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Interpreting IPC-A-600 Requirements for Annular Rings and Laminate Cracks

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Interpreting IPC-A-600



The Requirements for Annular Rings and Laminate Cracks

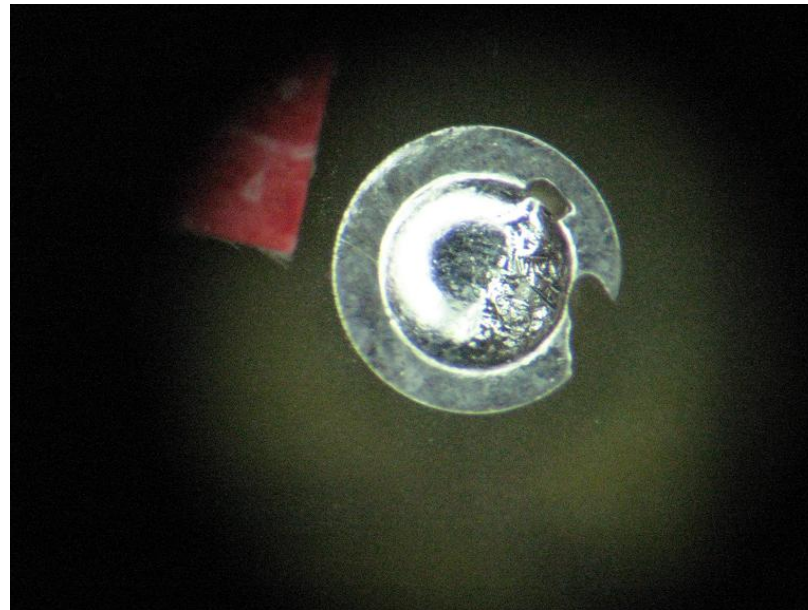


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Acceptable or Non Conforming?





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Definitions

- Make the distinction between
 - Annular Ring requirements and
 - Conductor Width requirements.



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Annular Ring Definition

- **External Annular Ring:** The minimum annular ring on external layers is the minimum amount of copper (at the narrowest point) between the edge of the hole and the edge of the land after plating of the finished hole. This is also identified as a supported hole.

Hole breakout refers to a condition where a hole is not completely surrounded by the land



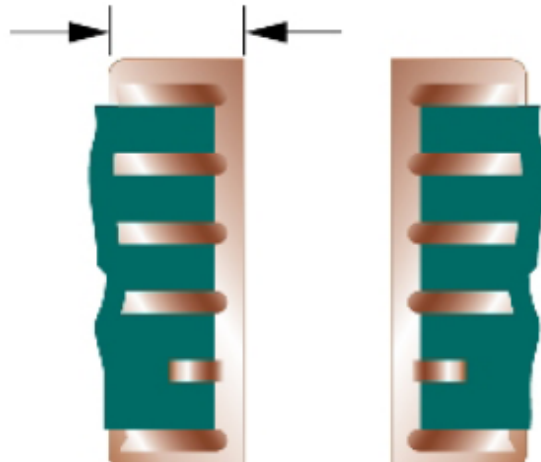
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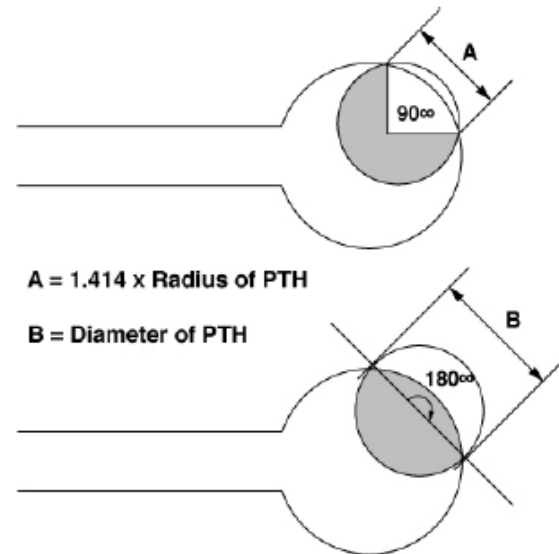
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Annular Ring Examples

