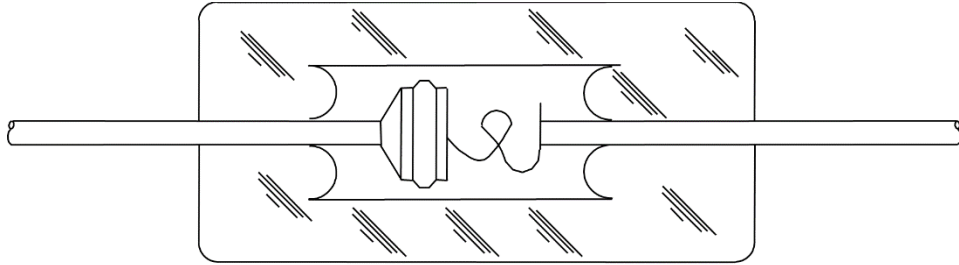


FIGURE 2074-E2. Whisker loops touch one another (reject).

- c. Whisker angle over 10 degrees from normal (see figure 2074-E3).

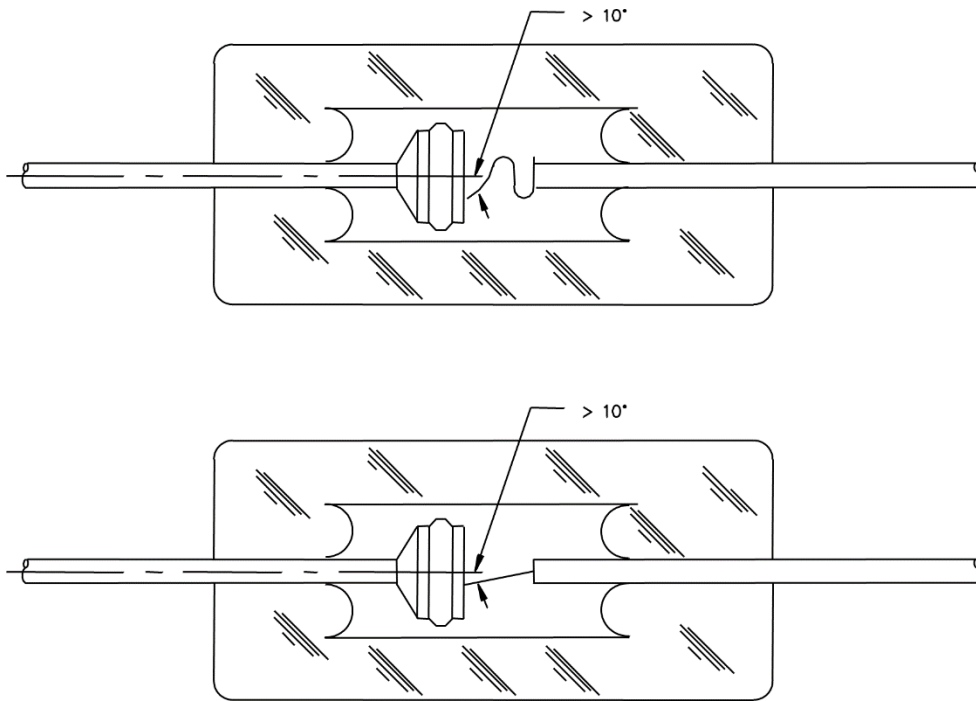


FIGURE 2074-E3. Whisker angle over 10 degrees from normal (reject).

E.1.7 Whisker weld to post. Any device that exhibits weld splash or splatter (tear dropped or balled) between whisker and post shall be rejected when it exceeds 25 percent of nominal lead diameter. The profile of whisker weld to the post shall not allow light penetration by more than 50 percent of lead diameter when using back lighting techniques.

E.1.8 Solder voids. A device shall be rejected if solder flow is less than 50 percent of the perimeter of the minimum available contact area of the die.

E.1.9 Die to post contact area. Solder shall be smoothly formed from one element to another and shall be fused to a minimum of one-half the available bonding area. Any solder overflow that touches the opposite surface of the die shall be cause for rejection.

E.1.10 Die alignment. A device shall be rejected if the die surface is not within 15 degrees of being normal to the centerline of the mounting post.

E.1.11 Lead alignment defects (applicable to that portion of each lead within the glass envelope). A device whose lead is either misaligned or bent so that it makes an angle with the principle device axis greater than 10 degrees shall be rejected.

E.12 Die touches glass package (see figure 2074-E4). A device shall be rejected if the die touches the glass envelope.

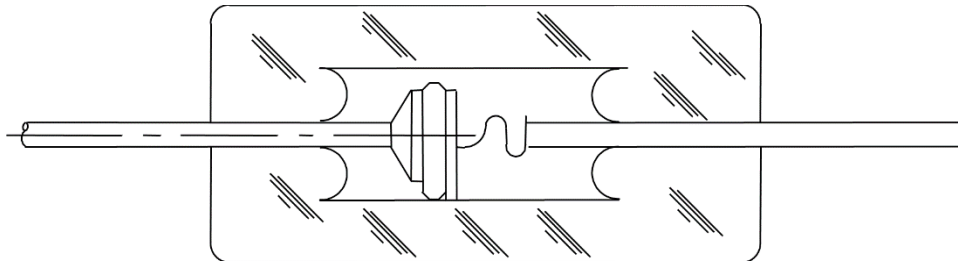


FIGURE 2074-E4. Die touches glass package (reject).

GLASS BODY (OPAQUE), AXIAL LEAD AND SURFACE MOUNT, DOUBLE PLUG
(POWER RECTIFIER AND REGULATOR) DESIGN

F.1 General. This appendix contains the acceptance criteria for the opaque glass body, axial lead and surface mount, double plug design used for power rectifier and regulator devices. The die related examinations shall be performed before encapsulation and remaining examinations shall be made after encapsulation but before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

F.1.1 Die mounting and alignment. After bonding die to the heat sink, plugs, or leads, the following shall be inspected for defects.

- a. Die geometry. A die shall be rejected if it is chipped or broken to the extent that 75 percent or less of the original surface remains.
- b. Plug alignment. A plug-to-plug displacement distance (offset) greater than 25 percent of the diameter of the plug shall be cause for rejection.
- c. Tilted die. A device shall be rejected if the die is tilted so that the die surface is greater than 5 degrees from being perpendicular to the mounting post axis.

F.1.2 Die cracks. Any die exhibiting cracks that reduce the total die area (or cracks extending into or across the junction area) to less than 75 percent of its original area shall be cause for rejection.

F.1.3 Braze (leaded and surface mount devices). Terminals that are not brazed to the plug around at least 90 percent of the lead perimeter are cause for rejection. When surface mount terminals are brazed to the lead shaft, the minimum 90 percent visual criteria applies to the outer face of the end cap. Any cracks or fissures in the braze are cause for rejection. Pin holes in the braze are acceptable.

F.1.4 Flaking or loose material. No unattached solder, braze, or other bonding material shall extend from the plugs. Any blistering or peeling of plug surface shall be cause for rejection.

F.1.5 Foreign material. A device shall be rejected if there is any extraneous, particulate matter between the terminal plugs or on the plug surface. No foreign stains shall be permitted on plug surfaces.

METAL BODY, AXIAL LEAD, SOLDER CONTACT DESIGN

G.1. General. This appendix contains the acceptance criteria for devices of the metal body, axial lead, solder contact design. The following inspections shall be made prior to capping. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

G.1.1 Examinations before capping.

- a. Solder defects (see figures 2074-G1 and 2074-G2). Any device with a solder protrusion that extends more than twice the smallest protrusion width shall be rejected. Solder shall be smoothly formed from one element to another and shall be fused to a minimum of 50 percent of the perimeter between adjacent elements.

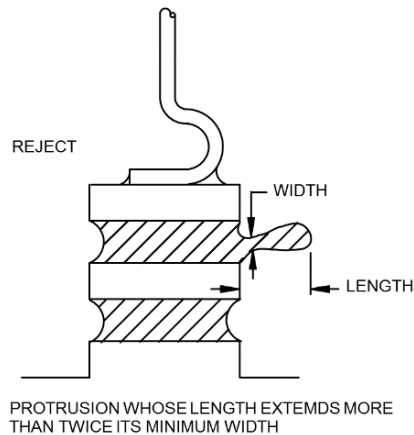


FIGURE 2074-G1. Solder protrusion.

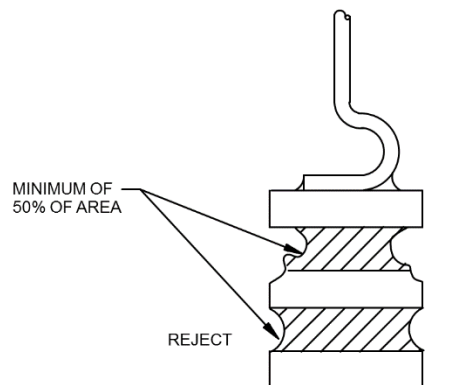


FIGURE 2074-G2. Solder flow.

- b. Alignment (see figure 2074-G3). Any device whose element has its geometric center displaced more than 33 percent of its width from the die, or die stack centerline, shall be rejected.
- c. Tilt (see figure 2074-G4). Any element of a device that is tilted more than 10 degrees from the mounting plane shall be cause for rejection.

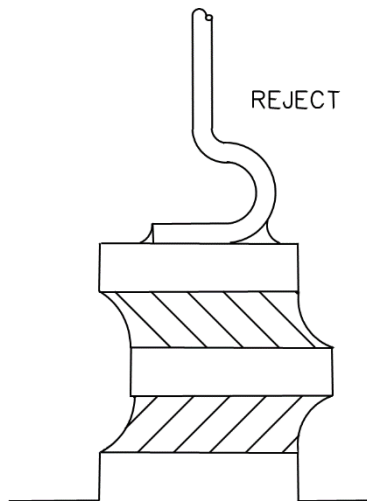


FIGURE 2074-G3. Element alignment.

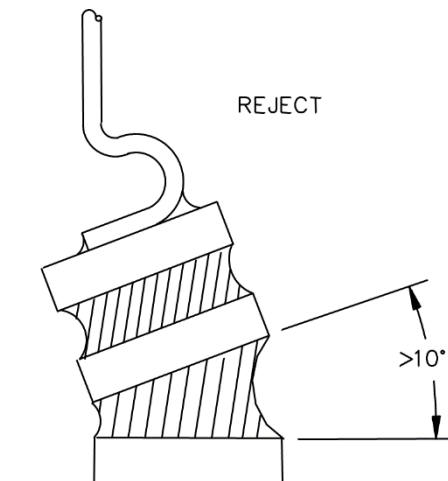


FIGURE 2074-G4. Element tilt.

- d. Die chipouts (see figure 2074-G5). Any device die that exhibits chipouts extending more than 25 percent of the die width or to within .002 inch (0.051 mm) of the junction area shall be cause for rejection.
- e. Die cracks (see figure 2074-G6). Any die exhibiting cracks that reduce the total die area (or cracks extending into or across the junction area) to less than 75 percent of its original area shall be cause for rejection.

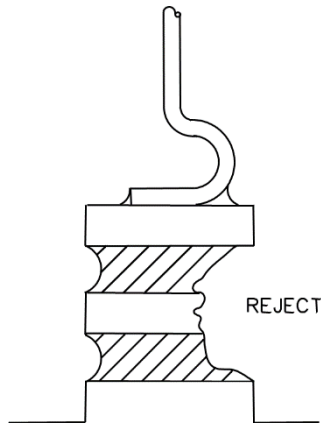


FIGURE 2074-G5. Die chipout.

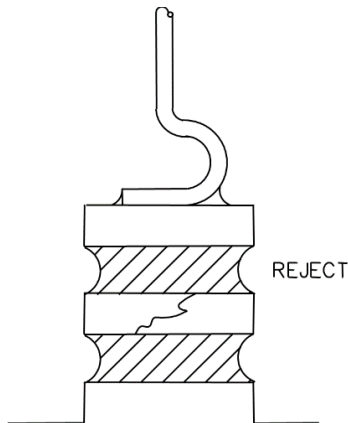


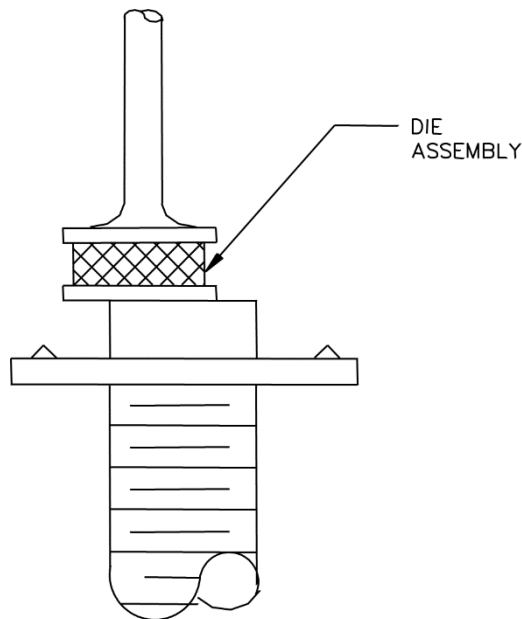
FIGURE 2074-G6. Die cracks.

- f. **Foreign material.** A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.

