



IPC-A-600H-2010

Acceptability of Printed Boards

Developed by the IPC-A-600 Task Group (7-31a) of the Product Assurance Committee (7-30) of IPC

Supersedes:

IPC-A-600G - July 2004

IPC-A-600F - November 1999

Users of this publication are encouraged to participate in the development of future revisions.

Contact:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

Table of Contents

<p>Acknowledgment i</p> <p>1 Introduction 1</p> <p>1.1 Scope 1</p> <p>1.2 Purpose 1</p> <p>1.3 Approach To This Document 1</p> <p>1.4 Classification 1</p> <p>1.5 Acceptance Criteria 2</p> <p>1.6 Applicable Documents 3</p> <p style="padding-left: 20px;">1.6.1 IPC 3</p> <p style="padding-left: 20px;">1.6.2 American Society of Mechanical Engineers 3</p> <p>1.7 Dimensions and Tolerances 3</p> <p>1.8 Terms and Definitions 3</p> <p>1.9 Revision Level Changes 3</p> <p>1.10 Workmanship 3</p> <p>2 Externally Observable Characteristics 4</p> <p>2.1 Printed Board Edges 4</p> <p style="padding-left: 20px;">2.1.1 Burrs 4</p> <p style="padding-left: 40px;">2.1.1.1 Nonmetallic Burrs 5</p> <p style="padding-left: 40px;">2.1.1.2 Metallic Burrs 6</p> <p style="padding-left: 20px;">2.1.2 Nicks 7</p> <p style="padding-left: 20px;">2.1.3 Haloing 8</p> <p>2.2 Base Material Surface 9</p> <p style="padding-left: 20px;">2.2.1 Weave Exposure 10</p> <p style="padding-left: 20px;">2.2.2 Weave Texture 11</p> <p style="padding-left: 20px;">2.2.3 Exposed/Disrupted Fibers 12</p> <p style="padding-left: 20px;">2.2.4 Pits and Voids 13</p> <p>2.3 Base Material Subsurface 14</p> <p style="padding-left: 20px;">2.3.1 Measling 17</p> <p style="padding-left: 20px;">2.3.2 Cracking 18</p> <p style="padding-left: 20px;">2.3.3 Delamination/Blister 20</p> <p style="padding-left: 20px;">2.3.4 Foreign Inclusions 22</p> <p>2.4 Solder Coatings and Fused Tin Lead 24</p> <p style="padding-left: 20px;">2.4.1 Nonwetting 24</p> <p style="padding-left: 20px;">2.4.2 Dewetting 25</p> <p>2.5 Holes – Plated-Through – General 27</p> <p style="padding-left: 20px;">2.5.1 Nodules/Burrs 27</p> <p style="padding-left: 20px;">2.5.2 Pink Ring 28</p> <p style="padding-left: 20px;">2.5.3 Voids – Copper Plating 29</p> <p style="padding-left: 20px;">2.5.4 Voids – Finished Coating 30</p> <p style="padding-left: 20px;">2.5.5 Lifted Lands – (Visual) 31</p> <p style="padding-left: 20px;">2.5.6 Cap Plating of Filled Holes – (Visual) 32</p> <p>2.6 Holes – Unsupported 34</p> <p style="padding-left: 20px;">2.6.1 Haloing 34</p>	<p>2.7 Printed Contacts 35</p> <p style="padding-left: 20px;">2.7.1 Surface Plating – Plated Contacts 35</p> <p style="padding-left: 40px;">2.7.1.1 Surface Plating – Wire Bond Pads 37</p> <p style="padding-left: 20px;">2.7.2 Burrs on Edge-Board Contacts 39</p> <p style="padding-left: 20px;">2.7.3 Adhesion of Overplate 40</p> <p>2.8 Marking 41</p> <p style="padding-left: 20px;">2.8.1 Etched Marking 42</p> <p style="padding-left: 20px;">2.8.2 Screened or Ink Stamped Marking 44</p> <p>2.9 Solder Mask 46</p> <p style="padding-left: 20px;">2.9.1 Coverage Over Conductors (Skip Coverage) 47</p> <p style="padding-left: 20px;">2.9.2 Registration to Holes (All Finishes) 48</p> <p style="padding-left: 20px;">2.9.3 Registration to Other Conductive Patterns 49</p> <p style="padding-left: 40px;">2.9.3.1 Ball Grid Array (Solder Mask-Defined Lands) 50</p> <p style="padding-left: 40px;">2.9.3.2 Ball Grid Array (Copper-Defined Lands) 51</p> <p style="padding-left: 40px;">2.9.3.3 Ball Grid Array (Solder Dam) 52</p> <p style="padding-left: 20px;">2.9.4 Blisters/Delamination 53</p> <p style="padding-left: 20px;">2.9.5 Adhesion (Flaking or Peeling) 55</p> <p style="padding-left: 20px;">2.9.6 Waves/Wrinkles/Ripples 56</p> <p style="padding-left: 20px;">2.9.7 Tenting (Via Holes) 57</p> <p style="padding-left: 20px;">2.9.8 Soda Strawing 58</p> <p>2.10 Pattern Definition – Dimensional 60</p> <p style="padding-left: 20px;">2.10.1 Conductor Width and Spacing 60</p> <p style="padding-left: 40px;">2.10.1.1 Conductor Width 61</p> <p style="padding-left: 40px;">2.10.1.2 Conductor Spacing 62</p> <p style="padding-left: 20px;">2.10.2 External Annular Ring – Measurement 63</p> <p style="padding-left: 20px;">2.10.3 External Annular Ring – Supported Holes 64</p> <p style="padding-left: 20px;">2.10.4 External Annular Ring – Unsupported Holes 66</p> <p>2.11 Flatness 67</p> <p>3 Internally Observable Characteristics 69</p> <p>3.1 Dielectric Materials 70</p> <p style="padding-left: 20px;">3.1.1 Laminate Voids/Cracks (Outside Thermal Zone) 70</p> <p style="padding-left: 20px;">3.1.2 Registration/Conductor to Holes 72</p> <p style="padding-left: 20px;">3.1.3 Clearance Hole, Unsupported, to Power/Ground Planes 73</p> <p style="padding-left: 20px;">3.1.4 Delamination/Blister 74</p> <p style="padding-left: 20px;">3.1.5 Etchback 75</p> <p style="padding-left: 40px;">3.1.5.1 Etchback 76</p> <p style="padding-left: 40px;">3.1.5.2 Negative Etchback 78</p> <p style="padding-left: 20px;">3.1.6 Smear Removal 79</p>
--	--

