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The Need For Gold Removal On Solderable Surfaces



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The Criteria J-STD-001

- 4.5.1 Gold Removal
 - Gold Shall Be Removed: N1P2D3
 - From at least 95% of the surfaces to be soldered of the through-hole component leads with 2.54 μm [100 μin] or more of gold thickness
 - From 95% of all surfaces to be soldered of surface mount components regardless of gold thickness.
 - From the surfaces to be soldered of solder terminals plated with 2.54 μm [100 μin] or more of gold thickness.
 - A double tinning process or dynamic solder wave may be used for gold removal prior to soldering the component on or in the assembly, either Surface Mount or Plated Through Hole components



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The Criteria J-STD-001 ES

4.5.1 Gold Removal

- **Gold Shall Be Removed: D3**
 - Gold shall be removed from at least 95% of the surface to-be-soldered of all component leads, component terminations, and solder terminals.
 - A double tinning process or dynamic solder wave may be used for gold removal prior to mounting the component on the assembly



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The Criteria – IPC/ WHMA-A-620

4.1.2 Material, Components and Equipment – Gold Removal

Gold **shall**⁴ be removed from the surface to be soldered when the thickness of gold exceeds 2.5 μm [0.0001 in].

A double tinning process or dynamic solder wave may be used for gold removal.

These requirements may be eliminated if there is documented objective evidence available for review that there are no gold related solder embrittlement problems associated with the soldering process being used.

(4) Class 1-Not Est Class 2-Proc Ind Class 3-Defect



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The Criteria – NASA – 8739.3

- 7.2.5 c - Gold plating on all surfaces that become part of finished solder connections shall be removed by two or more successive tinning operations (solder pot or iron), or by other processes demonstrated to have equivalent effectiveness
- 7.3.1 Termination areas shall have been "tinned" with hot-coated tin-lead solder or hot reflowed electrodeposited tin-lead solder prior to mounting the parts (Requirement). Final solder terminations shall not be made to any PWB or solder cup that has not had the gold removed from the termination area (Requirement).



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J-STD-001 Changes Between Revisions of Docs

The new revision of 001 now states the components must be tinned prior to assembly into the product.



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Why Gold Plating

Pro

- Gold:
 - Does not tarnish
 - Does not oxidized
 - Is solderable
 - Has a long shelf life

Con

- Gold:
 - Porous
 - Can be too thick
 - Dissolves in Eutectic Tin/Lead
 - Creates embrittlement of solder joints



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What is the Problem?

- Gold embrittlement and voiding in SMT solder joints.
- Gold plated components falling off the board
- Evaluations exhibited Au-Sn intermetallic platelets distribute over the fracture surface and in the surface of the voids.

Gold Embrittlement of Solder Joints

By Ed Hare, Ph.D.

Updated – February 2010



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Gold Embrittlement

- Additional phases form when gold is dissolved into the eutectic tin-lead alloy. The most important phases are AuSn₄ and AuSn₂ intermetallic compound phases.
- The embrittlement is the result of a large volume fraction of hard Au-Sn IMC platelets in the ductile Sn-Pb matrix.



