

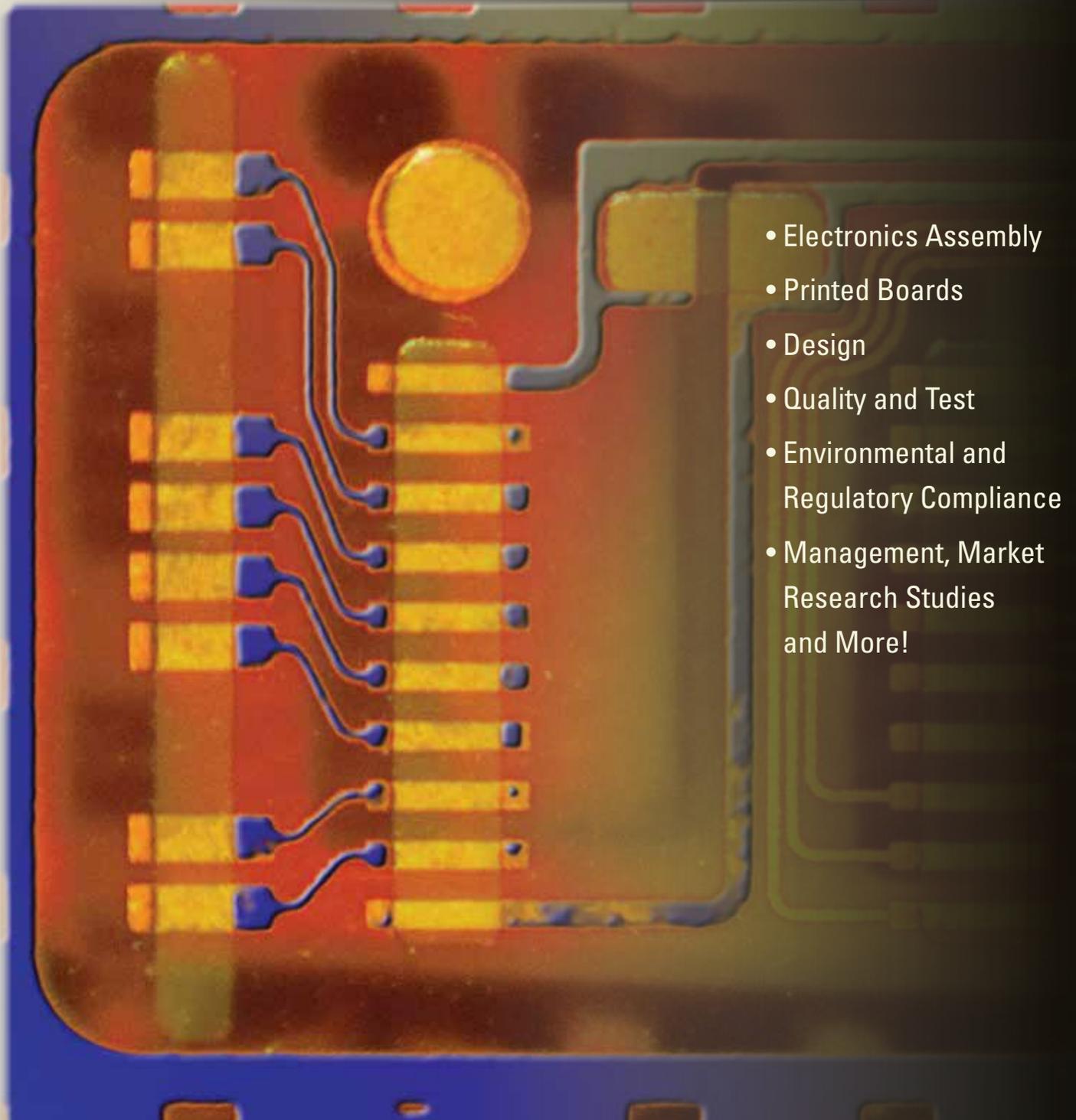
Association Connecting Electronics Industries



**39 NEW DOCUMENTS  
AND TRAINING PROGRAMS**

# IPC PUBLICATIONS CATALOG

## 2014



- Electronics Assembly
- Printed Boards
- Design
- Quality and Test
- Environmental and Regulatory Compliance
- Management, Market Research Studies and More!



IPC standards are associated with nearly every step of printed board production and assembly. From design and purchasing to assembly and acceptance, IPC offers a standard to help assure superior quality, reliability and consistency in the electronic assemblies that go into an electronic product.

Because of the involvement of industry members like you, IPC standards are accepted worldwide as the key manufacturing standards for the printed board and electronics manufacturing industries. More than

3,000 electronics industry professionals worldwide draft, edit and vote on these standards — assuring that they meet today's technical, business and regulatory challenges. To these volunteers, we offer our most sincere thanks.

In addition to industry standards and guidelines, this catalog also contains multimedia training tools, market research reports, regulatory compliance information and best practices for the entire supply chain. Because IPC offers an extensive selection, it is not possible to include every item in this catalog. If you don't find what you need in these pages, I encourage you to visit IPC's online store at [www.ipc.org/onlinestore](http://www.ipc.org/onlinestore).

Thank you for looking to IPC for the resources you need to promote excellence in your company.

Best regards,

John Mitchell  
President & CEO, IPC

## About IPC

IPC ([www.IPC.org](http://www.IPC.org)) is a global industry association based in Bannockburn, Ill., dedicated to the competitive excellence and financial success of its 3,400 member companies which represent all facets of the electronics industry, including design, printed board manufacturing, electronics assembly and test. As a member-driven organization and leading source for industry standards, training, market research and public policy advocacy, IPC supports programs to meet the needs of an estimated \$2.0 trillion global electronics industry. IPC maintains additional offices in Taos, N.M.; Washington, D.C.; Stockholm, Sweden; Moscow, Russia; Bangalore, India; Bangkok, Thailand; and Shanghai, Shenzhen, Chengdu, Suzhou and Beijing, China.