METAL BODY, STUD MOUNTED, SOLDER CONTACT DESIGN

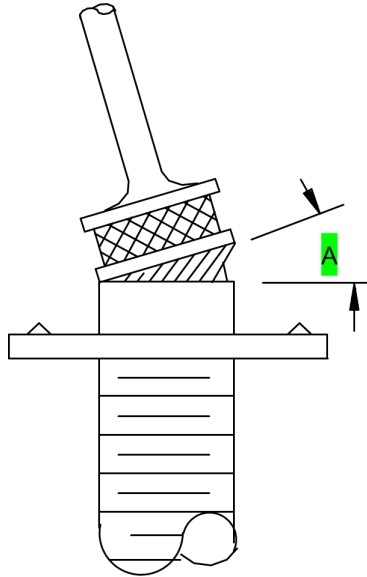
H.1 General. This appendix contains the acceptance criteria for devices of the metal body, stud mounted, solder contact design. The following inspections shall be made prior to capping. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

H.1.1 Die and lead assembly (see figures 2074-H1 and 2074-H2). The die and lead assembly shall be located on the base pedestal so that there is complete contact over the design contact area. The lead shall be free of nicks and scrapes that reduce the lead diameter by more than 5 percent. The die and lead assembly shall not be tilted more than 5 degrees with respect to the base.



DIE NOT CENTRALLY LOCATED

FIGURE 2074-H1. Offset die.



NOTE: Reject when angle A is greater than or equal to 5 degrees.

FIGURE 2074-H2. Tilted die and lead assembly.

H.1.2 Extraneous matter.

- a. Solder slivers and spikes. A device shall be rejected if solder slivers and spikes are not securely attached to the parent body of the solder. A securely attached sliver or spike is one having a cross sectional area greater at the area of attachment than anywhere else on the solder protrusion and having no necked-down areas.
- b. Foreign material. A device shall be rejected if there are unattached solder balls, semiconductor materials, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.
- c. Multiple die attachments. A device shall be rejected if the attached portion of an adjacent die exceeds 25 percent of the die area.

H.1.3 Assembly defects.

- a. Tilted elements. A device shall be rejected if any element of the assembly is tilted in excess of 10 degrees from the normal mounting plane.
- b. Misaligned elements. A device shall be rejected if any element of the assembly is misaligned or displaced in excess of 33 percent of its width from the die or die stack centerline, bridges two active regions, or extends beyond the isolation region of the oxide.

METAL BODY, DIAMOND BASE CASE MOUNT, SOLDER CONTACT DESIGN

I.1 General. This appendix contains the acceptance criteria for devices of the metal body, diamond base case mount, solder contact design (see figure 2074-I1). The following inspections shall be made prior to capping. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

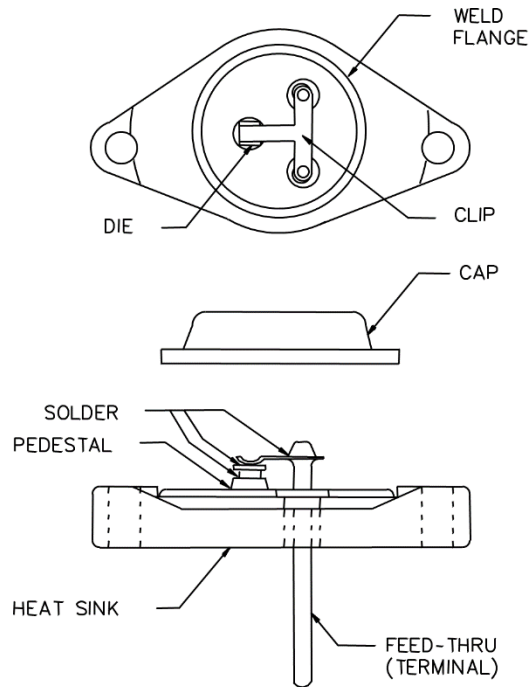


FIGURE 2074-I1. Metal body, diamond base case mount, solder contact construction.

I.1.1 Die-to-pedestal and die-to-clip solder connections.

- a. Solder voids. A device shall be rejected if solder flow is less than 50 percent of the perimeter of the minimum available contact area.
- b. Solder overflow. A device shall be rejected if any solder flow bridges from the top to bottom surface of the die or reduces the normal separation of two active regions by 50 percent or more.

I.1.2 Clip-to-post and feed-through to heat sink solder connections.

- a. Solder voids. A device shall be rejected if the wetting action of the solder to each member of the connection is not continuous.
- b. Solder overflow. A device shall be rejected if any solder flow extends on to any portion of the weld flange of the heat sink.

KEY to modifications:

Modification included in the initial draft: New text is **black with yellow highlighting**. Deleted text is ~~red with strikeout~~.

Modification as a result of comments to the initial draft: New text is **black with green highlighting**. Deleted text is ~~red with strikeout w/green highlighting~~.

METHOD 2074.6 7

INTERNAL VISUAL INSPECTION (DISCRETE SEMICONDUCTOR DIODES)

1. Purpose. The purpose of this test method is to ~~check~~ **verify that** the **internal** materials, design, construction, and workmanship of discrete semiconductor diodes and other two-terminal semiconductor devices (hereafter referred to as "device") are in compliance with the requirements described herein **and the applicable acquisition document**.

1.1 Application. All examinations and inspections shall be performed to ~~detect~~ **identify** and ~~eliminate~~ **reject** those devices with defects that could lead to device failures. **The following details apply:**

- a. Opaque glass ~~type~~ construction devices shall be examined before encapsulation. ~~(After encapsulation, see the requirements of test method 2068 of this standard apply).~~
- b. Metal can **construction** devices using **soldered contact style construction** (e.g. DO, TO, etc.) shall be examined before capping **or sealing**. ~~(After capping or sealing, see test method 2074 of this standard).~~
- c. ~~Clear~~ **Transparent** glass construction devices shall be examined after encapsulation.
- d. Internal cavity construction devices using bonded wire or ribbon style construction (e.g. DIP, LCC, UB, etc.) are inspected to the requirements of **test method 2078**.

1.2 Exclusions and limitations. The inspections of this test method excludes microwave and RF devices.

2. Apparatus. ~~a. The apparatus for these inspections shall include~~ **this test method shall consist of the following.**

- a. ~~b.~~ **Optical equipment** (a monocular, binocular, or stereo microscope) capable of **the specified** magnification. ~~from 20X minimum to 30X maximum, shall be used unless otherwise specified. The inspection shall be performed under suitable illumination.~~
- b. **Light sources** of sufficient intensity to adequately illuminate the devices being inspected.
- c. ~~a.~~ **Adequate necessary** fixturing for handling **the** devices during examination to promote efficient operation without **causing contamination or damage** ~~damaging the units shall be provided.~~
- d. **Adequate covered storage and transportation containers** to protect devices from mechanical damage and environmental contamination.
- e. ~~a.~~ ~~and any~~ **Visual standards** (e.g., gauges, drawings, photographs) necessary to perform an effective examination and enable the ~~operator~~ **inspector** to make objective decisions ~~on~~ **as to** the acceptability of the devices being examined.

3. Definitions. The following definitions shall apply:

3.1 Controlled environment. A controlled environment is an environment which controls airborne particle count and relative humidity.

3.2 Examples of foreign material. Examples of terms used to describe foreign material that are used in this test method include the following: chips, conductive contaminants, extraneous matter, flaked plating, foreign matter, foreign stains, opaque material, particulate matter, semiconductor material, and unattached solder balls.

4. General requirements.

4.1 ~~3.~~ Procedure.

4.1.1 **General.** The devices or die shall be examined in a suitable sequence of operations and at the specified magnifications to determine compliance with the requirements of the applicable acquisition document sections and the criteria specified herein and in the appendices of this test method based on device design and construction.

4.1.2 **Sequence of inspection.** The order in which acceptability criteria are presented herein is not a required order of examination and may be varied at the discretion of the manufacturer. The following details apply:

- a. Examinations for transparent glass body devices may be performed anytime prior to body coating or painting.
- b. Axial construction devices shall be viewed at approximate right angles to their major axis while being rotated through 360 degrees.

4.2 **Control of environment.** Within ~~For~~ the time interval, if any, between visual inspection and package sealing, devices shall be stored, handled, and processed ~~in a manner~~ in a controlled environment to avoid contamination and in a manner to preserve the integrity of the devices as inspected. The use of an inert gas environment, such as dry nitrogen, shall satisfy the requirements for storing in a controlled environment.

4.3 **Magnification.** Unless otherwise specified, examinations shall be performed at magnification ranges between 20X minimum and 30X maximum.

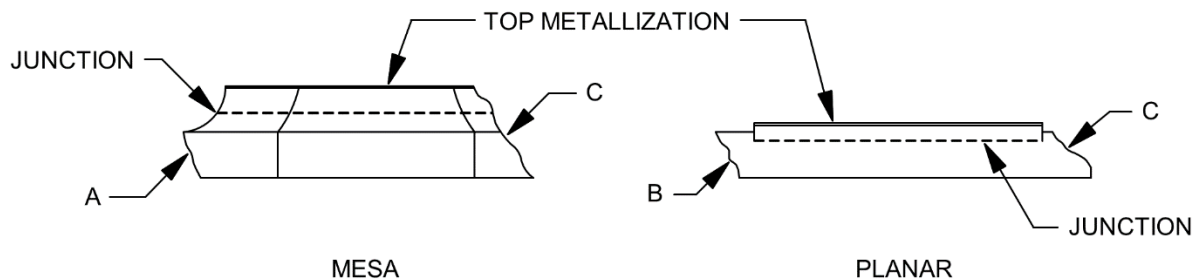
4.4 **Illumination.** The visual inspection shall be performed under suitable illumination.

5. Detailed requirements.

5.1 **Examinations of die for acceptability (accept and reject criteria).** ~~3.1 Die criteria (applicable to all body styles).~~ The following die criteria are applicable to the die of all body styles (see 5.2) listed herein. Any die that exhibits any of the following defects shall be rejected.

- a. Chipouts (see figure 2074-1). Reject die for chipouts that extend more than 50 percent of the way up the moat area (mesa devices) or that extend to within ~~2.0 mils~~ .002 inch (0.051 mm) of the junction.

NOTE: Actual junction location will vary depending on specific ~~device~~ die characteristics.



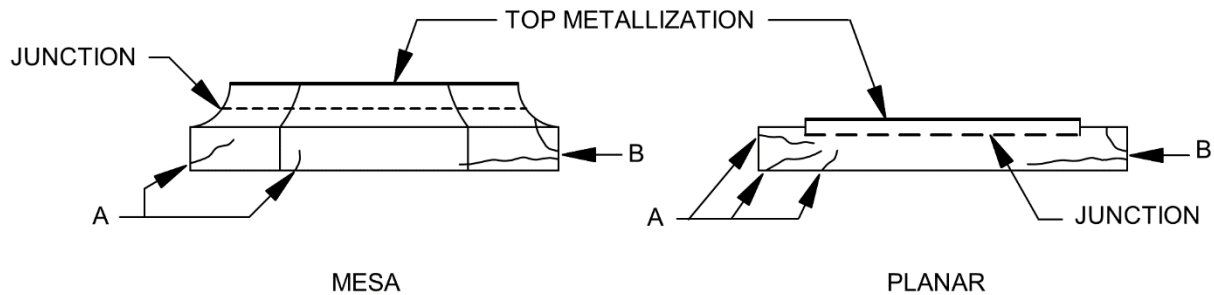
Accept: "A" chipouts $\leq$ 50 percent up moat and $\geq$ ~~2 mils~~ .002 inch (0.051 mm) from junction. ~~—"A"~~
 Accept: "B" chipouts $\geq$ ~~2 mils~~ .002 inch (0.051 mm) from junction. ~~—"B"~~
 Reject: "C" chipouts $\leq$ ~~2 mils~~ .002 inch (0.051 mm) from junction. ~~—"C"~~

FIGURE 2074-1. Die chipouts.

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- b. Cracks (see figure 2074-2). Reject **die** for cracks that extend to within **2.0 mils .002 inch** (0.051 mm) of the junction or propagate in the direction of the junction.

NOTE: The junction may be in a different place than shown depending on specific **device die** characteristics.



Reject: **"A"** Cracks $\leq$ **2-mils .002 inch** (0.051 mm) from junction or propagating toward junction. **—"A"**
 Accept: **"B"** Cracks $\geq$ **2-mils .002 inch** (0.051 mm) from junction and propagating away from junction. **—"B"**

FIGURE 2074-2. Die cracks.

5.2 3.2 Applicable body styles. The devices shall be examined in accordance with the following appendixes as applicable for the **design and construction of the** body style involved.

- Appendix A:** **Glass body (transparent),** axial lead, **transparent body,** pressure contact design.
- Appendix B:** **Glass body (transparent),** axial lead, **transparent body,** straight through lead to die contact design.
- Appendix C:** **Glass body (transparent),** axial lead and surface mount, double plug, **transparent body** (Dumet plug, round end-cap, soft glass) **design.**
- Appendix D:** **Glass body (transparent),** axial lead and surface mount, double plug, **transparent body** (tungsten or molybdenum plug, square end-cap, hard glass) **design.**
- Appendix E:** **Glass body (transparent),** axial lead, **transparent body,** point contact **design.**
- Appendix F:** **Glass body (opaque),** axial lead **and surface mount,** double plug, **opaque body,** (power rectifier and regulator) **design.**
- Appendix G:** Metal body, axial lead, solder contact design.
- Appendix H:** Metal body, stud mounted, solder contact design.
- Appendix I:** Metal body, diamond base regulators, solder contact design.

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

- Detailed requirements for materials, design, construction, and workmanship.
- Magnification requirements, if other than specified herein.