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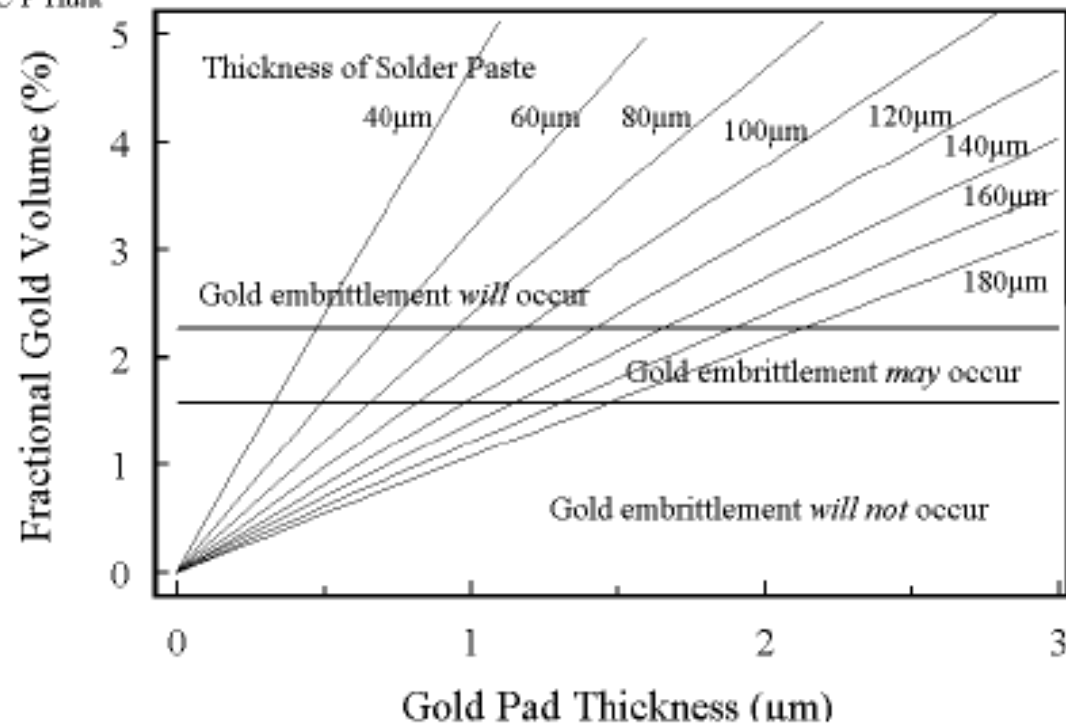


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Gold Embrittlement

National Physical Laboratory
C P Hunt

Gold Embrittlement



Electronics Interconnection
Free Downloads: www.npl.co.uk/ei



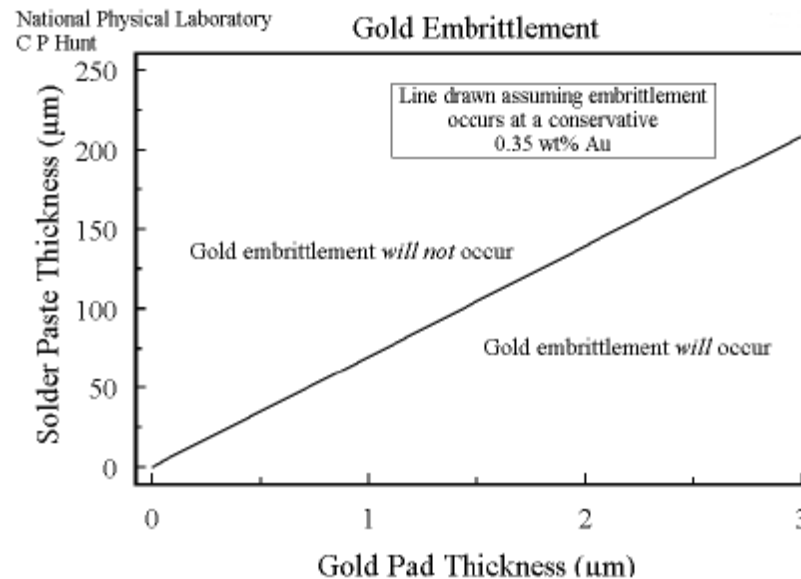
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Gold Embrittlement



The data presented in these figures are from a theoretical calculation and have not been tested in practice but should be useful as a guide to avoiding problems of embrittlement.