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IPC maintains additional offices in Bangkok, Thailand; Shanghai, Shenzhen, Chengdu, Suzhou and Beijing, China. For more information, visit [www.ipc.org](http://www.ipc.org).

## ABOUT THIS CATALOG

**Organization** — Documents in this catalog are grouped by subjects and subtopics. If you prefer to search by document number, the index (beginning on page 27) is in alpha-numeric order.



— A special icon designates documents that have met Department of Defense (DoD) Adoption requirements.

**Document Formats** — Each description in this catalog includes a series of format codes to indicate which formats are available for that specific document.

- **H– Hard Copy** — A professionally printed and bound document.
- **C– CD or D– Download** — Single-user electronic format allows one user to access the document from one stand-alone computer. Non-printable.
- **K– Kit** — Includes a printed document and a single-user CD.
- **S– Site and G– Global Licenses** — Licensing allows electronic access to an IPC document by all users at one facility (site) or an entire organization (global). There are no print restrictions.

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IPC subscription services are available at a discount to IPC members. At least 30 percent of your company's sites accessing the documents must be IPC members to qualify for the discount. Discount applies to IPC documents. Please contact IHS for details at 800-854-7179 (U.S./Canada), +1 303-397-7920 (international). Provide priority code T037.

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## TECHNICAL SUPPORT



Need answers to your technical questions? Connect with the experts in IPC's online community, Technet, at [www.ipc.org/Technet](http://www.ipc.org/Technet). With more than 1,000 participants, Technet is the best place to go for industry advice without a sales pitch. Need more help? Send your technical questions to [answers@ipc.org](mailto:answers@ipc.org).

## IPC CLASSROOM TRAINING AND CERTIFICATION PROGRAMS

Through its international network of licensed and audited training centers, IPC offers globally recognized, industry traceable training and certification programs on key industry standards. Developed by users, academics and professional trainers, IPC programs reflect a standardized industry consensus. Periodic recertification is required and course materials are updated for each document revision with support from the same industry experts who contributed to the standard.

### Certification Programs on Key Standards

- IPC-A-610, *Acceptability of Electronic Assemblies*
  - IPC-A-610EC, *Telecommunications Addendum to IPC-A-610* (in development)
  - \*IPC-J-STD-001, *Requirements for Soldered Electrical and Electronic Assemblies*
  - IPC-A-600, *Acceptability of Printed Boards*
  - IPC-6012, *Qualification and Performance Specification for Rigid Printed Boards*
  - \*IPC/WHMA-A-620, *Requirements and Acceptance for Cable and Wire Harness Assemblies*
  - IPC-7711/IPC-7721, *Rework, Modification, and Repair of Printed Boards and Electronic Assemblies*
  - IPC-A-630, *Guidelines for Design, Manufacture, Inspection, and Testing of Electronic Enclosures* (in development)
- \* Additional documentation and training tailored to specific industry segments is available.

### Other IPC Certification Programs

- IPC Designer Certification — CID (Certified Interconnect Designer) and CID+ (Advanced)
- IPC EMS Program Management Training and Certification

### Investing in IPC training and certification programs can help you:

- Demonstrate to current and potential customers that your company considers rigorous quality control practices very important.
- Meet the requirements of OEMs and electronics manufacturing companies that expect their suppliers to have these important credentials.
- Gain valuable industry recognition for you and your company.
- Facilitate quality assurance initiatives that have become important in international trading.

More than 250,000 individuals at thousands of companies worldwide have earned IPC certification. For more information, including detailed course information, schedules and course fees, visit [www.ipc.org/certification](http://www.ipc.org/certification). To view a list of IPC authorized training centers, visit [www.ipc.org/certification-centers](http://www.ipc.org/certification-centers).

*“Participation in IPC programs has been crucial for providing standardized, industry-accepted skills as fast and efficiently as possible. Our customers expect our operators to be certified to IPC standards and that our product is assembled to the quality levels defined by IPC standards. It is simply not an option to not be engaged with IPC. Our success with defect prevention and elimination, process control and methodology, and technology leadership is closely aligned with the success of our IPC program implementation.”*

Zenaida Valianu  
Operations Training Analyst  
Celestica, Inc.



## GENERAL PUBLICATIONS

### IPC-C-1000 IPC Essential Document Collection for Board Design, Assembly and Manufacture — includes 111 documents

Create an instant library with IPC's largest document collection, which includes 111 documents, including the widely used IPC-A-600, IPC-A-610, IPC J-STD-001 and IPC-A-620. Documents were reviewed and recommended for inclusion by IPC's technical staff.

Format: H

### NEW! IPC-T-50K Terms and Definitions for Interconnecting and Packaging Electronic Circuits



This essential industry standard provides descriptions and illustrations of electronic interconnect industry terminology to help users and their customers break down language barriers. Revision K contains more than 220 new or revised terms, including new terminology for thermal properties, etchback, assembly processing, hole drilling, and microvia technology. Also includes commonly used industry acronyms. 120 pages. Released June 2013.

Formats: H, C, D, K, S, G



### IPC-TM-650 Test Methods Manual

Contains more than 150 industry approved test techniques and procedures for chemical, electrical and environmental tests on all forms of printed boards and connectors. Updated regularly as test methods are revised or developed. Download individual test methods free at [www.ipc.org/downloads](http://www.ipc.org/downloads).

Formats: H, C

### NEW! IPC-TM-650-MDP Test Method Development Packet

This document has been created to help define criteria that will yield better test methods for use by the electronics and related industries. Key objectives to validating a new test method procedure are covered, including the usage of objective evidence to verify that the elements defined within a method fulfill the intended use and that the method yields repeatable and reproducible results when executed by multiple facilities. The document also addresses methods that use test equipment provided by a single source manufacturer or methods based on the usage of patented equipment or technologies. Released May 2012.

