



IPC-A-600J

Acceptability of Printed Boards

If a conflict occurs between the English and translated versions of this document, the English version will take precedence.

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

Supersedes:

IPC-A-600H - April 2010
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

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> 1.6.1 IPC 3</p> <p> 1.6.2 American Society of Mechanical Engineers 4</p> <p> 1.7 Dimensions and Tolerances 4</p> <p> 1.8 Terms and Definitions 4</p> <p> 1.9 Revision Level Changes 4</p> <p> 1.10 Workmanship 4</p> <p>2 Externally Observable Characteristics 5</p> <p> 2.1 Printed Board Edges 5</p> <p> 2.1.1 Burrs 5</p> <p> 2.1.1.1 Nonmetallic Burrs 6</p> <p> 2.1.1.2 Metallic Burrs 7</p> <p> 2.1.2 Nicks 8</p> <p> 2.1.3 Haloing 9</p> <p> 2.2 Base Material Surface 10</p> <p> 2.2.1 Weave Exposure 11</p> <p> 2.2.2 Weave Texture 12</p> <p> 2.2.3 Exposed/Disrupted Fibers 13</p> <p> 2.2.4 Pits and Voids 14</p> <p> 2.3 Base Material Subsurface 15</p> <p> 2.3.1 Measling 20</p> <p> 2.3.2 Crazeing 22</p> <p> 2.3.3 Delamination/Blister 25</p> <p> 2.3.4 Foreign Inclusions 28</p> <p> 2.4 Solder Coatings and Fused Tin Lead 30</p> <p> 2.4.1 Nonwetting 30</p> <p> 2.4.2 Dewetting 31</p> <p> 2.5 Holes – Plated-Through – General 33</p> <p> 2.5.1 Nodules/Rough Plating 33</p> <p> 2.5.2 Pink Ring 34</p> <p> 2.5.3 Voids – Copper Plating 35</p> <p> 2.5.4 Voids – Finished Coating 36</p> <p> 2.5.5 Lifted Lands – (Visual) 37</p> <p> 2.5.6 Cap Plating of Filled Holes – (Visual) 38</p>	<p> 2.6 Holes – Unsupported 40</p> <p> 2.6.1 Haloing 40</p> <p> 2.7 Printed Contacts 41</p> <p> 2.7.1 Surface Plating – Edge Connector Lands 41</p> <p> 2.7.1.1 Surface Plating – Rectangular Surface Mount Lands 43</p> <p> 2.7.1.2 Surface Plating – Round Surface Mount Lands (BGA) 45</p> <p> 2.7.1.3 Surface Plating – Wire Bond Pads .. 47</p> <p> 2.7.2 Burrs on Edge-Board Contacts 49</p> <p> 2.7.3 Adhesion of Overplate 50</p> <p> 2.8 Marking 52</p> <p> 2.8.1 Etched Marking 54</p> <p> 2.8.2 Ink Marking 56</p> <p> 2.9 Solder Mask 58</p> <p> 2.9.1 Coverage Over Conductors (Skip Coverage) 59</p> <p> 2.9.2 Registration to Holes (All Finishes) ... 60</p> <p> 2.9.3 Registration to Rectangular Surface Mount Lands 61</p> <p> 2.9.3.1 Registration to Round Surface Mount Lands (BGA) – Solder Mask-Defined Lands 62</p> <p> 2.9.3.2 Registration to Round Surface Mount Lands (BGA) – Copper-Defined Lands 63</p> <p> 2.9.3.3 Registration to Round Surface Mount Lands (BGA) – (Solder Dam) 64</p> <p> 2.9.4 Blisters/Delamination 65</p> <p> 2.9.5 Adhesion (Flaking or Peeling) 67</p> <p> 2.9.6 Waves/Wrinkles/Ripples 68</p> <p> 2.9.7 Tenting (Via Holes) 69</p> <p> 2.9.8 Soda Strawing 70</p> <p> 2.10 Pattern Definition – Dimensional 72</p> <p> 2.10.1 Conductor Width and Spacing 72</p> <p> 2.10.1.1 Conductor Width 73</p> <p> 2.10.1.2 Conductor Spacing 74</p> <p> 2.10.2 External Annular Ring – Measurement 75</p> <p> 2.10.3 External Annular Ring – Supported Holes and Microvia Capture Land ... 76</p> <p> 2.10.4 External Annular Ring – Unsupported Holes 78</p> <p> 2.11 Flatness 79</p>
--	--

Table of Contents (cont.)