Measurement of External Annular Ring



Break out of 90° and 180°



$$A = 1.414 \times \text{Radius of PTH}$$

$$B = \text{Diameter of PTH}$$



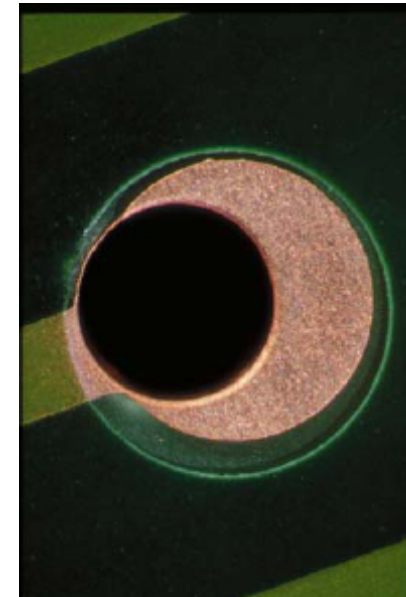
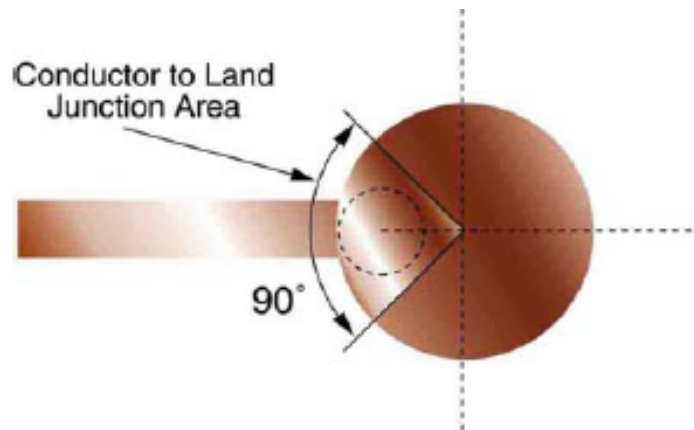
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Conductor to Land Junction Area

Conductor to Land Junction: A 90° area centered around the point where the conductor connects to the land and this area only applies to breakout conditions





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Annular Ring Acceptance Table

Characteristic	Class 1	Class 2	Class 3
Plated-through holes	180° breakout of hole from land is allowed provided minimum lateral spacing is maintained. The land/conductor junction is not reduced more than 30% of the minimum conductor width specified on the production master nominal.	90° breakout of hole from land is allowed provided minimum lateral spacing is maintained. The land/conductor junction is not reduced more than 20% of the minimum conductor width specified on the engineering drawing or the production master nominal. The conductor junction should never be less than 0.050 mm or the minimum line width, whichever is smaller.	The minimum annular ring shall not be less than 0.050 mm. The minimum external annular ring may have 20% reduction of the minimum annular ring in isolated areas due to defects such as pits, dents, nicks, pinholes, or splay.



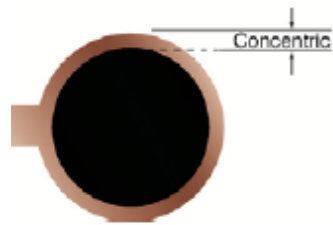
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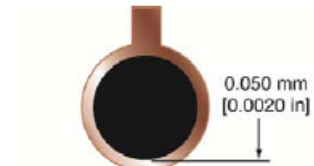
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Annular Ring Acceptance Criteria



Target Condition - Class 1, 2, 3

- Holes are centered in the lands.



Acceptable - Class 3

- Holes are not centered in the lands, but the annular ring measures 0.050 mm [0.0020 in] or more.



- The minimum external annular ring may have 20% reduction of the minimum annular at the measurement area due to defects such as pits, dents, nicks, pinholes, or splay.





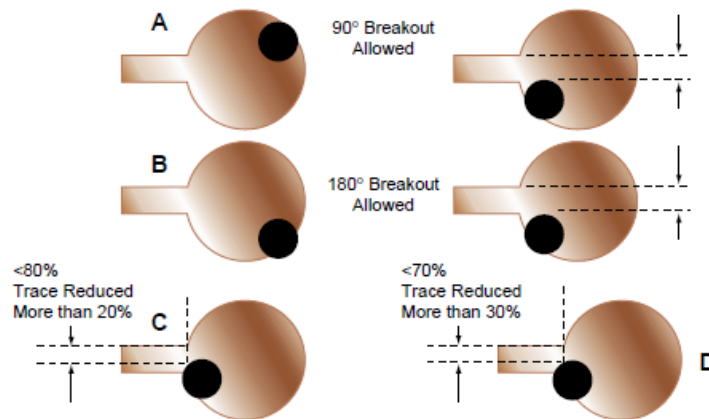
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Annular Ring Acceptance Criteria



Acceptable - Class 2

- 90° breakout or less (See item A)
- If breakout occurs at the conductor to land junction area, the land/ conductor junction is not reduced by more than 20% of the minimum conductor width specified on the engineering drawing or the production master nominal. The conductor junction should never be less than 0.050 mm [0.0020 in] or the minimum line width, whichever is smaller (See item C).
- Minimum lateral spacing is maintained.