Format: FREE DOWNLOAD



### IPC/JEDEC-J-STD-609A Marking and Labeling of Components, PCBs and PCBAs to Identify Lead (Pb), Lead-Free (Pb-Free) and Other Attributes



Provides a marking and labeling system that aids in assembly, rework, repair and recycling and provides for the identification of: 1) assemblies that are assembled with lead-containing or lead-free solder; 2) components that have lead-containing or lead-free second level interconnect terminal finishes and materials; 3) the maximum component temperature not to be exceeded during assembly or rework processing; 4) base materials used in PCB construction, including PCBs that use halogen-free resin; 5) the surface finish of PCBs; and 6) the conformal coating on PCBAs. New to this revision are additional codes for the more precise specification of certain lead-free solders. 13 pages. Released February 2010. Languages: English and Chinese

Formats: H, C, D, K, S, G

### NEW! IPC-9592B Requirements for Power Conversion Devices for the Computer and Telecommunications Industries

This document standardizes the requirements for power conversion devices (PCDs) for the computer and telecommunications industries. The phrase "power conversion devices" refers to AC-to-DC and DC-to-DC modules, converters and power supplies. This specification sets the requirements for design, qualification testing, conformance testing and manufacturing quality/reliability processes, but does not include the functional requirements of the specific equipment. PCDs addressed in this document are used in the electronics industry to provide conversion of main power sources. This revision includes updated performance evaluations, including thermal and vibration; temperature, humidity and bias; temperature cycling; shock and vibration; random vibration and free-fall drop and shock tests. Additionally, nearly all of the device (component) derating guidelines were updated. 126 pages. Released November 2012.

Formats: H, C, D, K, S, G



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## ELECTRONICS ASSEMBLY

## IPC-C-103

**Electronics Assembly Standards Collection — includes 47 documents**

Get the reference documents you need on all aspects of electronics assembly, from solder materials, component characteristics, manufacturing and quality requirements to acceptability of the final assembly. The collection includes 47 key documents for SMT and through hole assembly, including the widely used IPC-A-610, J-STD-001 and IPC-A-620. Visit the online store for a complete list of included documents.

Format: H

## IPC-C-108

**Cleaning Guides and Handbooks Collection — includes 11 documents**

This complete set of 11 documents includes the latest editions of every IPC cleaning guide and handbook. It is an invaluable tool for manufacturing engineers making decisions on cleaning products and processes. Also provides guidance for troubleshooting. Visit the online store for a complete list of included documents.

Format: H

## ACCEPTABILITY

## IPC-J-STD-001E

**Requirements for Soldered Electrical and Electronic Assemblies**

 IPC-J-STD-001E is recognized worldwide as the sole industry-consensus standard covering soldering assembly material and process requirements. This revision includes support for lead-free manufacturing, in addition to easier to understand criteria for materials, methods and verification for producing quality soldered interconnections and assemblies. The requirements for all three classes of acceptance are included. Full-color illustrations are provided for clarity. This standard fully complements IPC-A-610E. 54 pages. Released April 2010. **Languages:** English, Chinese, Danish, French, German, Hungarian, Polish, Romanian, Russian, Spanish, Swedish and Turkish.

Formats: H, C, D, K, S, G

Certification is available for J-STD-001E. Visit [www.ipc.org/certification](http://www.ipc.org/certification) for details.

## IPC-A-610E

**Acceptability of Electronic Assemblies**

Valuable for inspectors, operators and trainers, IPC-A-610 is the most widely used electronics assembly standard in the world. A must for all quality assurance and assembly departments, IPC-A-610E illustrates industry-accepted workmanship criteria for electronics assemblies through 809 full-color photographs and illustrations. Topics include flex attachment; board in board; part on part; lead free; component orientation and soldering criteria for through hole, SMT (new termination styles) and discrete wiring assemblies; mechanical assembly; cleaning; marking; coating; and laminate requirements. Critically reviewed for clarity and accuracy, the document synchronizes to the requirements expressed in other industry consensus documents and is used with the material and process standard IPC J-STD-001. 400 pages. Released April 2010. **Languages:** English, Chinese, Czech, Danish, Dutch, French, German, Hebrew, Hindi, Hungarian, Italian, Japanese, Korean, Polish, Romanian, Russian, Spanish, Swedish Turkish and Vietnamese.

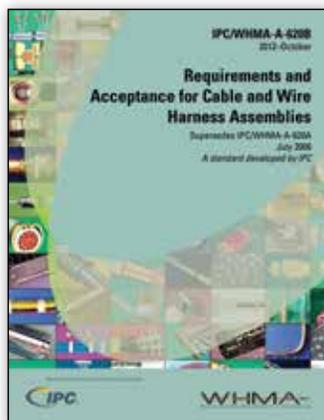
Formats: H, C, D, K, S, G

Certification on IPC-A-610E is available. Visit [www.ipc.org/certification](http://www.ipc.org/certification) for details.

**NEW! IPC/WHMA-A-620B****Requirements and Acceptance for Cable and Wire Harness Assemblies**

IPC and the Wire Harness Manufacturers Association (WHMA) developed this significant update, which remains the only industry-consensus standard addressing requirements and acceptance of cable and wire harness assemblies. This revision has 682 full-color pictures and illustrations, of which 125 are new or updated. Included in the 19 chapters are criteria for wire prep, soldering to terminals, crimping of stamped and formed contacts and machined contacts, insulation displacement connectors, ultrasonic welding, splicing, connectors, molding, marking, coax/biax cables, wrapping/lacing, shielding, assembly and wire-wrap terminations. 400 pages. Released October 2012. **Languages:** English, Chinese, Danish, French, German, Hungarian and Spanish.