GLASS BODY (TRANSPARENT), AXIAL LEAD, ~~TRANSPARENT BODY~~, PRESSURE CONTACT DESIGN

A.1 General. This appendix contains the acceptance criteria for devices of the transparent glass body, axial lead, pressure contact connection (C and S bend whisker) design. The following examinations shall be made after encapsulation (~~C and S bend whisker~~). This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

A.1.1 Glass cracks and chips (see figure 2074-A1). No cracks shall be allowed in the vicinity of the cavity. Any crack originating at either end of the package or crack that extends into the body of the glass toward the cavity more than 25 percent of the glass-to-glass or glass-to-metal seal length shall be cause for rejection. Any glass chip deep enough to expose the plug or lead surface and extending longitudinally into the glass-to-metal seal toward the cavity to reduce the effective seal length to less than one external lead diameter shall be cause for rejection.

A.1.2 Incomplete seal. All devices shall be inspected for glass-to-metal seal or glass-to-glass seal. Both seals shall be a minimum of one external lead diameter over the entire sealed portion (sealed interface).

A.1.3 Bubbles in seal. All devices shall be inspected for bubbles in the glass-to-metal or glass-to-glass seal. A series of bubbles that reduce the effective seal length to less than one external lead diameter shall be cause for rejection. Bubbles in the glass, but not affecting the glass-to-glass or glass-to-metal seal area, are not cause for rejection.

A.1.4 Glass package deformities (see figure 2074-A2). Any glass envelope deformity equal to or greater than 75 percent of the external lead diameter shall be cause for rejection.

A.1.5 ~~Extraneous matter~~ Foreign material. A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.

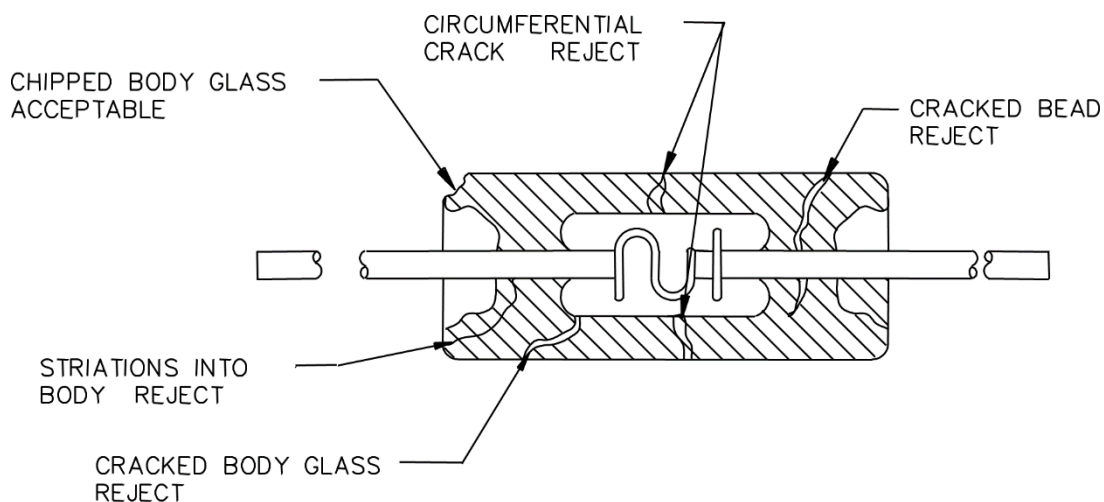
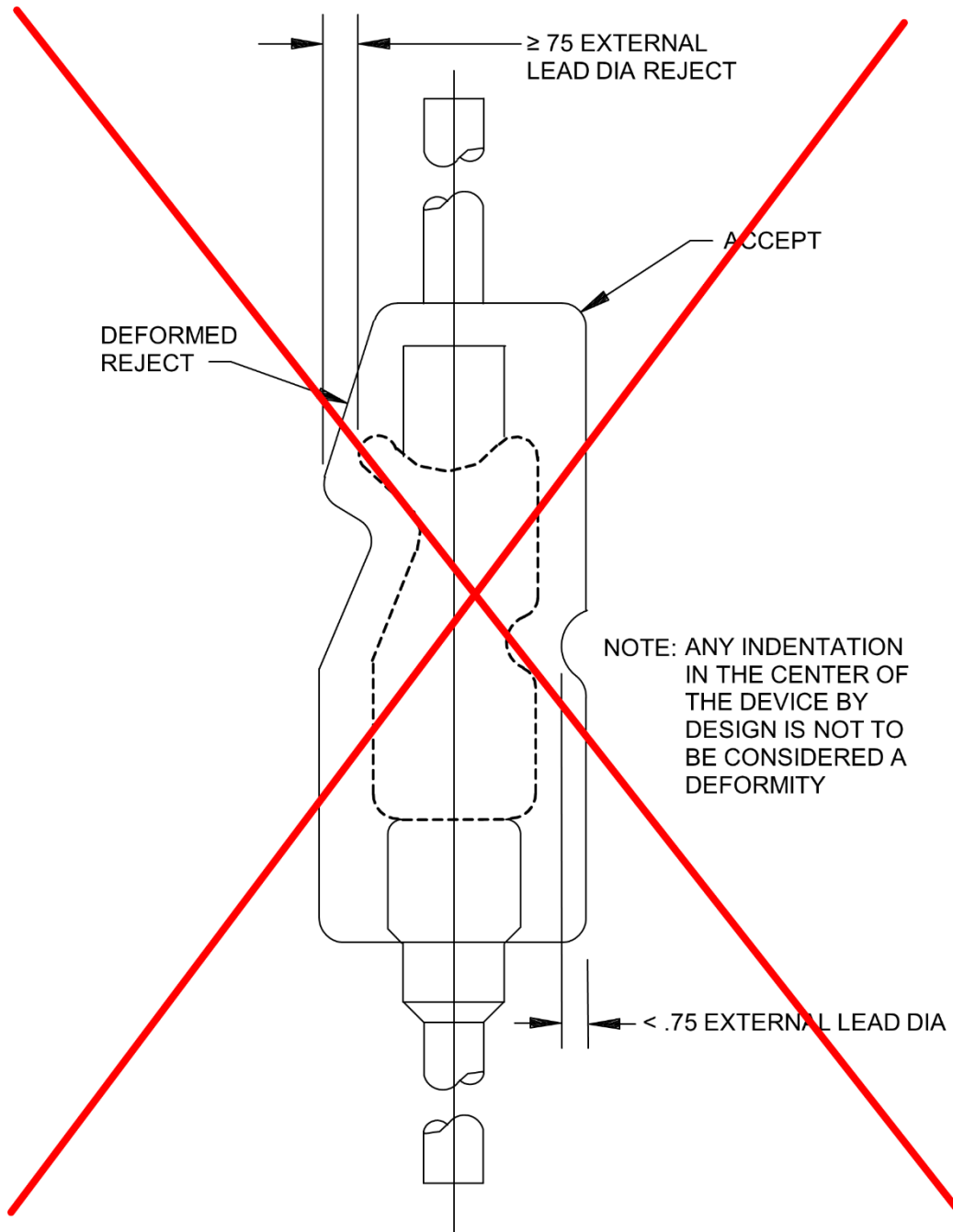
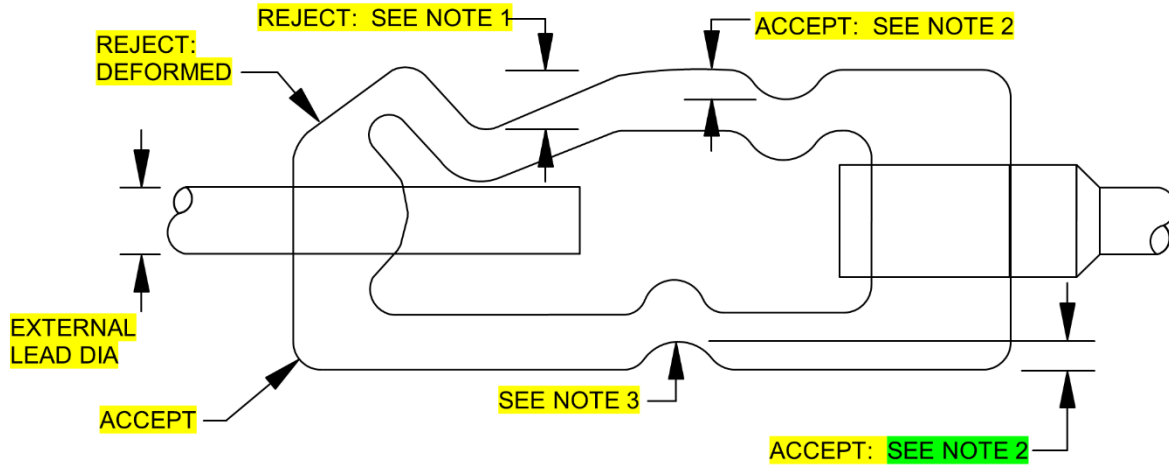


FIGURE 2074-A1. Glass cracks and chips.

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APPENDIX A





NOTES:

1. Reject if deformity is greater than or equal to 75 percent of external lead diameter.
2. Accept when deformity/indentation is less than 75 percent of external lead diameter.
3. Any indentation in the center of the device by design is not to be considered a deformity.

FIGURE 2074-A2. Package deformities.

A.1.6 Solder protrusions (see figure 2074-A3). ~~All devices shall be inspected for solder protrusions.~~ Any device with a solder protrusion that extends more than twice the smallest protrusion width of the protrusion shall be rejected.

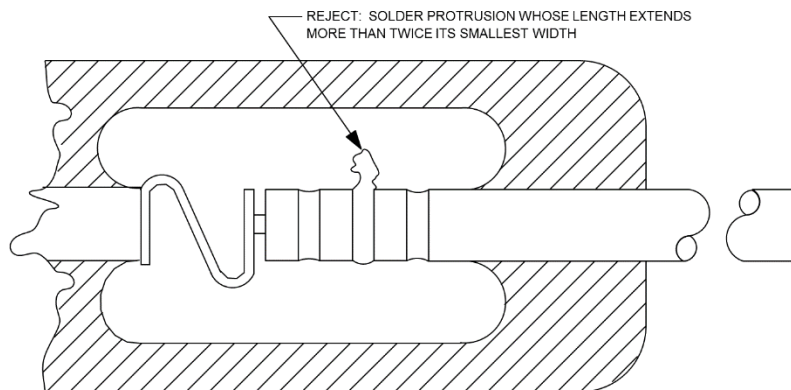


FIGURE 2074-A3. Solder protrusions.

APPENDIX A

A.1.7 Pressure contact defects. The following misalignments or deformations shall be cause for rejection:

- a. Whisker embedded within glass body wall (see figure 2074-A4).

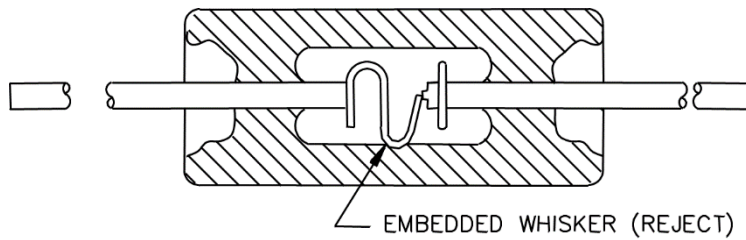


FIGURE 2074-A4. Embedded whisker.

- b. Toe contact between base of C or S bend whisker and top surface of die caused by insufficient loading (see figure 2074-A5).

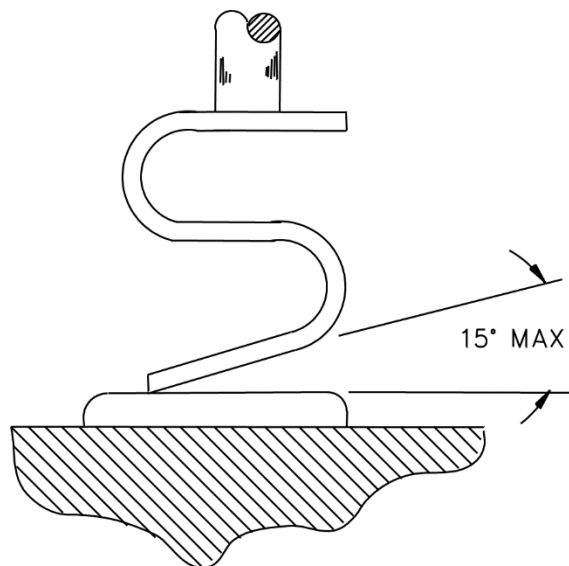


FIGURE 2074-A5. Whisker toe contact.

- c. Toe contact on top surface of die (see figure 2074-A6).

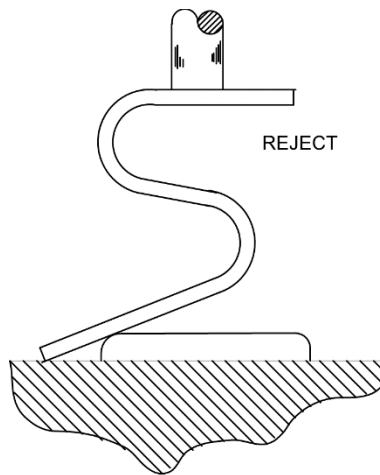


FIGURE 2074-A6. Whisker toe contact on top surface of die.

- d. Heel contact between base of C or S bend whisker and top surface of die (see figure 2074-A7).