Acceptable - Class 1

- 180° breakout or less (See item B).
- If breakout occurs at the conductor to land junction area, the conductor is not reduced by more than 30% of the minimum conductor width specified on the production master nominal (See item D).
- Form, fit and function are not affected.
- Minimum lateral spacing is maintained

Nonconforming – Class 1, 2, 3

- Defects either do not meet or exceed above criteria.



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Conductor Width



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IPC-6012 Definition

3.5.3 Conductor Imperfections

- The total combination of defect area lengths on a conductor **shall** not be greater than 10% of the conductor length or 25.0 mm [0.984 in] for Class 1 or 13.0 mm [0.512 in] for Class 2 or 3, whichever is less.

3.5.3.1 Conductor Width Reduction

- Allowable reduction of the minimum conductor width (specified or derived) due to misregistration or isolated defects (i.e., edge roughness, nicks, pinholes and scratches) which exposes base material **shall** not exceed 20% of the minimum conductor width for Class 2 and Class 3, and 30% of the minimum conductor width for Class 1.



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IPC-A-600 Definition of Conductor Width

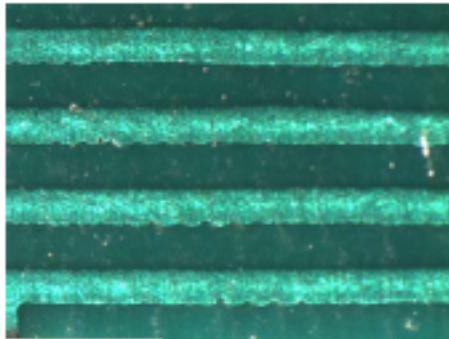


Figure 21011b



Acceptable - Class 2, 3

- Any combination of isolated edge roughness, nicks, pinholes, and scratches exposing base material that reduces the conductor width by 20% of the minimum value or less.
- There is no occurrence (edge roughness, nicks, etc.) greater than 10% of the conductor length or more than 13.0 mm [0.512 in], whichever is less.

Acceptable - Class 1

- Any combination of isolated edge roughness, nicks, pinholes, and scratches exposing base material that reduces the conductor width 30% of the minimum value or less.
- There is no occurrence (edge roughness, nicks, etc.) greater than 10% of the conductor length or more than 25.0 mm [0.984 in], whichever is less.

Nonconforming – Class 1, 2, 3

- Defects either do not meet or exceed above criteria.

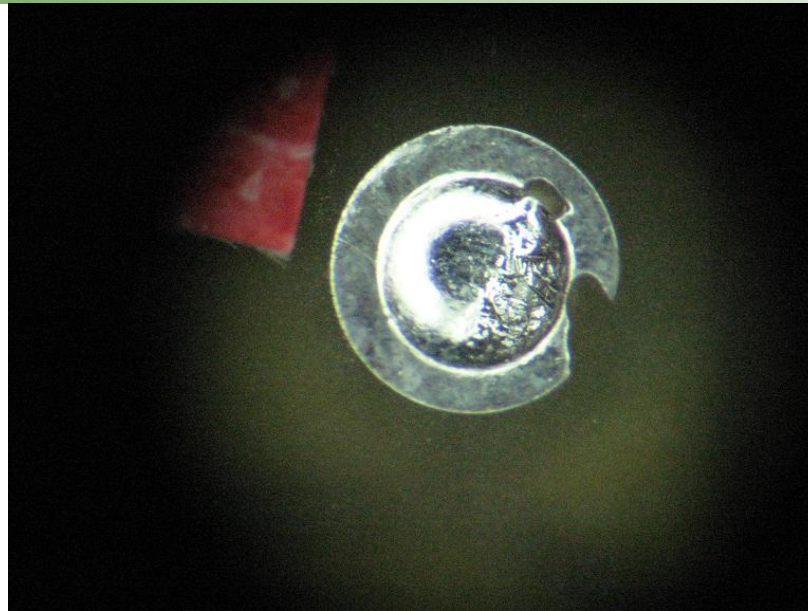


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Acceptable or Non Conforming?