Formats: H, C, D, K, S, G

**NEW! IPC-A-630****Acceptability Standard for Manufacture, Inspection and Testing of Electronic Enclosures**

This standard is the first of its kind for IPC; the first acceptability standard for electronic enclosures. It contains acceptability criteria that pertain to the "box build" of the assembly process. This standard has been written to direct manufacturers and end users of electronic enclosures of electrical and electronic equipment to understand the best practices to meet requirements, ensuring the reliability and function of the end-item assembly for its intended design life. 30 pages. Released September 2013.

Formats: H, C, D, K, S, G

**COMING SOON! IPC-HDBK-630****Acceptability Standard for Manufacture, Inspection and Testing of Electronic Enclosures Handbook**

Format: H

## ADVANCED TECHNOLOGIES

## IPC-7093

**Design and Assembly Process Implementation for Bottom Termination Components**

Describes the design and assembly challenges for implementing bottom termination components (BTCs) whose external connections consist of metallized terminals that are an integral part of the component body. The BTCs in this document include all types and forms of bottom-only termination components intended for surface mounting. This includes industry descriptive nomenclature such as QFN, DFN, SON, LGA, MLP and MLF. The focus of the information is on critical design, assembly, inspection, repair and reliability issues associated with BTCs. 68 pages. Released March 2011. **Languages:** English and German.

Formats: H, C, D, K, S, G

## IPC-7094

**Design and Assembly Process Implementation for Flip Chip and Die Size Components**

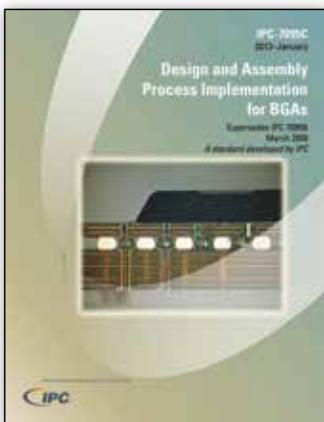
Delivers useful and practical information for products that employ the very complex and high density methods needed for flip-chip technology. The major emphasis of the new standard is to provide information on system-level issues, flip-chip and die-size assembly and the requirements for board and module-level reliability. In addition to providing guidelines for flip-chip inspection, IPC-7094 addresses the design of the initial element and how the die can be evaluated during its development process with a goal toward simplification of the final assembly. The standard also covers outsourcing manufacturing and the procurement of known good die to optimize the return on investment when developing products that use flip-chip technology. 75 pages. Released February 2009.

Formats: H, C, D, K, S, G

**NEW! IPC-7095C**  
**Design and Assembly Process Implementation for BGAs**

Implementing ball grid array (BGA) and fine-pitch ball grid array (FBGA) technology presents some unique challenges for design, assembly, inspection and repair personnel. The major emphasis of Revision C is on some of the new mechanical failure issues such as cratering or laminate defects caused after assembly. In addition to providing guidelines for BGA inspection and repair, IPC-7095C addresses reliability issues and the use of lead-free joint criteria associated with BGAs. There are many photographs of X-ray and endoscope illustrations to identify some of the conditions that the industry is experiencing in the implementation of BGA assembly processes. 165 pages. Released January 2013.

Formats: H, C, D, K, S, G



**IPC-SM-784**  
**Guidelines for Chip-on-Board Technology Implementation**

37 pages. Released November 1990.

Formats: H, C, D, S, G

**IPC/EIA J-STD-026**  
**Semiconductor Design Standard for Flip Chip Applications**

Developed by IPC and EIA. 43 pages. Released August 1999.

Formats: H, C, D, S, G

**IPC J-STD-027**  
**Mechanical Outline Standard for Flip Chip and Chip Size Configurations**

13 pages. Released February 2003

Formats: H, C, D, S, G

**IPC/EIA J-STD-028**  
**Performance Standard for Construction of Flip Chip and Chip Scale Bumps**

Developed by IPC and EIA. 36 pages. Released August 1999.

Formats: H, C, D, S, G

**IPC/EIA J-STD-032**  
**Performance Standard for Ball Grid Array Balls**

Developed by IPC and EIA. 10 pages. Released June 2002.

Formats: H, C, D, S, G

**IPC-MC-790**  
**Guidelines for Multichip Module Technology Utilization**

120 pages. Released 1992.

Formats: H, C, D, S, G

**CLEANING**

**NEW! IPC-5703**  
**Cleanliness Guidelines for Printed Board Fabricators**

Printed board cleanliness has historically been an unknown factor in the quality assessment of unpopulated (bare) printed boards; this has often been attributed to a lack of understanding of materials and processes. This document addresses the various printed board fabrication processes and how each may impact, directly or indirectly, the final cleanliness of packaged bare printed boards and ultimately printed board quality. 30 pages. Released May 2013.

Formats: H, C, D, K, S, G



**IPC-CH-65B**  
**Guidelines for Cleaning of Printed Boards and Assemblies**

Updated for new technologies including lead-free, no-clean and environmentally friendly chemistries. This is a collection of information on electronic board and assembly cleaning in a single document. This major revision explains the relationship between materials, processes and contaminants in fabrication and assembly operations. It also addresses cleanliness assessment and process control in relation to cleanliness. Color pictures help with understanding. Supersedes IPC-CH-65A, IPC-SC-60A, IPC-SA-61A, IPC-AC-62A and IPC-SM-839. 200 pages. Released July 2011.

Formats: H, C, D, K, S, G

**IPC-TR-476A**  
**Electrochemical Migration: Electrically Induced Failures in Printed Wiring Assemblies**

14 pages. Released 1997.

Format: H

**IPC-9201A**  
**Surface Insulation Resistance Handbook**

Surface insulation resistance (SIR) testing is a tool not only for characterization testing of production processes (such as solder masks, soldering flux and conformal coatings), but also for examining the electrochemical reactions at each stage of the electronics assembly production process. This handbook covers the terminology, theories, test procedures and test vehicles of SIR testing, including temperature-humidity (TH) and temperature-humidity-bias (THB). Discussions on failure modes and troubleshooting are also included. Revision A significantly expands on the discussion of available industry test vehicles for SIR as well as test chamber set-up. 86 pages. Released August 2007.