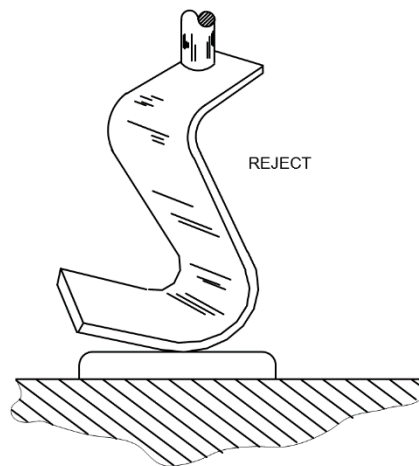


FIGURE 2074-A7. Whisker heel contact.

- e. Point contact between base of C or S bend whisker and top surface of die except by design (deformed or twisted whisker) (see figure 2074-A8).

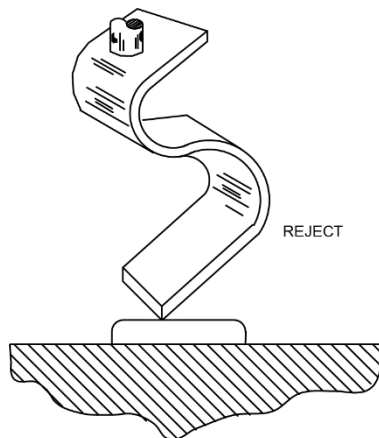


FIGURE 2074-A8. Whisker point contact.

- f. Design compressed height (see figures 2074-A9 and 2074-10). Either half of an S or a C bend whisker that is compressed so that any dimension is reduced to less than 50 percent of its design shall be rejected.

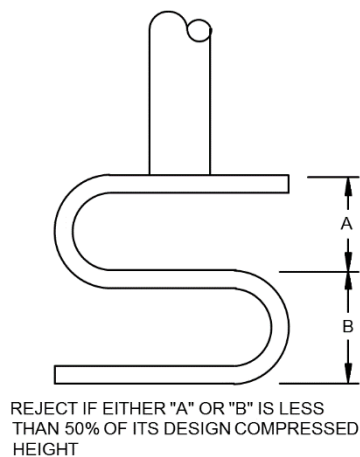


FIGURE 2074-A9. S bend whisker compressed height.

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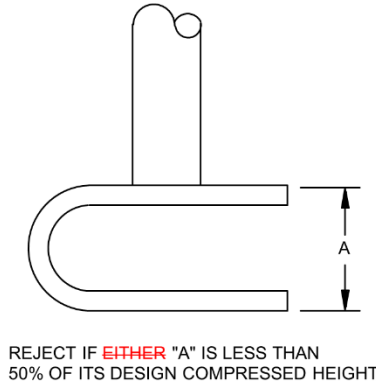


FIGURE 2074-A10. C bend whisker compressed height.

A.1.8 Whisker weld to post. Any device that exhibits weld splash or splatter (teardrop or balled) between whisker and post shall be rejected when it exceeds 25 percent of nominal lead diameter. The profile of the whisker weld to post shall not allow light penetration by more than 50 percent of lead diameter when using back lighting techniques.

A.1.9 Die-to-post or die-to-die contact area. Solder shall not be rough in appearance and shall be fused to a minimum of one-half the available bonding perimeter. Any solder overflow that touches the opposite surface of the die or dice shall be cause for rejection.

A.1.10 Die alignment (see figure 2074-A11). A device shall be rejected if the die surface is not within 15 degrees of being normal to the centerline of the mounting post.

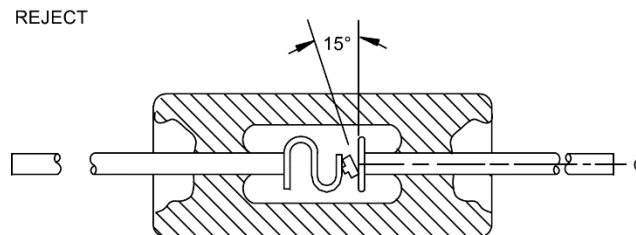


FIGURE 2074-A11. Die alignment.

A.1.11 Lead alignment defects (applicable to that portion of each lead within the glass envelope). A device lead which is either misaligned or bent so that it makes an angle with the principle device axis greater than 10 degrees shall be rejected.

A.1.12 Multiple chip die attachment defects. A multiple chip die stack that tilts more than 10 degrees from the principle axis of the device shall be cause for rejection.

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APPENDIX B

GLASS BODY (TRANSPARENT), AXIAL LEAD, ~~TRANSPARENT BODY~~, STRAIGHT THROUGH LEAD TO DIE CONTACT DESIGN

B.1 General. This appendix contains the acceptance criteria for devices of the axial lead, transparent body, straight through lead to die contact design (see figure 2074-B1). The following ~~criteria~~ examinations shall be ~~specified for the straight through construction (see figure 2074-B1)~~ performed after encapsulation but before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

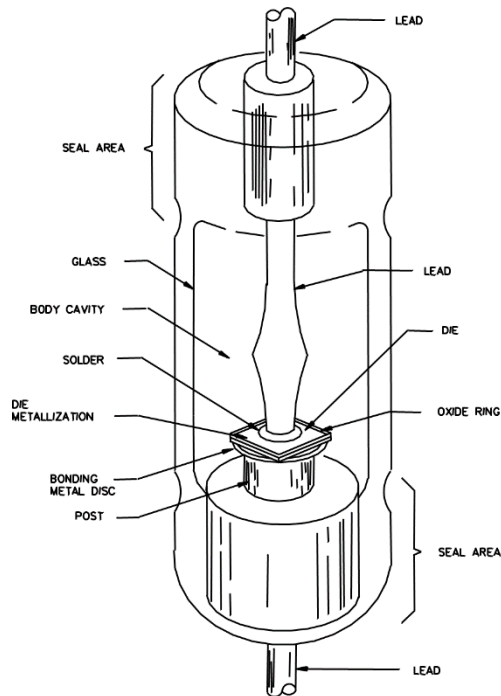


FIGURE 2074-B1. Straight through internal construction.

B.1.1 Glass cracks and chips (see figure 2074-A1). No cracks shall be allowed in the vicinity of the cavity. Any crack originating at either end of the package or crack that extends into the body of the glass toward the cavity more than 25 percent of the glass-to-glass or glass-to-metal seal length shall be cause for rejection. Any glass chip deep enough to expose the plug or lead surface and extending longitudinally into the glass-to-metal seal toward the cavity to reduce the effective seal length to less than one external lead diameter shall be cause for rejection.

B.1.2 Incomplete seal. All devices shall be inspected for glass-to-metal seal or glass-to-glass seal. Both seals shall be a minimum of one external lead diameter over the entire sealed portion (sealed interface).

B.1.3 Bubbles in seal. All devices shall be inspected for bubbles in the glass-to-metal or glass-to-glass seal. A series of bubbles that reduce the effective seal length to less than one external lead diameter shall be cause for rejection. Bubbles in the glass, but not affecting the glass-to-glass or glass-to-metal seal area, are not cause for rejection.

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APPENDIX B

B.1.4 Glass package deformities (see [figure 2074-A2](#)). Any glass envelope deformity equal to or greater than 75 percent of the external lead diameter shall be cause for rejection.

B.1.5 ~~Extraneous matter~~ **Foreign material**. A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.

B.1.6 Die to post solder connection.

- a. Solder voids (see figure 2074-B2). A device shall be rejected if solder flow is less than 50 percent of the perimeter of the minimum available contact area of the post.

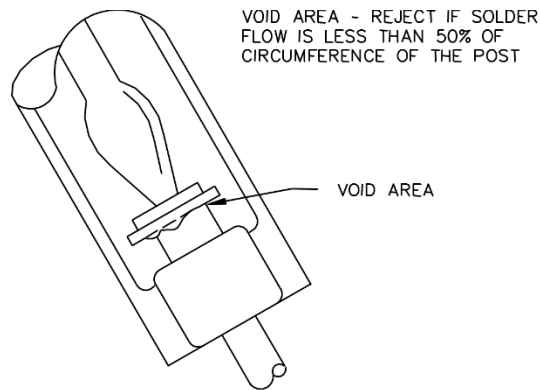


FIGURE 2074-B2. Solder voids.

- b. Solder overflow (see figure 2074-B3). A device shall be rejected if any solder flow touches the opposite surface of the die.

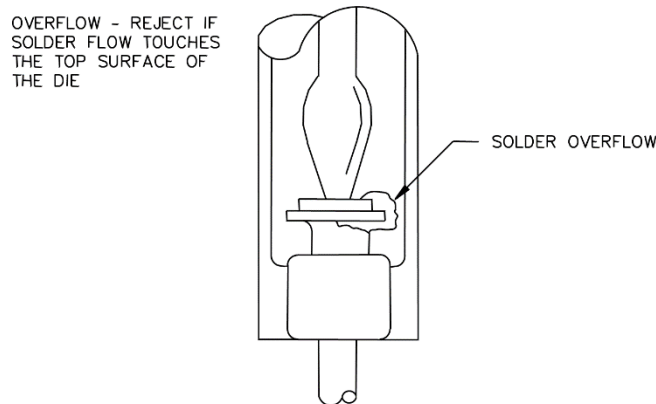


FIGURE 2074-B3. Solder bridge.

B.1.7 Lead to die solder connection (see figure 2074-B4). A device shall be rejected if more than 50 percent of the perimeter of the available contact area of the lead is void of solder.

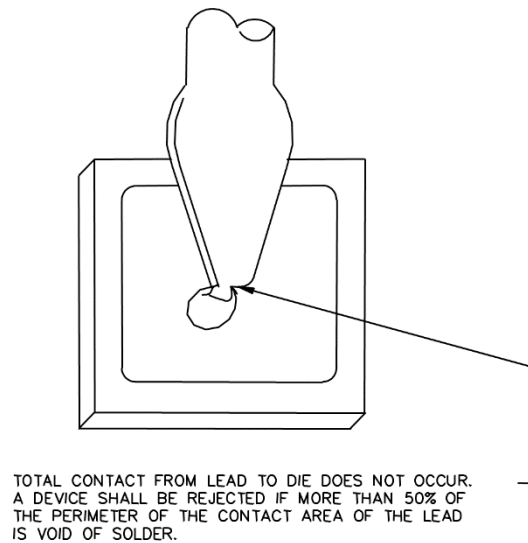


FIGURE 2074-B4. Lead to die solder voids.

- a. Solder overflow (see figure 2074-B5). A device shall be rejected if solder flow extends beyond 50 percent of the distance from the metal to the outer edge of the oxide.

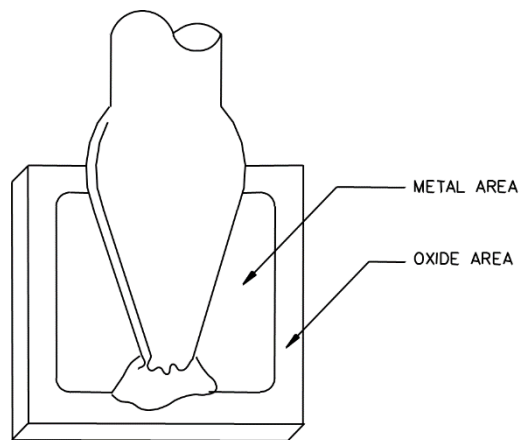


FIGURE 2074-B5. Solder overflow onto oxide area.

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APPENDIX B

- b. Solder protrusion, slivers, and spikes (see figure 2074-B6). A device shall be rejected if solder slivers and spikes are not securely attached to the main body. A securely attached sliver or spike is one having a cross sectional area greater at the area of attachment than anywhere else on the solder protrusion and having no necked down areas. Solder protrusions, slivers, and spikes whose length exceeds twice the smallest width of attachment shall be rejected.

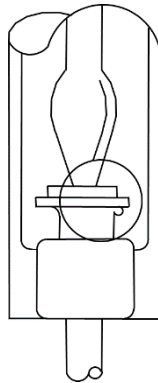


FIGURE 2074-B6. Solder slivers and spikes.

- c. Solder balls. A device shall be rejected if there are any insecurely attached solder balls. An insecurely attached solder ball is one whose major cross sectional area is more than twice the cross sectional area of the attachment.

B.1.8 Die-to-die solder connection (see figure 2074-B7). A device shall be rejected if more than 50 percent of the perimeter of the available contact area of the die is void of solder.

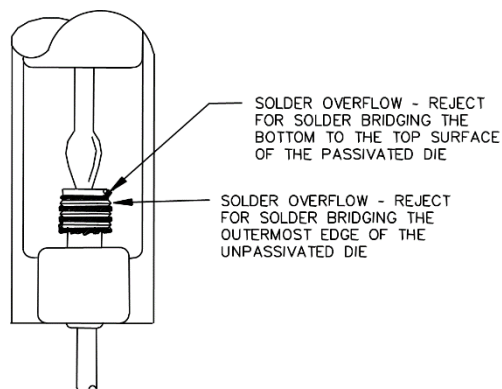


FIGURE 2074-B7. Die-to-die solder connection.

GLASS BODY (TRANSPARENT), AXIAL LEAD AND SURFACE MOUNT, DOUBLE PLUG, ~~TRANSPARENT BODY~~ (DUMET PLUG, ROUND END-CAP, SOFT GLASS) DESIGN

C.1 General. This appendix contains the acceptance criteria for devices of the transparent glass body, axial lead and surface mount, double plug, soft glass design. The following inspections shall be performed after encapsulation and before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

C.1.1 Glass cracking (see figure 2074-C1). Spiral or longitudinal cracks of any length originating at either end that propagate in the direction of the die are cause for rejection. Reject for cracks that are not confined to the glass surface or the outer 25 percent of the seal length. 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. Cracks confined to the outer 25 percent of the designed seal length that propagate back toward the starting edge (away from the die area) are acceptable.