3 Internally Observable Characteristics	81	3.3.17 Copper Plating Thickness – Hole Wall	131
3.1 Dielectric Materials	82	3.3.18 Copper Wrap Plating	132
3.1.1 Laminate Voids/Cracks (Outside Thermal Zone)	82	3.3.19 Copper Cap Plating of Filled Holes	135
3.1.2 Registration/Conductor to Holes	84	3.3.20 Plated Copper Filled Microvias (Blind and Buried)	137
3.1.3 Clearance Hole, Unsupported, to Power/Ground Planes	85	3.3.21 Material Fill of Through, Blind, Buried and Microvia Structures (Other than Copper Plating)	139
3.1.4 Delamination/Blister	86	3.3.22 Solder Coating Thickness (Only When Specified)	141
3.1.5 Dielectric Removal	87	3.3.23 Solder Mask Thickness	142
3.1.5.1 Etchback	89	3.4 Plated-Through Holes – Drilled	143
3.1.5.2 Smear Removal	91	3.4.1 Burrs	144
3.1.5.3 Negative Etchback	93	3.4.2 Nailheading	145
3.1.6 Dielectric Material, Clearance, Metal Plane for Supported Holes	95	3.5 Plated-Through Holes – Punched	146
3.1.7 Layer-to-Layer Spacing	96	3.5.1 Roughness and Nodules	147
3.1.8 Resin Recession	98	3.5.2 Flare	148
3.1.9 Hole Wall Dielectric/Plated Barrel Separation (Hole Wall Pullaway)	99	4 Miscellaneous	149
3.2 Conductive Patterns – General	100	4.1 Flexible and Rigid-Flex Printed Boards	149
3.2.1 Etching Characteristics	102	4.1.1 Coverlay Coverage – Coverfilm Separations	150
3.2.2 Print and Etch	104	4.1.2 Coverlay/Covercoat Coverage – Adhesives	152
3.2.3 External Conductor Thickness (Foil Plus Plating)	105	4.1.2.1 Adhesive Squeeze-Out – Land Area	152
3.2.4 Internal Layer Foil Thickness	106	4.1.2.2 Adhesive Squeeze-Out – Foil Surface	153
3.3 Plated-Through Holes – General	107	4.1.3 Access Hole Registration for Coverlay and Stiffeners	154
3.3.1 Copper Plating Voids	109	4.1.4 Plating Defects	155
3.3.2 Plating Nodules	110	4.1.5 Stiffener Bonding	156
3.3.3 Plating Folds/Inclusions	111	4.1.6 Transition Zone, Rigid Area to Flexible Area	157
3.3.4 Wicking	113	4.1.7 Solder Wicking/Plating Penetration Under Coverlay	158
3.3.4.1 Wicking, Clearance Holes	114	4.1.8 Laminate Integrity	159
3.3.5 Innerlayer Inclusions	115	4.1.8.1 Laminate Integrity – Flexible Printed Board	160
3.3.6 Innerlayer Separation – Vertical (Axial) Microsection	116	4.1.8.2 Laminate Integrity – Rigid-Flex Printed Board	161
3.3.7 Innerlayer Separation – Horizontal (Transverse) Microsection	117	4.1.9 Etchback (Type 3 and Type 4 Only)	162
3.3.8 Foil Crack – (Internal Foil) “C” Crack	118	4.1.10 Smear Removal (Type 3 and 4 Only)	163
3.3.9 Foil Crack (External Foil)	119	4.1.11 Trimmed Edges/Edge Delamination	164
3.3.10 Plating Crack (Barrel) “E” Crack	120		
3.3.11 Plating Crack – (Corner) “F” Crack	121		
3.3.12 Annular Ring – Internal Layers	122		
3.3.13 Annular Ring – Microvia to Target Land	125		
3.3.14 Microvia Target Land Contact Dimension	127		
3.3.15 Microvia Target Land Penetration	129		
3.3.16 Lifted Lands – (Cross-Sections)	130		

Table of Contents (cont.)

4.1.12	Silver Film Integrity	166
4.2	Metal Core Printed Boards	168
4.2.1	Type Classifications	169
4.2.2	Spacing Laminated Type	170
4.2.3	Insulation Thickness, Insulated Metal Substrate	171
4.2.4	Insulation Material Fill, Laminated Type Metal Core	172
4.2.5	Cracks in Insulation Material Fill, Laminated Type	173
4.2.6	Core Bond to Plated-Through Hole Wall	174
4.3	Flush Printed Boards	175
4.3.1	Flushness of Surface Conductor	175
5	Cleanliness Testing	176
5.1	Solderability Testing	177
5.1.1	Plated-Through Holes (Applicable to Test C/C1)	178
5.2	Electrical Integrity	180

1 INTRODUCTION

Introduction

1.1 SCOPE

This document describes the target, acceptable, and nonconforming 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.