Formats: H, C, D, K, S, G

**IPC-9202**  
**Material and Process Characterization/Qualification Test Protocol for Assessing Electrochemical Performance**

This document provides tests that record changes in surface insulation resistance (SIR) on a representative sample of a printed circuit assembly. It quantifies any deleterious effects that might arise from solder flux or other process residues left on external surfaces after soldering, including unwanted electrochemical reactions that grossly affect reliability. It uses test vehicles that are intended to be representative of the electronic circuits that are in production and is a test yielding both quantitative and qualitative data. This test may be used for process qualification, demonstrating that a proposed manufacturing process or process change can produce hardware with acceptable end-item performance related to cleanliness. This test may also be used for process characterizations, including development of new processes or improvements to an existing process. 11 pages. Released October 2011.

Formats: H, C, D, K, S, G

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[www.ipc.org/onlinestore](http://www.ipc.org/onlinestore)

**IPC-9203****Users Guide to IPC-9202 and the IPC-B-52 Standard Test Vehicle**

While there are a variety of industry test vehicles for the examination of materials compatibility, most available test boards leave something to be desired because of the often dramatic difference in materials between test boards and produced assemblies. A test vehicle was needed which could be used for both ion chromatography and SIR testing that would be more representative of mainstream manufacturing materials and processes. This document addresses the IPC-B-52 standard test vehicle which can be used to evaluate and optimize a manufacturing process or to provide objective evidence that a chosen manufacturing material set and manufacturing process are compatible from a cleanliness standpoint. This user guideline has also been written as a companion document to IPC-9202, providing clarification on what a manufacturer "should" or "must" do for demonstrating materials and process compatibility. 31 pages. Released May 2012.

Formats: H, C, D, K, S, G

**COMPONENTS****IPC/JEDEC J-STD-020D.1****Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices — Includes Amendment 1**

Developed by IPC and JEDEC, this standard identifies the classification levels of nonhermetic solid state surface mount devices that are sensitive to moisture-induced stress. It is used to determine which classification level should be used for initial reliability qualification. These devices can be properly packaged, stored and handled to avoid subsequent thermal/mechanical damage during solder reflow attachment. 14 pages. Released March 2008. Languages: English, Chinese and German.

Formats: H, C, D, K, S, G

**COMING SOON! IPC/JEDEC J-STD-020E Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices**

Formats: H, C, D, K, S, G

**IPC/JEDEC J-STD-035****Acoustic Microscopy for Non-Hermetic Encapsulated Electronic Components**

Developed by IPC and JEDEC. 16 pages. Released April 1999.

Formats: H, C, D, S, G

**IPC/JEDEC J-STD-033C****Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices**

Developed by IPC and JEDEC, this document provides surface mount device manufacturers and users with standardized methods for handling, packing, shipping and use of moisture/reflow sensitive SMDs. These methods help avoid damage from moisture absorption and exposure to solder reflow temperatures that can result in yield and reliability degradation. By following the procedures, safe and damage-free reflow can be achieved with the dry packing process, providing a minimum shelf life of 12 months from the seal date when using sealed dry bags. 18 pages. Released February 2012. Languages: English and German.

Formats: H, C, D, K, S, G

**EIA/IPC/JEDEC J-STD-075****Classification of Non-IC Electronic Components for Assembly Processes**

Developed by IPC, EIA and JEDEC, J-STD-075 provides test methods to classify worst-case thermal process limitations for electronic components. Classification is referenced to common industry wave and reflow solder profiles, including lead-free processing. The classifications represent maximum process sensitivity levels and do not establish rework conditions or recommended processes for an assembler. It outlines a process to classify and label non-semiconductor electronic process components' sensitivity level (PSL) and moisture sensitivity level (MSL) consistent with the semiconductor industry's classification levels (IPC J-STD-020, *Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Devices* and *IPC-J-STD-033, Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices*). This standard supersedes IPC-9503. 12 pages. Released August 2008. Languages: English, Chinese and German.

Formats: H, C, D, K, S, G

**GENERAL****IPC-TA-724****Technology Assessment Series on Clean Rooms**

Released April 1998.

Format: H

**IPC-SM-780****Component Packaging and Interconnecting with Emphasis on Surface Mounting**

138 pages. Released March 1988.

Formats: H, C, D, S, G

**IPC-SM-785****Guidelines for Accelerated Reliability Testing of Surface Mount Solder Attachments**

50 pages. Released November 1992.

Formats: H, C, D, S, G

**IPC-9701A****Performance Test Methods and Qualification Requirements for Surface Mount Solder Attachments**

Provides specific test methods to evaluate the performance and reliability of surface mount solder attachments of electronics assemblies. Establishes levels of performance and reliability of the solder attachments of surface mount devices to rigid, flexible and rigid-flex circuit structures. When used with IPC-SM-785, the document provides an understanding of the physics of SMT solder joint failure and an approximate means of relating performance tests results to the reliability of solder attachments in their use environments. Revision A includes Appendix B, which provides recommended changes to the thermal cycling profiles given in the document when utilizing lead-free solder joints. 24 pages. Released February 2006. Languages: English and Chinese.

Formats: H, C, D, K, S, G

**IPC/JEDEC-9702****Monotonic Bend Characterization of Board-Level Interconnects**

Developed by IPC and JEDEC. 14 pages. Released June 2004. Languages: English and Chinese.