REJECT: CRACKS NOT CONFINED TO SURFACE OR OUTER 25% OF SEAL LENGTH - "A"

REJECT: CRACKS OF ANY LENGTH THAT PROPAGATE TOWARD DIE - "B"

REJECT: SPIRAL CRACKS PROPAGATING TOWARD DIE - "C"

ACCEPT: SMALL C-CRACKS OR MICRO CRACKS IN GLASS SURFACE - "D"

ACCEPT: CRACKS IN OUTER 25% OF SEAL LENGTH THAT PROPAGATE AWAY FROM DIE - "E"

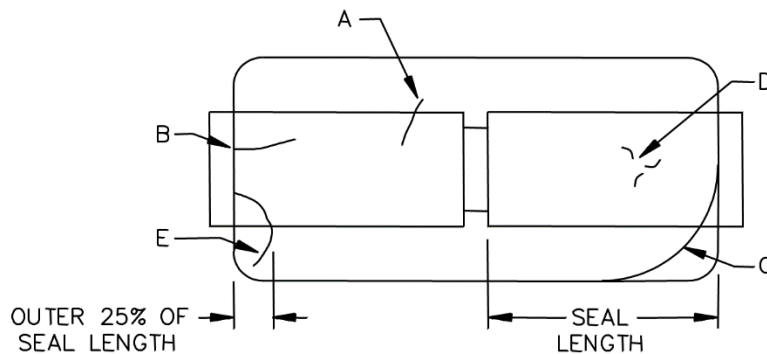


FIGURE 2074-C1. Glass cracks.

C.1.2 High seal (see figure 2074-C2). Any device which displays a glass case off center condition reducing the seal band of either plug by more than 25 percent of its designed length shall be cause for rejection.

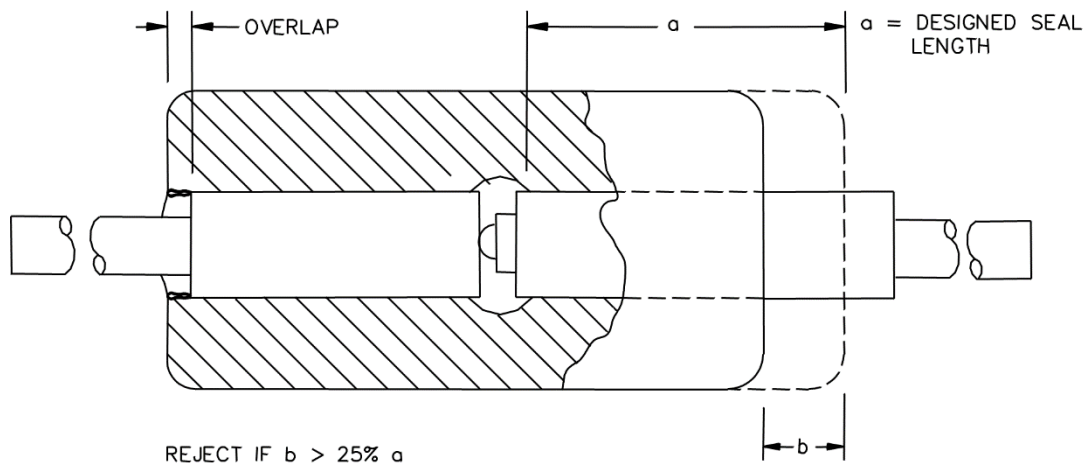
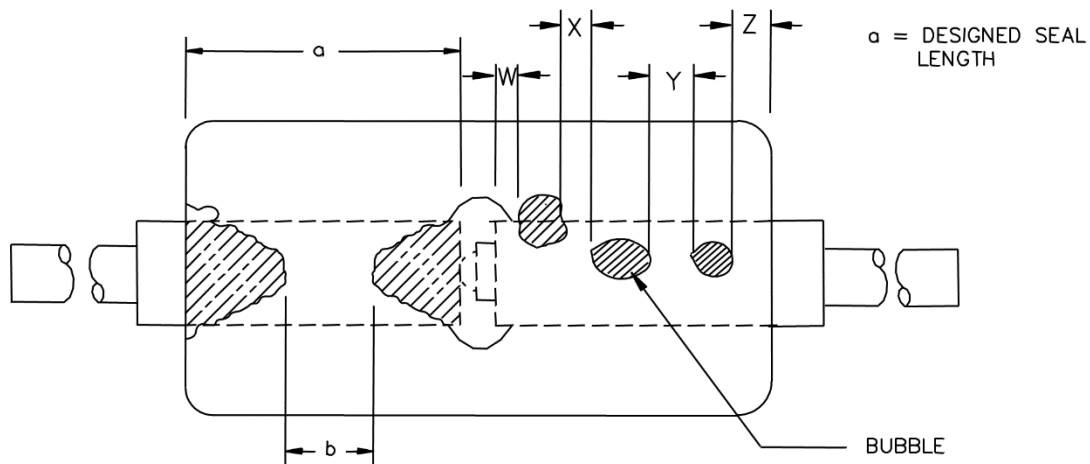


FIGURE 2074-C2. High seal.

C.1.3 Insufficient seal (see 2074-C3). Any anomaly such as bubbles, plug blisters, separations, leaching, or undersealing that affects the combined seal length of either plug by reducing the a sealing band to less than 50 percent of the designed seal length on any package type shall be cause for rejection.

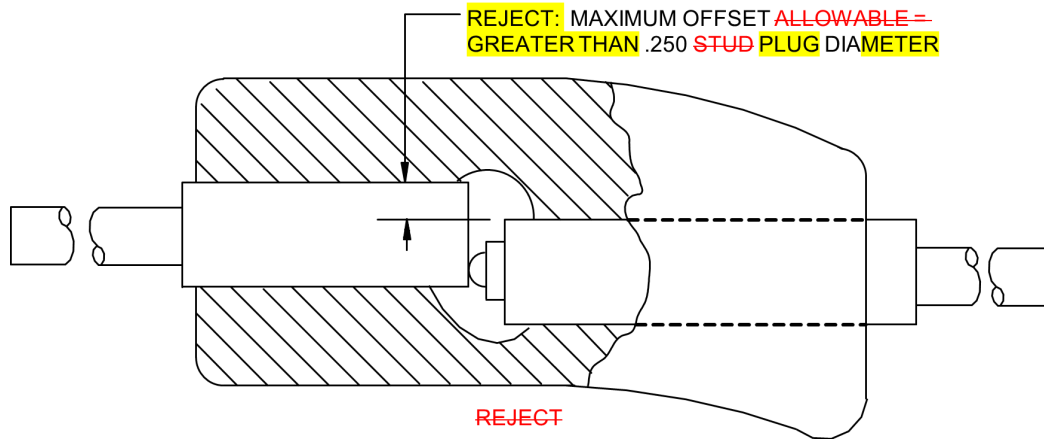
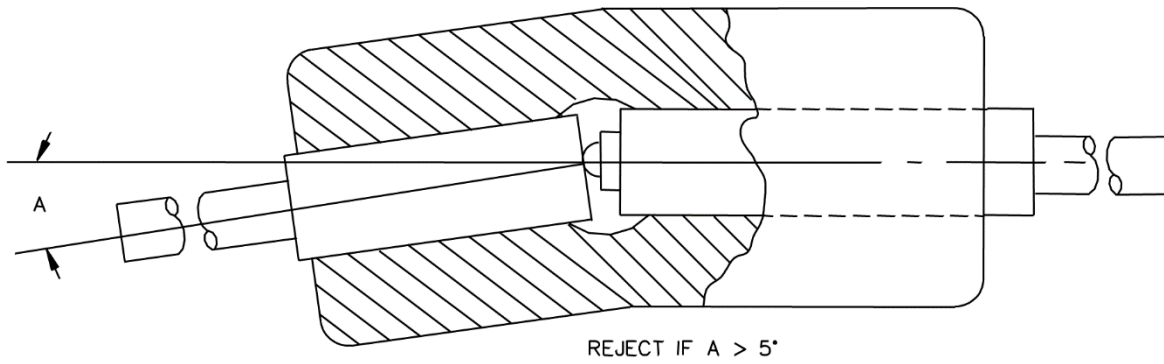


REJECT IF $b < 50\% a$

REJECT IF $W + X + Y + Z < 50\% a$

FIGURE 2074-C3. Insufficient seal.

C.1.4 Plug alignment and displacement (see figure 2074-C4 and 2074-C5). ~~All devices shall be inspected for proper plug alignment.~~ A plug-to-plug displacement distance (offset) greater ~~more~~ than 25 percent of the diameter of the plug shall be cause for rejection. The plug shall not tilt to the degree that it touches the chip or is misaligned from the other plug axis more than 5 degrees.

FIGURE 2074-C4. Plug-to-plug offset alignment.FIGURE 2074-C5. Plug tilt angle displacement.

C.1.5 ~~Extraneous matter~~ Foreign material. A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas (die cavity area). Extraneous materials between the glass seal and the ~~slug~~ plug is considered attached and shall not be cause for rejection.

C.1.6 Lead connections (see figure 2074-C6). Lead to plug connections shall be inspected for incomplete welds. Any partial welds less than 75 percent of total weld area shall be cause for rejection.

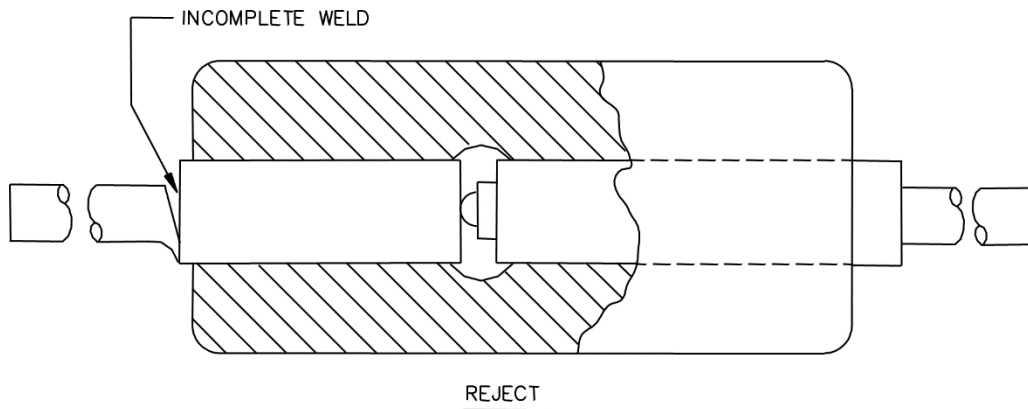


FIGURE 2074-C6. Incomplete weld.

C.1.7 Die defects. The following die defects shall be cause for rejection.

C.1.7.1 Tilt. Die tilt greater than 5 degrees, or **slug plug**, or preform makes contact to **chip die** on bump side.

C.1.7.2 Chipouts or cracks. Die chipouts or die cracks shall use the criteria detailed in **3.4 5.1** of this test method and **figures 2074-1** and **2074-2**.

C.1.8 Criteria for round end-cap surface mount devices. The following criteria shall apply for end-cap surface mount devices:

- a. Glass-to-metal seal shall be .015 inch (0.381 mm) **minimum** for DO-213AA and .020 inch (0.508 mm) **minimum** for DO-213AB, around the diameter of each **slug plug**.
- b. **Slug Plug** exposure shall not exceed 30 percent of the **slug plug** length .014 inch (0.3556 mm) min for DO-213AA and .022 inch (0.5588 mm) **minimum** for DO-213AB.
- c. There shall be no cracks in the device within .010 inch (0.254 mm) of the die.
- d. There shall be no cracks in the glass that are pointed towards the die.
- e. There shall be no conductive contaminants in the die cavity area.
- f. For plug alignment, including end-caps, see **C.1.4**.
- g. For end-cap connections, see C.1.6.

GLASS BODY (TRANSPARENT), AXIAL LEAD AND SURFACE MOUNT, DOUBLE PLUG, ~~TRANSPARENT BODY~~ (TUNGSTEN OR MOLYBDENUM PLUG, SQUARE END-CAP, HARD GLASS) DESIGN

D.1 General. This appendix contains the acceptance criteria for devices of the transparent glass body, axial lead and surface mount, double plug, hard glass design. The following inspections shall be performed after encapsulation and before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

D.1.1 Glass.

- a. Cracks. No cracks allowed except cracks confined to the outer 25 percent of the designed seal length that propagate back toward the starting edge (away from the die area) are acceptable. 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.
- b. Chipouts (see figure 2074–D1). Edge chipouts that expose a plug and are not confined to the outer 25 percent of the designed seal length are cause for rejection. Edge chipouts (regardless of size) that expose a plug and create a sharp angle or "V" shape that points toward the die area are rejects.

REJECT: CHIPOUTS NOT CONFINED TO OUTER 25% OF SEAL LENGTH -

REJECT: CHIPOUTS OF ANY SIZE WITH SHARP POINT - "B"

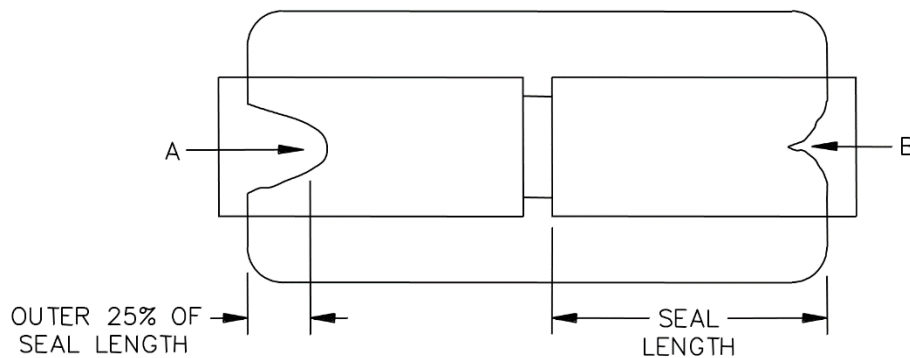


FIGURE 2074–D1. Chipouts.

