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ELECTRONICS INDUSTRIES ®

# IPC-HDBK-610

## Handbook and Guide to IPC-A-610 (Includes IPC-A-610B to C Comparison)

**IPC-HDBK-610**
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A standard developed by IPC

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- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

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- Increase time-to-market
- Keep people out
- Increase cycle time
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- Contain anything that cannot be defended with data

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Adopted October 6. 1998

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Developed by the IPC-HDBK-610 Task Group (7-31g) of the Product Assurance Committee (7-30) of IPC

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

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# Acknowledgment

Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the IPC-HDBK-610 Task Group (7-31g) of the Product Assurance Committee (7-30) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

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# Handbook and Guide to IPC-A-610 (Includes IPC-A-610B to C Comparison)

## 1 ACCEPTABILITY OF ELECTRONIC ASSEMBLIES

**1.0.1 Preamble/Foreword** This handbook is a companion reference to and was prepared using IPC-A-610C and IPC-A-610C Amendment 1. The amendment provides additional criteria and clarification statements. The amendment is included with this handbook following Appendix C and can be downloaded at no cost from the IPC website at the following link:

www.ipc.org/html/610C%2BAmendment.pdf

Electrical Conductor Spacing that is provided in IPC-A-610C Appendix A has been incorporated into the text of this handbook and is also included as Appendix A to this handbook.

Information on metric conversion is provided as Appendix B.

An expanded subject matter based cross-reference of the two versions is provided in Appendix C.

A copy of the IPC-A-610 Department of Defense Adoption Notice is provided as Appendix D.

The intent of this handbook is to explain the technical rationale for selected Acceptability, Process Indicator and Defect criteria and to provide information regarding assembly technology. Additional information is provided to give a broader understanding of the process considerations needed for the production of acceptable hardware.

**Note:** Not all information provided in IPC-A-610C is addressed in this handbook.

While IPC-T-50 establishes unique definitions for the acronyms PCB, PWB, PCA and PWA, the term PCB (printed circuit board) is used generically in this handbook.

**1.0.2 Format of this Handbook** The section and paragraph numbers in this handbook refer and correspond to the section and paragraph numbers in Revision C of IPC-A-610. Where used verbatim, text of IPC-A-610C is identified by being boxed.

For the purposes of the handbook, a capitalized ‘‘Standard’’ in the handbook text refers to IPC-A-610C. It should also be noted that any references in the handbook text (not text taken from the Standard) refer to sections, tables, and figures in the handbook; see Example 1. References in the handbook text to sections, tables, and figures in the Standard will be followed by ‘‘of the Standard’’; see Example 2.

***Example 1:***

> 4.4.2 For more information on adhesive on areas to be soldered see 12.1 on page 12-3 of the Standard.

***Example 2:***

> 9.1.2 For more information on magnification power for inspection see Table 1-2 of the Standard.

Text excerpted from documents other than IPC-A-610 is shown in **BOLD SMALL CAPS** to assist with clarity.

**1.0.3 Supplemental Definitions** These supplemental definitions are provided to assist the reader in understanding the intent of portions of the text of the Standard. Terms used in the Standard or this Handbook and not otherwise defined are defined as follows. Definitions from IPC-T-50 are identified with *.

***Barely/slightly*** **–** By a very little, almost not discernable/measurable/perceptible.

***Clearly*** **–** Free from anything that dims, obscures or inhibits observation. Easily discernable to the eye.

***Coefficient of Thermal Expansion*** **–** The CTE is the amount that a material (component, PWB laminate, etc.) changes dimension as a result of temperature change. The CTE is expressed in parts per million per degree Celsius (p/m/C°). The CTE differential that exists between the component and the PWB is a factor in determining the reliability of the assembly. If a ceramic surface mount component that has a CTE of 6p/m/C° is placed on a laminate material such as FR-4 that has a CTE of 14 - 16 p/m/C°, the designer needs to assure that compliance of the component leads is sufficient to accommodate the differential in CTE. The coefficient of thermal expansion (CTE) is sometimes also referred to as the Thermal Coefficient of Expansion (TCE). In this Handbook the term CTE is used.

***Disposition*** **–** A final settlement. The act of identifying the action to be taken on a Defect.

***Minimum Electrical Clearance (Minimum Electrical Spacing)**** **–** The minimum allowable distance between adjacent conductors, at a given voltage and altitude, that is sufficient to prevent dielectric breakdown, corona, or both from occurring between the conductors. Minimum electrical clearance is a value determined by the designer and is based on multiple factors.

***Pitch*** **–** The nominal center-to-center distance of adjacent conductors. When the conductors are of equal size and their spacing is uniform, the pitch is usually measured from the reference edge of the adjacent conductors, as illustrated in Figure 1-1.