Formats: H, C, D, S, G

**IPC/JEDEC-9703****Mechanical Shock Test Guidelines for Solder Joint Reliability**

Developed by IPC and JEDEC, this document establishes mechanical drop and shock and test guidelines for assessing solder joint reliability of printed board assemblies from system to component level. It addresses methods to define mechanical shock use-conditions as well as methods to define system level, system printed board level and component test board level testing that correlate to use conditions, and provides guidance on the use of experimental metrologies for mechanical shock tests. 42 pages. Released March 2009.

Formats: H, C, D, K, S, G

### IPC/JEDEC-9704A

#### Printed Circuit Assembly Strain Gage Test Guideline

This document describes specific guidelines for strain gage testing during the printed board manufacturing process, including board assembly, test, system integration and other types of operations that may induce board flexure. It also provides coverage of test setup and equipment requirements, strain measurement techniques and test report formats. Revision A contains 22 full-color photographs and illustrations depicting instrumented boards and gage placement, and has been updated to address lead-free assembly technology. 25 pages. Released February 2012. **Languages:** English and Chinese.

Formats: H, C, D, K, S, G

### **NEW!** IPC/JEDEC-9706

#### Mechanical Shock In-situ Electrical Metrology Test Guidelines for FCBGA SMT Component Solder Crack and Pad Crater/Trace Crack Detection

This document establishes metrology guidelines to electrically and reliably detect solder joint opens on Flip-Chip Ball Grid Array (FCBGA) SMT board assemblies during the mechanical shock or drop event. Some of the existing industry metrologies do not provide in-situ electrical monitoring of FCBGA solder joint opens during test. They either rely on electrical test before or after the test or use less efficient destructive physical analysis techniques which are either not reliable, cost-effective, or are time consuming. In-situ metrology can monitor not only FCBGA assembly with daisy-chain components but also product components with power or ground planes or equivalent daisy-chain test structures. In addition, the metrology in this document provides reliable electrical data with ball-level resolution, thereby eliminating the need for further fault isolation. 18 pages. Released December 2013.

Formats: H, C, D, K, S, G

### IPC/JEDEC-9707

#### Spherical Bend Test Method for Characterization of Board Level Interconnects

This standard on spherical transient bend testing characterizes the maximum allowable strain that a surface mount component's board level interconnects can withstand in flexural loading. Whereas four-point monotonic bend test methods only address simple planar bending, spherical bend tests establish strain limits of board level interconnects under worst-case flexure conditions that can occur during conventional printed board/system assembly, manufacturing and test operations. This method is applicable to surface mounted BGA components larger than 15.0 mm on a side with organically based substrates attached to printed boards using conventional solder reflow technologies. Developed by IPC and JEDEC. 15 pages. Released September 2011.

Formats: H, C, D, K, S, G

### IPC-9708

#### Test Methods for Characterization of Printed Board Assembly Pad Cratering

Provides test methods to evaluate the susceptibility of printed board assembly (PBA) materials and designs to cohesive dielectric failure underneath surface mount technology (SMT) attach pads. The test methods, including pin-pull, ball-pull and ball shear, can be used to rank order and compare different printed board materials and design parameters. 17 pages. Released December 2010. **Languages:** English and Chinese.

Formats: H, C, D, K, S, G

### **NEW!** IPC-9709

#### Test Guidelines for Acoustic Emission Measurement during Mechanical Testing

Pad cratering typically initiates prior to detection by existing electrical monitoring test methods. There are limited instrumentation techniques that are currently available that can identify non-electrical damage and its location to a high degree of accuracy. This guideline establishes an acoustic emission (AE) method to evaluate the performance and reliability of surface mount attachments of electronics assemblies during mechanical loading. 11 pages. Released 2013.

Formats: H, C, D, K, S, G

### IPC-9850A

#### Surface Mount Placement Equipment Characterization

Standardizes the parameters, measurement procedures and methodologies used to measure and report pick-and-place machine accuracy to placement speed for a range of SMT component sizes and configurations. IPC-9850A includes one printed copy of the standard and a CD with support documentation, report forms and the test material drawings in DWG format. 40 pages. Released November 2011.

Formats: H, C, D, K, S, G

### IPC/SMEMA-9851

#### Mechanical Equipment Interface Standard

7 pages. Released February 2007.

Format: FREE DOWNLOAD

### IPC-PD-335

#### Electronic Packaging Handbook

470 pages. Released December 1989.

Format: H

### IPC-7525B

#### Stencil Design Guidelines

Provides guidelines for the design and fabrication of stencils for solder paste and surface mount adhesive with discussion on through-hole and mixed technology. These guidelines detail the differences for tin-lead and lead-free solder paste, overprint, two-print and step stencil designs. A sample order form and user inspection checklist are included. 14 pages. Released October 2011. **Languages:** English and German.

Formats: H, C, D, K, S, G

### IPC-7526

#### Stencil and Misprinted Board Cleaning Handbook

Cleaning of stencils and misprinted PCBs has become increasingly important in surface mount technology. Fine and ultra-fine pitch lands, together with other advanced packages, place new demands on stencil cleaning. Paste volume is a critical issue for fine, ultra-fine, chip-scale, BGA and flip-chip components. Insufficient solder due to clogging of stencil apertures is a primary cause of defects. This handbook provides a basic understanding of stencil/misprint cleaning processes. 24 pages. Released February 2007. **Languages:** English and Russian. Note: The Russian document is available in hard copy only.

Formats: H, FREE DOWNLOAD

### IPC-7527

#### Requirements for Solder Paste Printing

This standard is a collection of visual quality acceptability criteria for solder paste printing. The purpose of this document is to support the user in the visual evaluation of the solder paste printing process, which makes subsequent process optimizing possible. 23 pages. Released May 2012. **Languages:** English, Danish and German.

Formats: H, C, D, K, S, G

### IPC-TR-581

#### IPC Phase III Controlled Atmosphere Soldering Study

90 pages. Released August 1994.