- c. Holes. Any hole over the die or ~~slug~~ plug area greater than 50 percent of the glass thickness in depth is cause for rejection, except that holes of any depth are acceptable in the outer 25 percent of the designed seal length.
- d. Deformities (see figure 2074–D2). Any glass surface deformity that causes the glass surface to be displaced by more than 10 percent of the designed glass diameter, or that results in the device not meeting a dimensional requirement, is cause for rejection.

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REJECT: AMOUNT OF SURFACE GLASS DISPLACEMENT "a" OR "b" FROM A DEFORMITY" IS $\geq 10\%$ OF DESIGNED GLASS DIAMETER

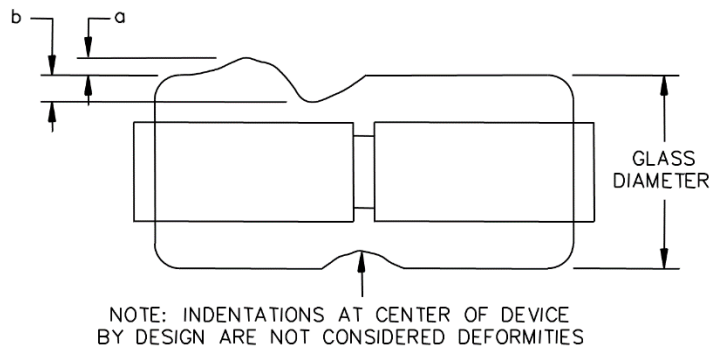


FIGURE 2074-D2. Deformity.

- e. Surface damage and discoloration. Any device with surface abrasions, chips, scratches, rough or discolored (darkened) glass over the die area that result in the die not being clearly visible, is a reject. Using liquid immersion to improve die visibility is acceptable.

D.1.2 Seal.

- a. Glass positioning and missing glass (see figure 2074-D3). Off center glass and portions of missing glass that reduce the seal length on either plug by more than 25 percent of the designed seal length is cause for rejection.

REJECT: GLASS OFF CENTER AND/OR MISSING GLASS THAT REDUCES SEAL LENGTH BY $\geq 25\%$ - "A"

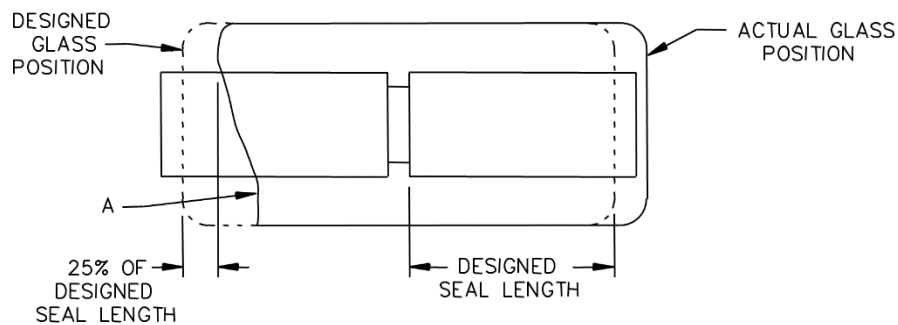


FIGURE 2074-D3. Positioning.

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- b. Insufficient seal (see figure 2074–D4). Seal surface anomalies such as undercut, separations, plug blisters, scratches or cracks, bubbles, silicon chips, fibers, or missing plating which, when combined, reduce the sealing length along any linear path to less than 50 percent of the designed seal length are cause for rejection.

NOTE: Lines or "strings" of small bubbles are considered to be seal anomalies for the entire length of the line.

REJECT: SEAL LENGTH "a" REDUCED TO $\leq 50\%$ OF DESIGNED SEAL LENGTH

REJECT: COMBINED SEAL LENGTHS "x"+"y"+"z" ALONG ANY LINE $\leq 50\%$ OF DESIGNED SEAL LENGTH

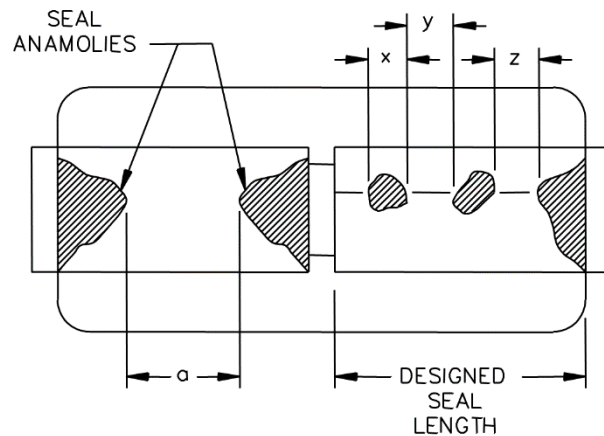


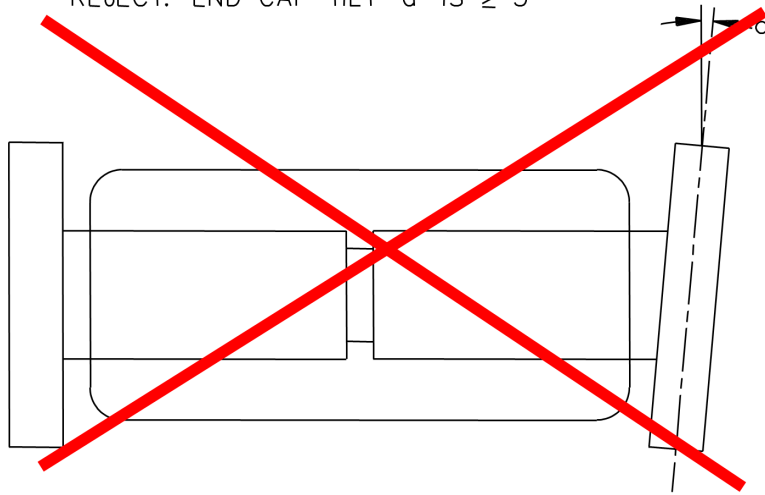
FIGURE 2074–D4. Insufficient seal.

- c. ~~Extraneous materials~~ Foreign material. A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas (die cavity area). Extraneous materials between the glass seal and the ~~slug~~ plug are considered attached and shall not be cause for rejection.

D.1.3 Alignment. NOTE: Any die to plug non-contact that occurs as a result of die or plug misalignment is most accurately evaluated by thermal impedance testing. In cases where pass/fail status of a device is unclear based on the alignment requirements presented herein, thermal impedance testing may be used to determine the acceptability of the device.

- a. Die alignment. Any die that tilts more than 5 degrees with respect to the surface of either plug or that tilts sufficiently to make any unintended contact with the plug is cause for rejection (see figure 2074–D5). Any die that is out of axial alignment such that it extends beyond the ~~slug~~ plug more than 20 percent of its length or width is cause for rejection (see figure 2074–D6).

REJECT: END CAP TILT "α" IS $\geq 5^\circ$



REJECT: DIE TILT "A" $> 5^\circ$

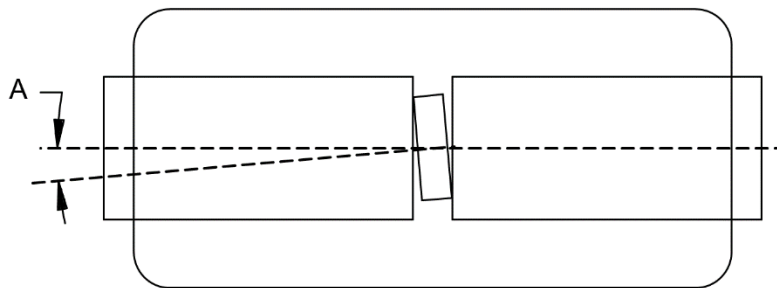


FIGURE 2074-D5. Die tilt.

REJECT: LENGTH OF DIE NON-CONTACT "a" IS $\geq 20\%$ OF DIE LENGTH

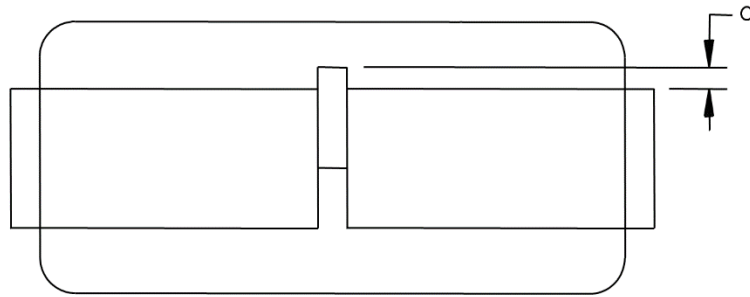


FIGURE 2074-D6. Die non-contact.

- b. Plug alignment. Plugs that are not axially aligned other than in the die area to within A plug-to-plug displacement distance (offset) greater than 12.5 25 percent of the diameter of the plug are shall be cause for rejection (see figure 2074-D7). Any plug that tilts more than 5 degrees with respect to the other or that tilts sufficiently to make any unintended contact with the die is cause for rejection (see figure 2074-D8).

REJECT: PLUG OFFSET "A" IS GREATER THAN $\geq 1/8$ (12.5%) OF PLUG DIAMETER

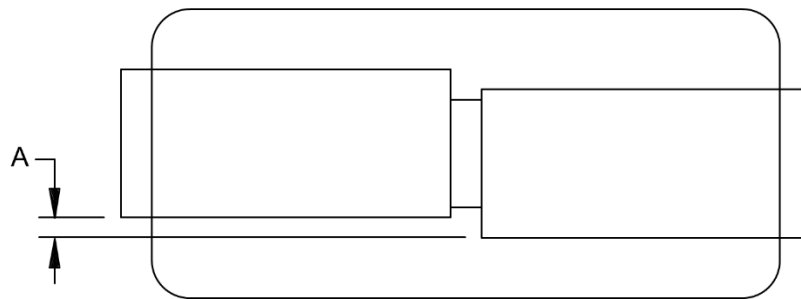


FIGURE 2074-D7. Plug-to-plug offset alignment.

REJECT: PLUG TILT ANGLE "α" IS $\geq 5^\circ$

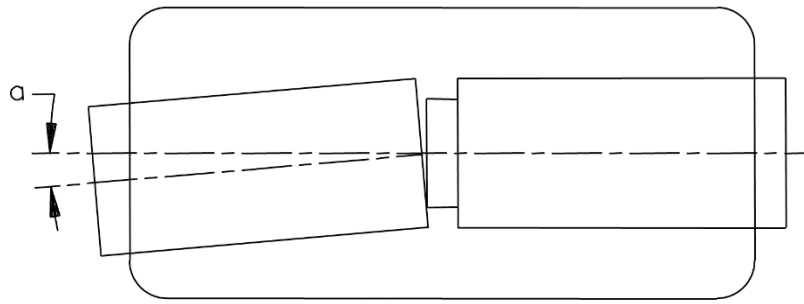


FIGURE 2074-D8. Plug tilt angle.

D.1.4 Lead and end-cap attach.

- a. Lead alignment (leaded devices). Leads that are not axially aligned to within one lead diameter, or leads that are not contained completely within the diameter of the plug, are cause for rejection (see [figure 2074-D9](#)).

REJECT: LEAD OFFSET "α" IS GREATER THAN ONE LEAD DIAMETER
REJECT: LEAD IS NOT COMPLETELY CONTAINED WITHIN PLUG DIAMETER "B"

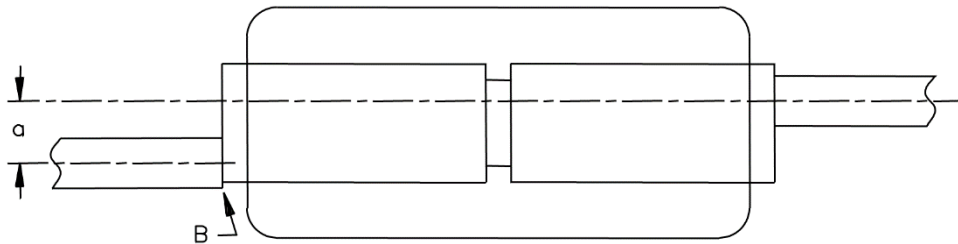


FIGURE 2074-D9. Lead offset.

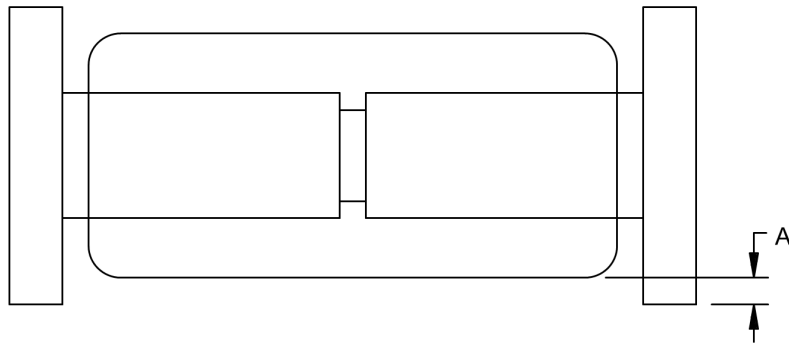
- b. Braze. Terminals that are not brazed to the plug around at least 90 percent of the terminal perimeter are cause for rejection. Any cracks or fissures in the braze are cause for rejection. Pin holes in the braze are acceptable.