Table of Contents (cont.)

3.1.7	Dielectric Material, Clearance, Metal Plane for Supported Holes	81	4.1.2	Coverlay/Covercoat Coverage – Adhesives	124
3.1.8	Layer-to-Layer Spacing	82	4.1.2.1	Adhesive Squeeze-Out – Land Area	124
3.1.9	Resin Recession	83	4.1.2.2	Adhesive Squeeze-Out – Foil Surface	125
3.1.10	Hole Wall Dielectric/Plated Barrel Separation (Hole Wall Pullaway)	84	4.1.3	Access Hole Registration for Coverlay and Stiffeners	126
3.2	Conductive Patterns – General	85	4.1.4	Plating Defects	127
3.2.1	Etching Characteristics	86	4.1.5	Stiffener Bonding	128
3.2.2	Print and Etch	88	4.1.6	Transition Zone, Rigid Area to Flexible Area	129
3.2.3	Surface Conductor Thickness (Foil Plus Plating)	89	4.1.7	Solder Wicking/Plating Penetration Under Coverlay	130
3.2.4	Foil Thickness – Internal Layers	90	4.1.8	Laminate Integrity	131
3.3	Plated-Through Holes – General	91	4.1.8.1	Laminate Integrity – Flexible Printed Board	132
3.3.1	Annular Ring – Internal Layers	93	4.1.8.2	Laminate Integrity – Rigid-Flex Printed Board	133
3.3.2	Lifted Lands – (Cross-Sections)	95	4.1.9	Etchback (Type 3 and Type 4 Only)	134
3.3.3	Foil Crack – (Internal Foil) “C” Crack	96	4.1.10	Smear Removal (Type 3 and 4 Only)	135
3.3.4	Foil Crack (External Foil)	97	4.1.11	Trimmed Edges/Edge Delamination	136
3.3.5	Plating Crack (Barrel) “E” Crack	98	4.1.12	Fold/Bend Marks	138
3.3.6	Plating Crack – (Corner) “F” Crack ...	99	4.1.13	Silver Film Integrity	139
3.3.7	Plating Nodules	100	4.2	Metal Core Printed Boards	141
3.3.8	Copper Plating Thickness – Hole Wall	101	4.2.1	Type Classifications	142
3.3.9	Copper Wrap Plating	102	4.2.2	Spacing Laminated Type	143
3.3.10	Plating Voids	104	4.2.3	Insulation Thickness, Insulated Metal Substrate	144
3.3.11	Solder Coating Thickness (Only When Specified)	105	4.2.4	Insulation Material Fill, Laminated Type Metal Core	145
3.3.12	Solder Mask Thickness	106	4.2.5	Cracks in Insulation Material Fill, Laminated Type	146
3.3.13	Wicking	107	4.2.6	Core Bond to Plated-Through Hole Wall	147
3.3.13.1	Wicking, Clearance Holes	108	4.3	Flush Printed Boards	148
3.3.14	Innerlayer Separation – Vertical (Axial) Microsection	109	4.3.1	Flushness of Surface Conductor	148
3.3.15	Innerlayer Separation – Horizontal (Transverse) Microsection	110	5	Cleanliness Testing	149
3.3.16	Material Fill of Blind and Buried Vias	111	5.1	Solderability Testing	150
3.3.17	Cap Plating of Filled Holes	113	5.1.1	Plated-Through Holes (Applicable to Test C/C1)	151
3.4	Plated-Through Holes – Drilled	115	5.2	Electrical Integrity	152
3.4.1	Burrs	116			
3.4.2	Nailheading	117			
3.5	Plated-Through Holes – Punched	118			
3.5.1	Roughness and Nodules	119			
3.5.2	Flare	120			
4	Miscellaneous	121			
4.1	Flexible and Rigid-Flex Printed Boards	122			
4.1.1	Coverlay Coverage – Coverfilm Separations	123			