Format: H

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## MATERIALS

### IPC J-STD-004B Requirements for Soldering Fluxes — with Amendment 1



Classifies and characterizes tin-lead and lead-free soldering flux materials for use in electronic metallurgical interconnections for printed board assembly. Soldering flux materials include: liquid flux, paste flux, solder paste, solder cream, and flux-coated and flux-cored solder wires and preforms. It is not the intent of this standard to exclude any acceptable flux or soldering material; however, these materials must produce the desired electrical and metallurgical interconnections. 20 pages. Released November 2011. **Languages:** English, Chinese and Russian. Note: The Russian document is available in hard copy only.

Formats: H, C, D, K, S, G

### IPC J-STD-005A Requirements for Soldering Pastes



This standard lists requirements for qualification and characterization of solder paste. It references test methods and criteria for metal content, viscosity, slump, solder ball, tack and wetting of solder pastes. Additional support is provided in IPC-HDBK-005, *Guide to Solder Paste Assessment* (not included with purchase of this standard). 10 pages. Released February 2012. **Languages:** English, Chinese and Russian. Note: The Russian document is available in hard copy only.

Formats: H, C, D, K, S, G

### IPC-HDBK-005 Guide to Solder Paste Assessment

Use this handbook with the solder paste standard J-STD-005 and as a guide to help assess the applicability of a solder paste for its use in surface mount technology (SMT) processes. This document also suggests test methods that can help with designing and testing solder pastes. It is intended for use by both vendors and users of solder paste. 50 pages. Released January 2006.

Formats: H, C, D, K, S, G

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### **NEW!** IPC J-STD-006C Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications



This standard prescribes the nomenclature, requirements and test methods for electronic-grade solder alloys; fluxed and non-fluxed bar, ribbon and powder solders for electronic soldering applications; and "special" electronic-grade solders. This is a quality control standard and is not intended to relate directly to the materials' performance in the manufacturing process. Revision C has been updated to address intentional additions to a solder alloy and impurities in the alloy. In addition, the tables and appendices have been updated with the latest alloy information. This standard is one of a set of three joint-industry standards prescribing requirements and test methods for soldering materials to be used in the electronics industry. The other standards in the set are IPC J-STD-004, *Requirements for Soldering Fluxes*, and IPC J-STD-005, *Requirements for Soldering Pastes*. 22 pages. Released July 2013.

Formats: H, C, D, K, S



### **COMING SOON!** IPC J-STD-030A Guideline for Selection and Application of Underfill Material for Flip Chip and Other Micropackages

Formats: H, C, D, K, S, G

### IPC-SM-817 General Requirements for Dielectric Surface Mounting Adhesives

22 pages. Released November 1989.

Formats: H, C, D, S, G

### IPC-SPVC-WP-006 Round Robin Testing and Analysis: Lead- Free Alloys — Tin, Silver and Copper

19 pages. Released July 2003.

Format: D

### SPVC2005-CD Round Robin Testing and Analysis of Lead-Free Solder Pastes with Alloys of Tin, Silver and Copper

50 pages. Released 2005.

Formats: C, G

### JEDEC/IPC-JP002 Current Tin Whiskers Theory and Mitigation Practices Guideline

26 pages. Released March 2006

Formats: H, C, D, K, S, G

### IPC-CA-821 General Requirements for Thermally Conductive Adhesives

18 pages. Released January 1995.

Formats: H, C, D, S, G

### IPC-3406 Guidelines for Electrically Conductive Surface Mount Adhesives

15 pages. Released July 1996.

Formats: H, C, D, S, G

### IPC-3408 General Requirements for Anisotropically Conductive Adhesive Films

25 pages. Released November 1996.

Formats: H, C, D, S, G

### IPC-CC-830B Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies — with Amendment 1

This is the industry standard for qualification and quality conformance of conformal coating. Its intent is to show how to obtain maximum information with minimum test redundancy. Includes requirements and evaluations of material properties using standardized test vehicles. Amendment 1 updates include new qualification, retention and conformance inspection requirements for FTIR, MIR and hydrolytic stability. 18 pages. Released October 2008. **Languages:** English and Chinese.

Formats: H, C, D, K, S, G

**NEW! IPC-HDBK-830A**  
**Guidelines for Design, Selection and Application of Conformal Coatings**

This handbook is a compilation of the conformal coating industry's practical experience, and will assist designers and users of conformal coatings in making informed choices. Users will better understand the properties of the various conformal coatings, the results to be achieved by its application and how to verify that these goals have been met. Use this document as a supplement in conjunction with the industry standard for qualification and quality conformance of conformal coating, IPC-CC-830B. Revision A significantly updates the environmental, health and safety information when dealing with conformal coatings including advice on use of Web-based MSDS reporting. Use of conformal coating for tin whisker and fungus mitigation is also discussed as well as flammability issues. Content of the standard includes the very latest from industry experts on the application and selection of conformal coatings. 183 pages. Released August 2013.  
 Formats: H, C, D, K, S, G



**IPC-SM-840E**  
**Qualification and Performance Specification of Permanent Solder Mask and Flexible Cover Materials**

 Establishes the requirements for the evaluation of liquid and dry film solder mask material and for the determination of the acceptability of use on a standard printed board system. IPC-SM-840 provides two classes of requirements to reflect functional performance requirements and testing severity based on industry/end-use requirements. It covers adhesion, material qualification, resistances to solvents and electrical requirements. Revision E incorporates requirements for flexible cover materials used as a flexible dielectric protective layer over etched conductors and other conductive features. 19 pages. Released December 2010. **Languages:** English and Chinese.  
 Formats: H, C, D, K, S, G

**IPC-HDBK-840**  
**Solder Mask Handbook**

IPC-HDBK-840 supplements IPC solder mask requirements by providing detailed information on solder mask types, application processes, pre- and post-assembly processes, characteristics and properties that are useful in the selection and use of the most appropriate mask type for a given application. 72 pages. Released September 2006.  
 Formats: C, D, S, G