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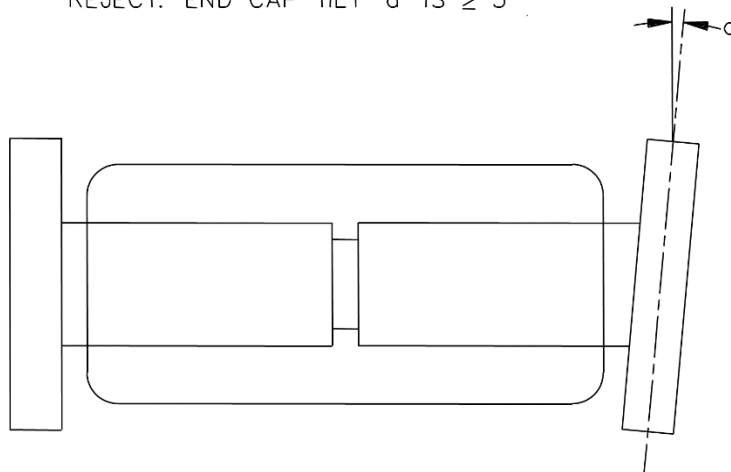
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- c. End-caps (surface mount). Reject for end-caps that do not allow at least ~~3.0 mils~~ .003 inch (0.076 mm) clearance from the glass body to the mounting surface on all four sides (see figure 2074-D10). Reject for end-caps that are not perpendicular to the plugs to within 5 degrees (see figure 2074-D11). Reject for end-caps that are bent sufficiently to cause the device to exceed any specified diode or end-cap dimension (see figure 2074-D12). Reject for end-cap rotation where mounting surfaces are not co-planar to each other to within 5 degrees (see figure 2074-D13). Reject for tabs that have indentations, holes, or other damage affecting more than 25 percent of any mounting surface (see figure 2074-D14). Reject for end-caps that exhibit flaking, blistering, or peeling.

REJECT: GLASS BODY TO END CAP CLEARANCE "A" IS $\leq$ ~~3.0 MILS~~ .003 INCH (0.076 mm)

FIGURE 2074-D10. End-cap clearance.

REJECT: END CAP TILT "α" IS $\geq 5^\circ$

FIGURE 2074-D11. End-cap tilt.

REJECT: DEVICE WITH END CAP DEFORMATION THAT
EXCEEDS ANY SPEIFIED DEMENSION - "A"

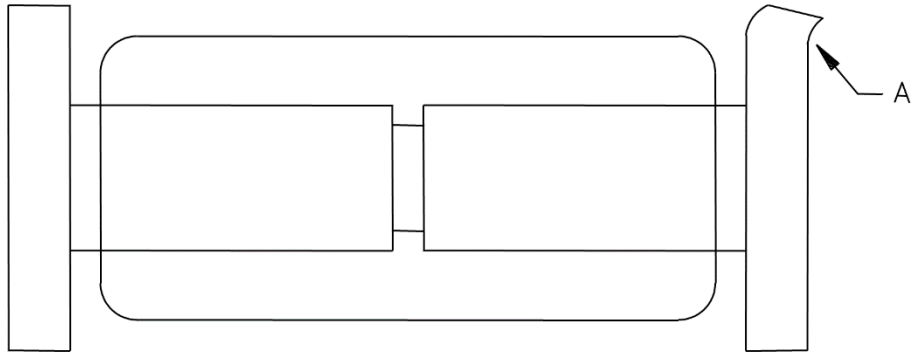


FIGURE 2074-D12. End-cap deformation.

REJECT: END CAP ROTATION " α " $\geq 5^\circ$

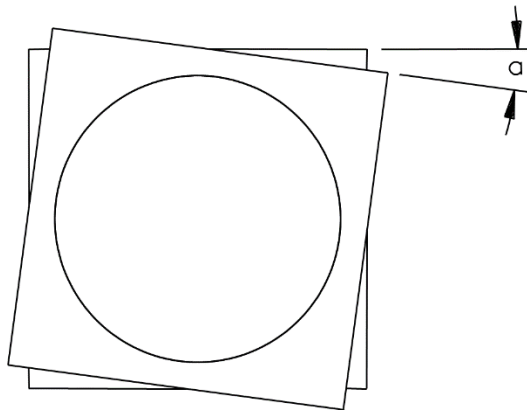


FIGURE 2074-D13. End-cap rotation.

REJECT: ANY MOUNTING SURFACE REDUCED TO $\leq 75\%$
OF IT'S DESIGNED AREA DUE TO NICKS("A"), PITS("B"), ECT.

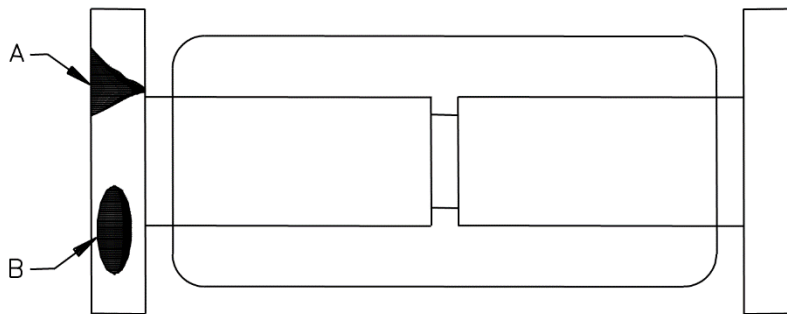


FIGURE 2074-D14. Mounting surface nicks and pits.

D.1.5 Die effects defects.

- a. Chipouts or cracks. Die chipouts or die cracks shall use the criteria detailed in paragraph ~~3.4~~ 5.1 of this test method and figures 2074-1 and 2074-2.
- b. Conductive contaminants. There shall be no conductive contaminants in the die cavity area.

GLASS BODY (TRANSPARENT), AXIAL LEAD, ~~TRANSPARENT BODY~~, POINT CONTACT DESIGN

E.1 **General.** This appendix contains the acceptance criteria for devices of the transparent glass body, axial lead, point contact design. The following ~~additional criteria shall be specified for the point contact construction~~ examinations shall be made after encapsulation but before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

E.1.1 **Glass cracks and chips** (see figure 2074-A1). No cracks shall be allowed in the vicinity of the cavity. Any crack originating at either end of the package or crack that extends into the body of the glass toward the cavity more than 25 percent of the glass-to-glass or glass-to-metal seal length shall be cause for rejection. Any glass chip deep enough to expose the plug or lead surface and extending longitudinally into the glass-to-metal seal toward the cavity to reduce the effective seal length to less than one external lead diameter shall be cause for rejection.

E.1.2 **Incomplete seal.** All devices shall be inspected for glass-to-metal seal or glass-to-glass seal. Both seals shall be a minimum of one external lead diameter over the entire sealed portion (sealed interface).

E.1.3 **Bubbles in seal.** All devices shall be inspected for bubbles in the glass-to-metal or glass-to-glass seal. A series of bubbles that reduce the effective seal length to less than one external lead diameter shall be cause for rejection. Bubbles in the glass, but not effecting the glass-to-glass or glass-to-metal seal area, are not cause for rejection.

E.1.4 **Glass package deformities** (see figure 2074-A2). Any glass envelope deformity equal to or greater than 75 percent of the external lead diameter shall be cause for rejection.

E.1.5 ~~Extraneous matter~~ **Foreign material.** A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.

E.1.6 **Pressure contact defects.** The following misalignments or deformities shall be cause for rejection.

- a. Whisker touches glass body wall (see figure 2074-E1).

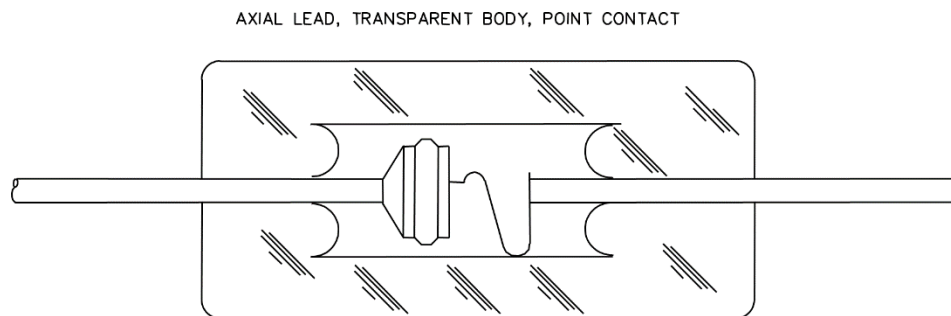


FIGURE 2074-E1. Whisker touches glass body wall (reject).

- b. Whisker loops touch one another (see figure 2074-E2).

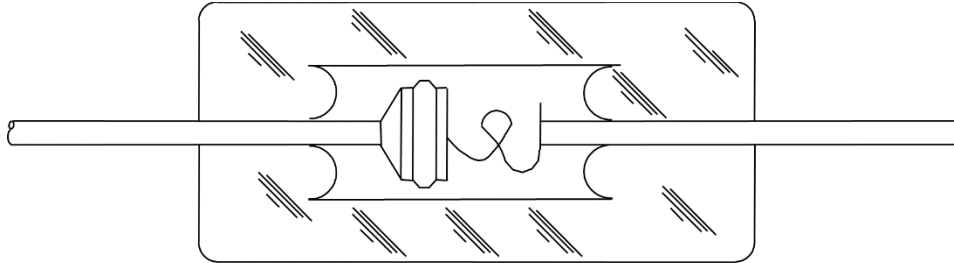


FIGURE 2074-E2. Whisker loops touch one another (reject).

- c. Whisker angle over 10 degrees from normal (see figure 2074-E3).

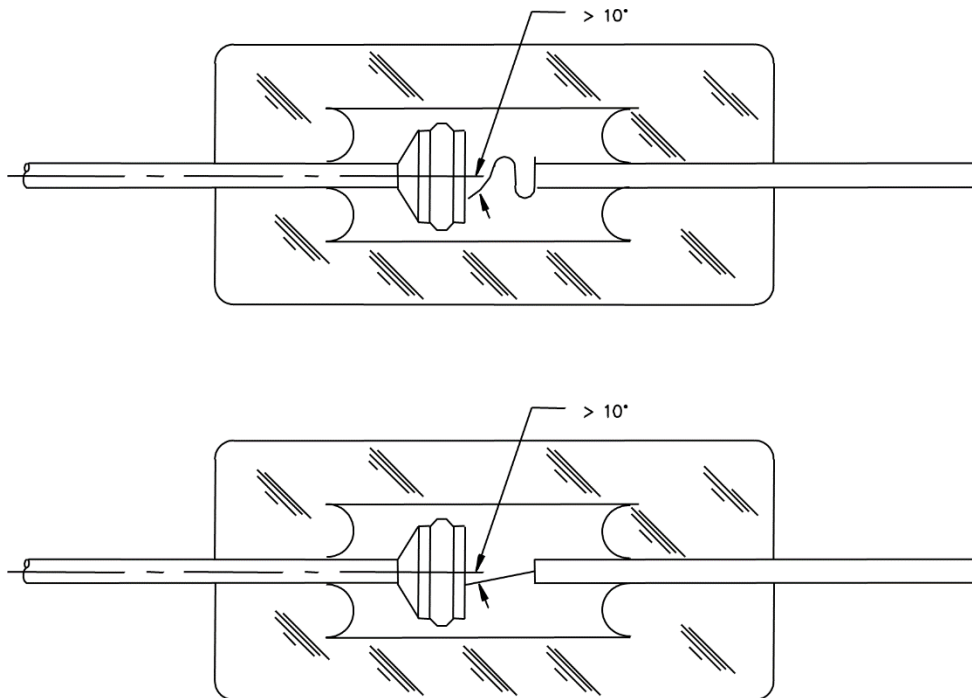


FIGURE 2074-E3. Whisker angle over 10 degrees from normal (reject).

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E.1.7 Whisker weld to post. Any device that exhibits weld splash or splatter (tear dropped or balled) between whisker and post shall be rejected when it exceeds 25 percent of nominal lead diameter. The profile of whisker weld to the post shall not allow light penetration by more than 50 percent of lead diameter when using back lighting techniques.

E.1.8 Solder voids. A device shall be rejected if solder flow is less than 50 percent of the perimeter of the minimum available contact area of the die.

E.1.9 Die to post contact area. Solder shall be smoothly formed from one element to another and shall be fused to a minimum of one-half the available bonding area. Any solder overflow that touches the opposite surface of the die shall be cause for rejection.

E.1.10 Die alignment. A device shall be rejected if the die surface is not within 15 degrees of being normal to the centerline of the mounting post.

E.1.11 Lead alignment defects (applicable to that portion of each lead within the glass envelope). A device whose lead is either misaligned or bent so that it makes an angle with the principle device axis greater than 10 degrees shall be rejected.

E.1.12 Die touches glass package (see figure 2074-E4). A device shall be rejected if the die touches the glass envelope.