This is a non conforming condition for all 3 Classes



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Laminate Cracks



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Definition

- If any portion of a crack that exists in Thermal Zone A cross over into Thermal Zone B, then it's entire dimension gets factored in to the minimum criteria for voids/cracks, that being 0.08 mm or less, in accordance with 3.1.1 of IPC-A-600H and 3.6.2.4 of IPC-6012C.
- We don't subtract from the laminate crack/void any portion of it that resides in Zone A. If it crosses between the two zones, it's treated in its entirety as a crack in Zone B.



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Laminate Cracks

3.1.1 Laminate Voids (Outside Thermal Zone)

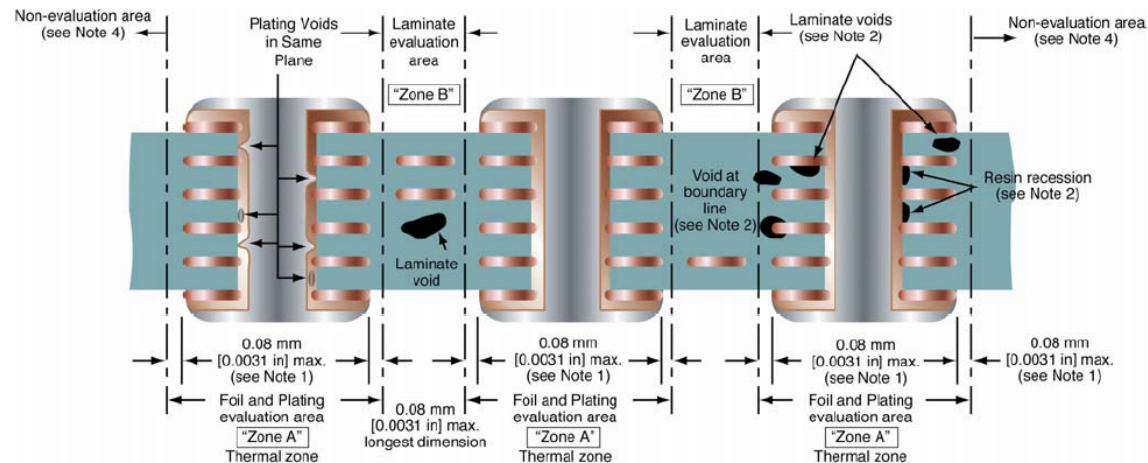


Figure 311a

Notes:

Note 1. The thermal zone extends 0.08 mm [0.0031 in] beyond the end of the land, either internal or external, extending furthest into the laminate area.

Note 2. Laminate anomalies or imperfections in the Zone A area are not evaluated on specimens which have been exposed to thermal stress or rework simulation.

Note 3. Delamination/Blistering is evaluated in both Zone A and Zone B.

Note 4. Laminate anomalies or imperfections in the non-evaluation areas are not evaluated on specimens which have been exposed to thermal stress or rework simulation.



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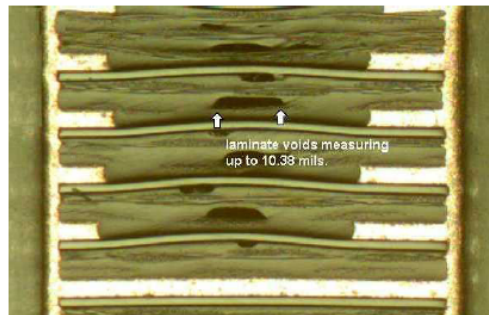
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Laminate Cracks



Acceptable - Class 2, 3

- Void less than or equal to 0.08 mm [0.0031 in] and does not violate minimum dielectric spacing.
- Laminate anomalies or imperfections, such as voids or resin recession, in Zone A areas that have been exposed to thermal stress and rework simulation.
- Multiple voids between two adjacent plated-through holes in the same plane shall not have combined length which exceeds these limits.



Acceptable - Class 1

- Void less than or equal to 0.15 mm [0.00591 in] and does not violate minimum dielectric spacing.
- Laminate anomalies or imperfections, such as voids or resin recession, in Zone A areas that have been exposed to thermal stress and rework simulation.
- Multiple voids between two adjacent plated-through holes in the same plane shall not have combined length which exceeds these limits.