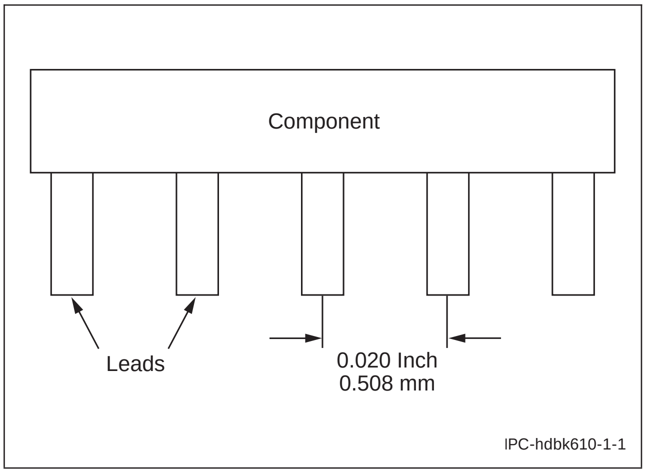

**Figure 1-1 Pitch**

When referring to a device as being a ‘‘20 mil pitch component’’ that means that the leads are 0.020 inch apart measured center-to-center.

***Repair** –** The act of restoring the functional capability of a defective article in a manner that precludes compliance of the article with applicable drawings or specifications.

***Rework** –** The act of reprocessing noncomplying articles, through the use of original or alternate equivalent processing, in a manner that assures compliance of the article with applicable drawings or specifications.

***Scrap* –** In some cases the cost to repair an assembly exceeds the cost to replace it with a like item or may cause the assembly to be unreliable. In such cases the defective assembly is usually dispositioned as Scrap.

***Use-As-Is* –** Products containing defects that do not impact performance may sometimes be dispositioned Use-As-Is. For instance, loss of date code part marking on a finished assembly is a Defect, but not a Defect that affects the performance of the product. Such a Defect could be dispositioned Use-As-Is. The disposition Use-As-Is may require approval of the customer/user.

**1.0.4 Background on IPC-A-610 Revision C** The Standard is an industry consensus document published by IPC. The technical content and criteria of any amendments or revisions to the IPC-A-610 were developed by the collective efforts of the IPC Task Group 7-31b under the 7-30 Product Assurance Committee. This Task Group is comprised of individuals from a wide sector of the electronics manufacturing community. IPC-A-610 is currently in its ‘‘C’’ Revision meaning it has been revised three times since its initial release.

## 1.1 Scope

> **1.1 Scope**
>
> This standard is a collection of visual quality acceptability requirements for electronic assemblies. It was prepared by the Product Assurance Committee of the IPC.
>
> This document presents acceptance requirements for the manufacture of electrical and electronic assemblies. Historically, electronic assembly standards contained a more comprehensive tutorial addressing principles and techniques. For a more complete understanding of this document’s recommendations and requirements, one may use this document in conjunction with IPC-HDBK-001 and J-STD-001.
>
> IPC-A-610 has criteria outside the scope of J-STD-001 defining handling, mechanical and other workmanship requirements. Table 1-1 is a summary of related documents.

The Standard provides visual characteristics of products with criteria that can be applied without making physical measurements to the electronic assembly to determine final acceptability (unless for referee purposes); see 1.4.3 regarding the relationship between the IPC-A-610 and the J-STD-001.

## 1.2 Purpose

> **1.2 Purpose**
>
> The visual standards in this document reflect the requirements of existing IPC and other applicable specifications.
>
> In order for the user to apply and use the content of this document, the assembly/product should comply with other existing IPC requirements, such as IPC-SM-782, IPC-2221, IPC-6011 and IPC-A-600. If the assembly does not comply with these or equivalent requirements, then the acceptance criteria needs to be defined between the customer and supplier.
>
> The illustrations in this document portray specific points noted in the title of each page. A brief description follows each illustration. It is not the intent of this document to exclude any Acceptable procedure for component placement or for applying flux and solder used to make the electrical connection; however, the methods used must produce completed solder joints conforming to the acceptability requirements described in this document.
>
> In the case of a discrepancy, the description or written criteria always takes precedence over the illustrations.

Existing IPC and applicable industry specifications have been selected to reflect Best Manufacturing Practices.

The intent is not to require the use of the Standards listed by Table 1-1, but rather to advise or warn users of IPC-A-610C that unless acceptable guidelines and requirements are used in the design of equipment, the acceptability criteria depicted by the Standard may not be achievable. For example, if a design standard other than IPC-2221 was used to design a SMT printed wiring board assembly, there