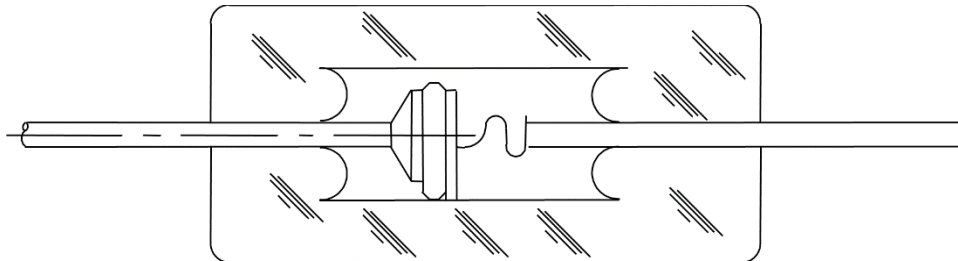


FIGURE 2074-E4. Die touches glass package (reject).

GLASS BODY (OPAQUE), AXIAL LEAD AND SURFACE MOUNT, DOUBLE PLUG, ~~OPAQUE BODY,~~
(POWER RECTIFIER AND REGULATOR) DESIGN

F.1 General. This appendix contains the acceptance criteria for the opaque glass body, axial lead and surface mount, double plug design used for power rectifier and regulator devices. The die related examinations shall be performed before encapsulation and remaining examinations shall be made after encapsulation but before body coating or painting. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

F.1.1 Die mounting and alignment. After bonding die to the heat sink, plugs, or leads, the following shall be inspected for defects.

- a. Die geometry. A die shall be rejected if it is chipped or broken to the extent that 75 percent or less of the original surface remains.
- b. ~~Axial alignment of plugs and die. Plugs shall be aligned axially within 25 percent of the diameter of either plug.~~ Plug alignment. A plug-to-plug displacement distance (offset) greater than 25 percent of the diameter of the plug shall be cause for rejection.
- c. Tilted die. A device shall be rejected if the die is tilted so that the die surface is greater than 5 degrees from being perpendicular to the mounting post axis.

F.1.2 Die cracks. Any die exhibiting cracks that reduce the total die area (or cracks extending into or across the junction area) to less than 75 percent of its original area shall be cause for rejection.

F.1.3 Braze (leaded and surface mount devices). ~~Leads~~ Terminals that are not brazed to the plug around at least 90 percent of the lead perimeter are cause for rejection. When surface mount terminals are brazed to the lead shaft, the minimum 90 percent visual criteria applies to the outer face of the end cap. Any cracks or fissures in the braze are cause for rejection. Pin holes in the braze are acceptable.

F.1.4 Flaking or loose material. No unattached solder, braze, or other bonding material shall extend from the plugs. Any blistering or peeling of plug surface shall be cause for rejection.

F.1.5 ~~Extraneous matter~~ Foreign material. A device shall be rejected if there is any extraneous, particulate matter between the terminal plugs or on the plug surface. No foreign stains shall be permitted on plug surfaces.

METAL BODY, AXIAL LEAD, SOLDER CONTACT DESIGN

G.1. General. This appendix contains the acceptance criteria for devices of the metal body, axial lead, solder contact design. The following inspections shall be made prior to capping. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

G.1.1 Examinations before capping.

- a. Solder defects (see figures 2074-G1 and 2074-G2). Any device with a solder protrusion that extends more than twice the smallest protrusion width shall be rejected. Solder shall be smoothly formed from one element to another and shall be fused to a minimum of 50 percent of the perimeter between adjacent elements.

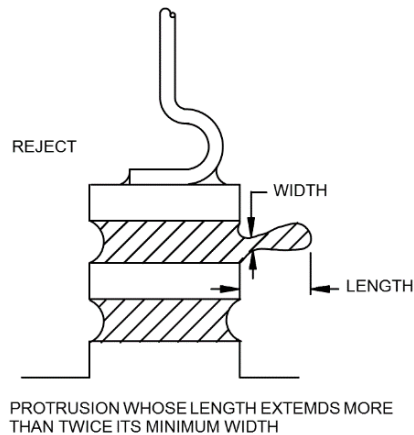


FIGURE 2074-G1. Solder protrusion.

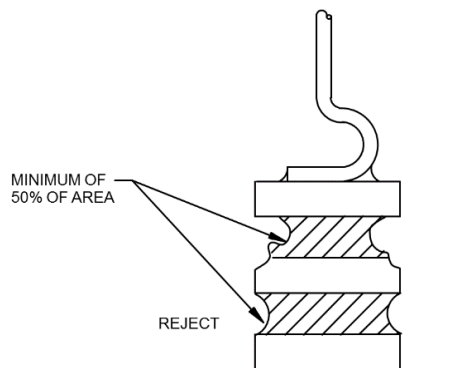


FIGURE 2074-G2. Solder flow.

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- b. Alignment (see figure 2074-G3). Any device whose element has its geometric center displaced more than 33 percent of its width from the die, or die stack centerline, shall be rejected.
- c. Tilt (see figure 2074-G4). Any element of a device that is tilted more than 10 degrees from the mounting plane shall be cause for rejection.

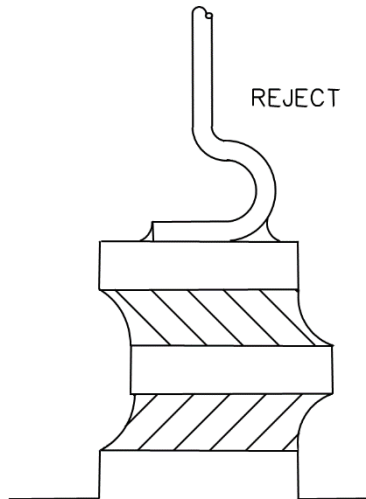


FIGURE 2074-G3. Element alignment.

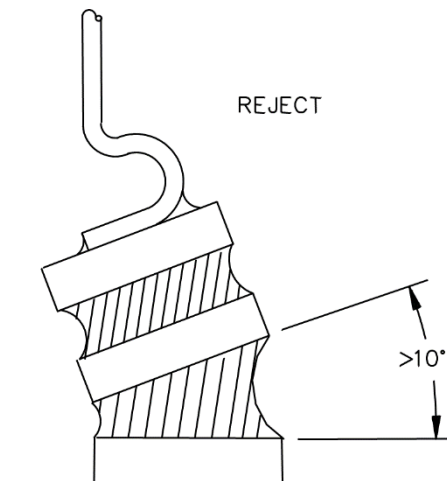


FIGURE 2074-G4. Element tilt.

- d. Die chipouts (see figure 2074–G5). Any device die that exhibits chipouts extending more than 25 percent of the die width or to within ~~2.0 mils~~ .002 inch (0.051 mm) of the junction area shall be cause for rejection.
- e. Die cracks (see figure 2074–G6). Any die exhibiting cracks that reduce the total die area (or cracks extending into or across the junction area) to less than 75 percent of its original area shall be cause for rejection.

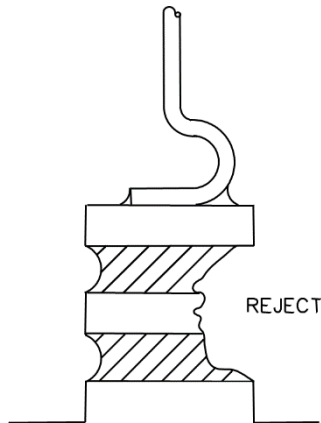


FIGURE 2074–G5. Die chipout.

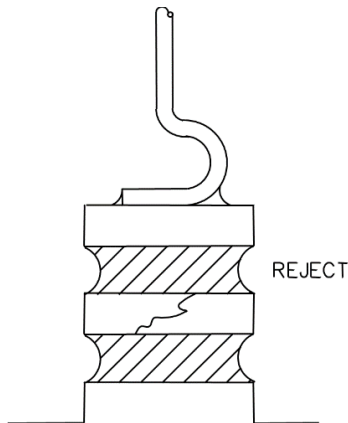


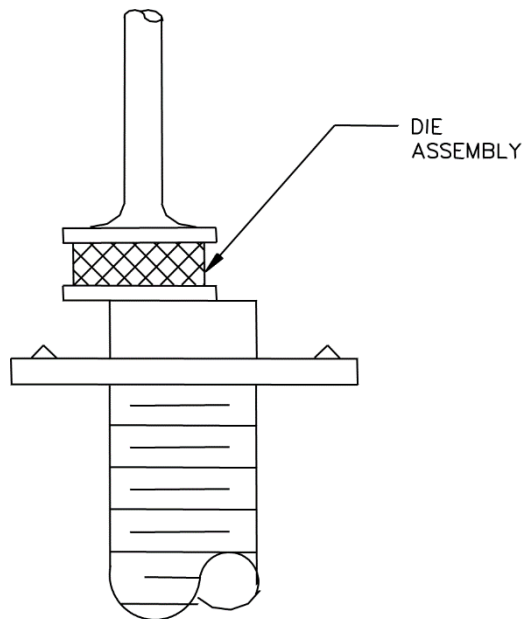
FIGURE 2074–G6. Die cracks.

- f. ~~Extraneous matter~~ Foreign material. A device shall be rejected if there are unattached solder balls, semiconductor material, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.

METAL BODY, STUD MOUNTED, SOLDER CONTACT DESIGN

H.1 General. This appendix contains the acceptance criteria for devices of the metal body, stud mounted, solder contact design. The following inspections shall be made prior to capping. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

H.1.1 Die and lead assembly (see figures 2074-H1 and 2074-H2). The die and lead assembly shall be located on the base pedestal so that there is complete contact over the design contact area. The lead shall be free of nicks and scrapes that reduce the lead diameter by more than 5 percent. The die and lead assembly shall not be tilted more than 5 degrees with respect to the base.

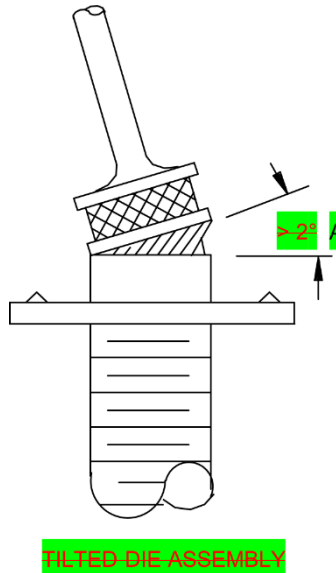


DIE NOT CENTRALLY LOCATED

FIGURE 2074-H1. Offset die.

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NOTE: Reject when angle A is greater than or equal to 5 degrees.

FIGURE 2074-H2. Tilted die and lead assembly.

H.1.2 Extraneous matter.

- Solder slivers and spikes. A device shall be rejected if solder slivers and spikes are not securely attached to the parent body of the solder. A securely attached sliver or spike is one having a cross sectional area greater at the area of attachment than anywhere else on the solder protrusion and having no necked-down areas.
- Foreign matter material. A device shall be rejected if there are unattached solder balls, semiconductor materials, chips, flaked plating, or opaque material that is larger than the smallest distance between exposed active areas.
- Multiple die attachments. A device shall be rejected if the attached portion of an adjacent die exceeds 25 percent of the die area.

H.1.3 Assembly defects.

- Tilted elements. A device shall be rejected if any element of the assembly is tilted in excess of 10 degrees from the normal mounting plane.
- Misaligned elements. A device shall be rejected if any element of the assembly is misaligned or displaced in excess of 33 percent of its width from the die or die stack centerline, bridges two active regions, or extends beyond the isolation region of the oxide.

METAL BODY, DIAMOND BASE CASE MOUNT REGULATORS, SOLDER CONTACT DESIGN

I.1 General ~~(see figure 2074-I1)~~. This appendix contains the acceptance criteria for devices of the metal body, diamond base case mount, solder contact design (see figure 2074-I1). The following inspections shall be made prior to capping. This appendix is a mandatory part of this test method. The information contained herein is intended for compliance.

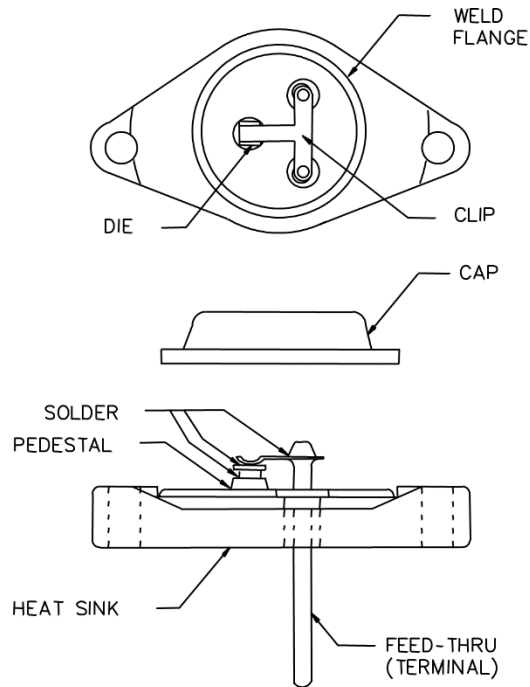


FIGURE 2074-I1. Metal body, diamond base case mount, solder contact construction.

I.1.1 Die-to-pedestal and die-to-clip solder connections.

- a. Solder voids. A device shall be rejected if solder flow is less than 50 percent of the perimeter of the minimum available contact area.
- b. Solder overflow. A device shall be rejected if any solder flow bridges from the top to bottom surface of the die or reduces the normal separation of two active regions by 50 percent or more.

I.1.2 Clip-to-post and feed-through to heat sink solder connections.

- a. Solder voids. A device shall be rejected if the wetting action of the solder to each member of the connection is not continuous.
- b. Solder overflow. A device shall be rejected if any solder flow extends on to any portion of the weld flange of the heat sink.