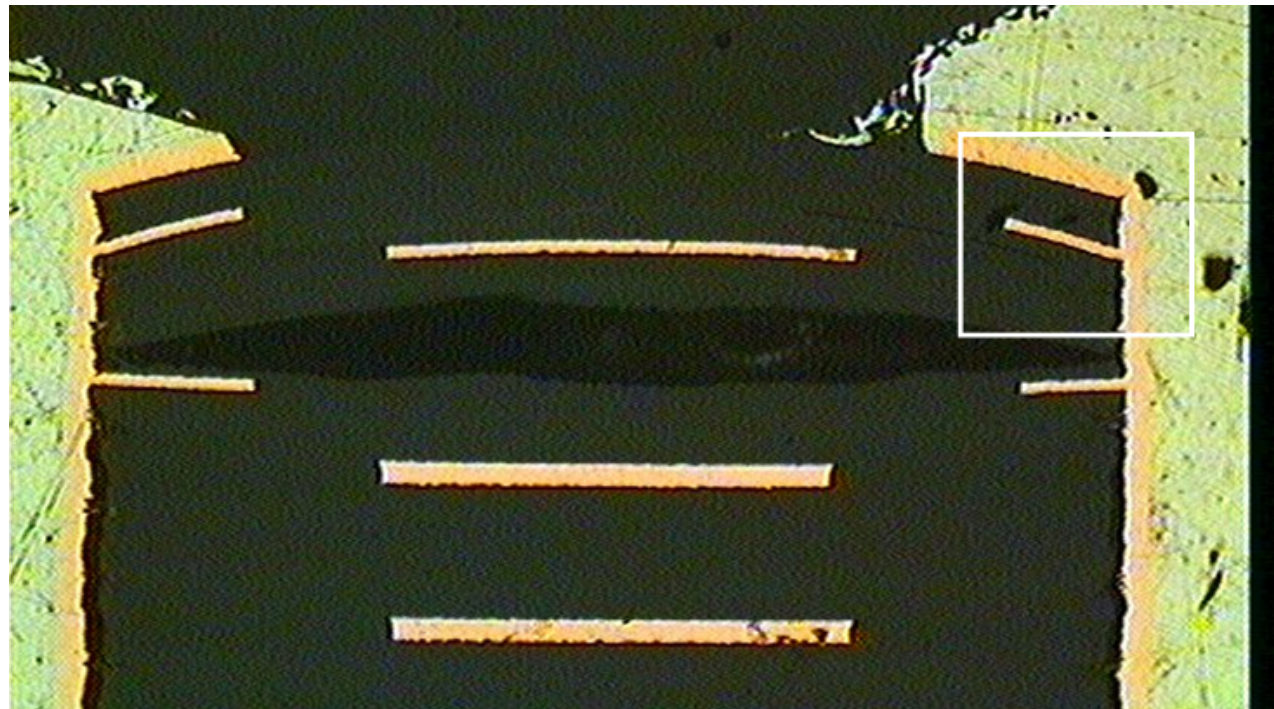


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Laminate Cracks



Adapted from : Metallization Process Technologies for Via-in-Pad Multilayer printed Wiring Boards

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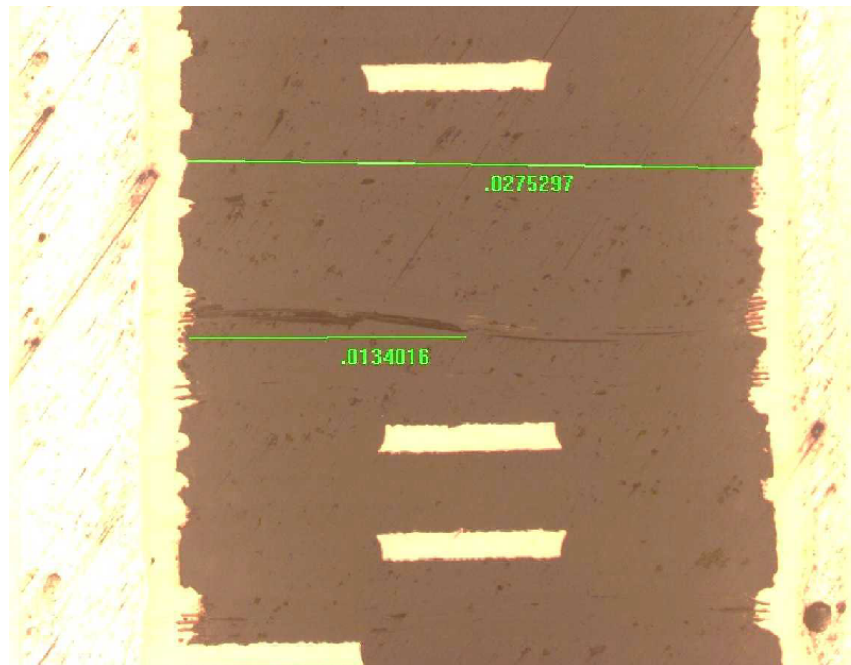
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