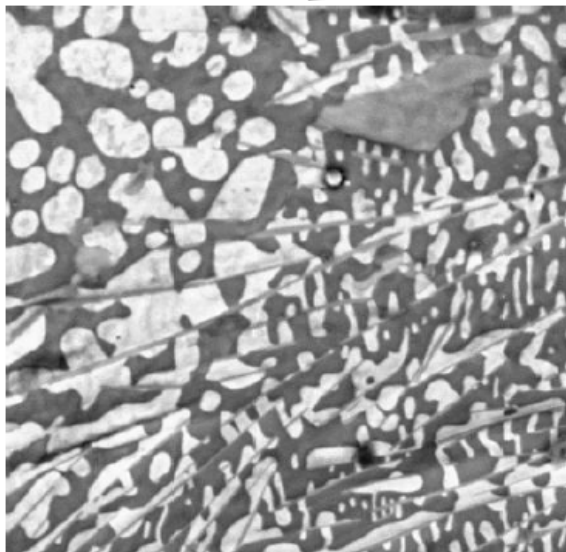


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Gold Embrittlement

- Eutectic tin-lead microstructure with gold embrittlement [BSE SEM image at 3400X]. Bright areas are Pb-phase, darker areas are Sn-phase, and intermediate contrast areas are Au-Sn IMC (primarily AuSn₄ and AuSn₂).
- Image processing was used to estimate the area fraction of IMC in this image, which was calculated at 20.5% corresponding to a severely embrittled solder joint.
- At a fixed concentration of gold, thinner plates would have a larger total interface area with the surrounding matrix and therefore a stronger contribution to the overall mechanical behavior of the solder joint. This makes it somewhat precarious to rely on general rules such as the 3 wt% gold threshold for embrittlement.



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Gold Embrittlement

- Figure 3: [Ref. IFN 897A_1, BSE SEM image, 94X] This is a BSE SEM image of the fracture surfaces of failed connector solder joints. There is severe voiding and flux entrapment (dark material) associated with the fracture surface.



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Gold Embrittlement

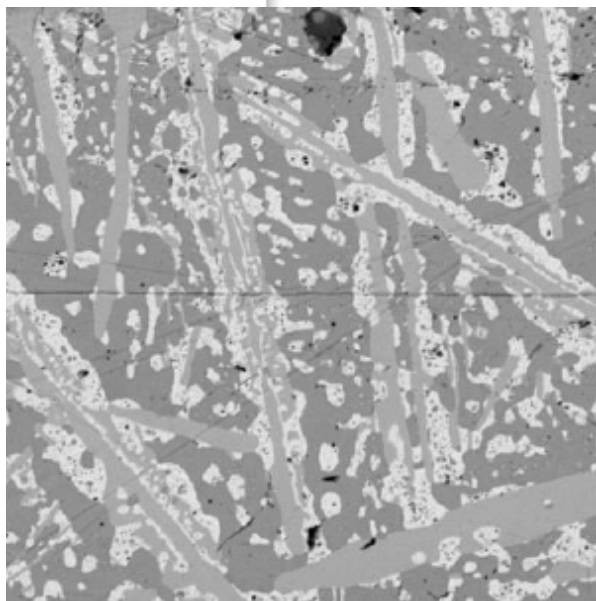


Figure 5: [Ref. IFN 370_5, BSE SEM image, 1513X]. This is the microstructure of the solder joint showing the distribution of Sn-phase (dark gray), Pb-phase (light gray) and Au-Sn IMC (intermediate gray). Image analysis suggests the Au-Sn IMC is ~28% area fraction. EDS results gave ~ 10 wt% Au, which is ~3X the 3 wt% threshold.

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Gold Embrittlement

Typical Gold Plated Items

- Lead Frames
- Special ASIC component
- Connector Pins
- Terminals
 - Cups
- Board Contact
- Board conductor traces



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Class 3 requirement

- Double tinning of the gold plated item to remove all the gold.
- Train all people to build and solder to class three



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Thank You

Any Questions?



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Further Information

Next Month I will discuss

What are Intermetallic Compounds as related to Tin and Tin/Lead Soldering

For questions regarding this webinar, please
contact Leo Lambert at leo@eptac.com

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Certification Courses, please visit our website at
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