1 INTRODUCTION

Introduction

1.1 SCOPE

This document describes the preferred, acceptable, and non-conforming conditions that are either externally or internally observable on printed boards. It represents the visual interpretation of minimum requirements set forth in various printed board specifications, e.g.; IPC-6010 series, J-STD-003, etc.

1.2 PURPOSE

The visual illustrations in this document portray specific criteria of the requirements of current IPC specifications. In order to properly apply and use the content of this document, the printed board should comply with the design requirements of the applicable IPC-2220 series document and the performance requirements of the applicable IPC-6010 series document. In the event the printed board does not comply with these or equivalent requirements, then the acceptance criteria should be as agreed between user and supplier (AABUS).

1.3 APPROACH TO THIS DOCUMENT

Characteristics are divided into two general groups:

- Externally Observable (section 2)
- Internally Observable (section 3)

“Externally observable” conditions are those features or imperfections which can be seen and evaluated on or from the exterior surface of the board. In some cases, such as voids or blisters, the actual condition is an internal phenomenon and is detectable from the exterior.

“Internally observable” conditions are those features or imperfections that require microsectioning of the specimen or other forms of conditioning for detection and evaluation. In some cases, these features may be visible from the exterior and require microsectioning in order to assess acceptability requirements.

Specimens should be illuminated during evaluation to the extent needed for effective examination. The illumination should be such that no shadow falls on the area of interest except those shadows caused by the specimen itself. It is recommended that polarization and/or dark field illumination be employed to prevent glare during the examination of highly reflective materials.

The illustrations in this document portray specific criteria relating to the heading and subheading of each page, with brief descriptions of the acceptable and nonconforming conditions for each product class. (See 1.4.) The visual quality acceptance criteria are intended to provide proper tools for the evaluation of visual anomalies. The illustrations and photographs in each situation are related to specific requirements.

The characteristics addressed are those that can be evaluated by visual observation and/or measurement of visually observable features.

Supported by appropriate user requirements, this document should provide effective visual criteria to quality assurance and manufacturing personnel.

This document cannot cover all of the reliability concerns encountered in the printed board industry; therefore, attributes not addressed in this issue **shall** be AABUS. The value of this document lies in its use as a baseline document that may be modified by expansions, exceptions, and variations which may be appropriate for specific applications.

When making accept and/or reject decisions, the awareness of documentation precedence must be maintained.

This document is a tool for observing how a product may deviate due to variation in processes. Refer to IPC-9191.

IPC-A-600 provides a useful tool for understanding and interpreting Automated Inspection Technology (AIT) results. AIT may be applicable to the evaluation of many of the dimensional characteristics illustrated in this document.

1.4 CLASSIFICATION

This standard recognizes that electrical and electronic products are subject to classifications by intended end-item use. Three general end-product classes have been established to reflect differences in producibility, complexity, functional performance requirements, and verification (inspection/test) frequency. It should be recognized that there may be overlaps of product between classes.

Process Indicator imperfections are permitted and are deliverable.

The user is responsible for defining the product class. The procurement documentation package **shall** state the product class and any exceptions to specific parameters, where appropriate.

Criteria defined in this document reflect three classes, which are as follows:

Class 1 — Includes limited life products suitable for applications where the requirement is function of the completed product.

Class 2 — Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical.

Class 3 — Includes products where continued high performance or performance-on-demand is critical, product downtime cannot be tolerated, and the product must function when required.