**NEW! IPC-HDBK-850**  
**Guidelines for Design, Selection and Application of Potting Materials and Encapsulation Processes Used for Electronics Printed Circuit Board Assembly**

This handbook assists designers and users of potting and encapsulation in understanding the characteristics of various materials, as well as the factors that can modify those characteristics when the potting or encapsulation is applied. The equipment and processes involved in the preparation and application of potting and encapsulation are also covered. The challenge in developing this handbook was that there had been no clear industry definition that distinguished between potting and encapsulation. From glob-top to dam-and-fill, the terminology in this document is associated with processes related only to electronics printed board assembly and protection. Understanding and accounting for these materials can ensure the reliability and function of electronics. 68 pages. Released July 2012.  
 Formats: H, C, D, K, S, G



**IPC-1756**  
**Manufacturing Process Data Management**

This standard establishes the requirements for exchanging manufacturing data between suppliers and customers for electrical and electronic products. IPC-1756 establishes 23 fields for the declaration of manufacturing data supported by Scriba and other tools developed for use between users and suppliers. The type of manufacturing information includes sensitivity to moisture and high temperature, different alloy compositions and component package configurations. The data incorporates the requirements of IPC-1751A for generic company information. As such, IPC-1751A is a mandatory part of this standard and all conditions apply to the characteristics of the data structure as defined by the XML schema, version 2.0. 29 pages. Released March 2010.  
 Formats: H, D

**OPTOELECTRONICS**

**IPC-0040**  
**Optoelectronics Assembly and Packaging Technology**

163 pages. Released May 2003.  
 Formats: H, C, D, S, G

**IPC-8413-1**  
**Specification for Process Carriers Used to Handle Optical Fibers in Manufacturing**

15 pages. Released April 2003.  
 Formats: H, C, D, S, G

**IPC-8497-1**  
**Cleaning Methods and Contamination Assessment for Optical Assembly**

38 pages. Released January 2006.  
 Formats: H, C, D, K, S, G

**PROCESS SUPPORT**

**IPC-TP-1114**  
**The Layman's Guide to Qualifying a Process to J-STD-001**

13 pages. Released January 1998.  
 Formats: H, C, D

## IPC-HDBK-001E

### Handbook and Guide to Supplement J-STD-001



This handbook is a companion reference to J-STD-001, *Requirements for Soldered Electrical and Electronic Assemblies*. It describes materials, methods and verification criteria that, when applied as recommended or required, will produce quality soldered electrical and electronics assemblies. The handbook explains the how-to, why and fundamentals of these processes, and helps implement control over processes rather than depending on end-item inspection. 100 pages. Released February 2012.

Formats: H, C, D, K, S, G

## IPC-AJ-820A

### Assembly and Joining Handbook

This handbook contains general information and descriptions of proven techniques for assembly and soldering electronics assemblies. Sections include: handling electronics assemblies, design considerations, PCBs, components, solderability, materials, component mounting, solder techniques and connections, cleaning, conformal coating, encapsulation and potting, and rework and repair. 290 pages. Released February 2012.

Formats: H, C, D, K, S, G

## IPC-7530

### Guidelines for Temperature Profiling for Mass Soldering Processes (Reflow and Wave)

This document provides guidelines for the construction of appropriate profiling test vehicles and various techniques and methodologies for temperature profiling. 18 pages. Released May 2001.

Formats: H, C, D, K, S, G

## IPC-TP-1115

### Selection & Implementation Strategy for a Low-Residue No-Clean Process

120 pages. Released December 1998.

Format: H

## IPC-S-816

### SMT Process Guideline and Checklist

38 pages. Released July 1993. Languages: English and Russian. Note: The Russian document is available in hard copy only.

Formats: H, C, D, S, G

## IPC-CM-770E

### Component Mounting Guidelines for Printed Boards

This document provides guidelines in the preparation and attachment of components for printed board assembly and reviews pertinent design criteria, impacts and issues. It contains techniques for assembly (both manual and machines, including SMT, BGA and flip chip) and consideration of, and impact upon, subsequent soldering, cleaning and coating processes. 150 pages. Revised January 2004.

Formats: H, C, D, K, S, G

## IPC-7912A

### End-Item DPMO for Printed Circuit Board Assemblies

This is the first revision to the industry's first consensus document on calculating benchmark indices for defects and quality. The document provides consistent methodologies for calculating benchmark indices for DPMO Index, Component DPMO, Placement DPMO, Termination DPMO, and Overall Manufacturing Index (OMI). This document is for end-of-process benchmarking. Revision A provides support for unpopulated terminations and has much clearer examples. 12 pages. Released January 2004.

Formats: H, C, D, S, G

## IPC-9261A

### In-Process DPMO and Estimated Yield for PCAs

This document defines consistent methodologies for computation of in-process defects per million opportunities (DPMO) metrics for any evaluation stage in the assembly process. It is intended for use in measuring in-process assembly steps rather than end-product determination. Calculation of completed item DPMO is addressed in IPC-7912A. A guide to defect categorization is provided that can serve as a base for summarizing and reporting in-process defects when used with J-STD-001 and IPC-A-610. It can also be used to develop process step estimated yield — the expected percentage of assemblies with no defects for a particular process step or combined process steps, based on historical defect rates. 12 pages. Released October 2006.

Formats: H, C, D, K, S, G

## IPC-DPMO-202

### IPC 7912A/9261A End Item and In-Process DPMO Set

IPC-7912A is 12 pages. Released January 2004. IPC-9261A is 12 pages. Released October 2006.

Formats: H, C, D, S, G

## REWORK/REPAIR

### IPC-7711/21B

#### Rework, Modification and Repair of Electronic Assemblies

This guide includes everything needed for the repair and rework of electronics assemblies and printed boards for both lead-free and traditional SnPb soldered assemblies. This single volume includes all previously published changes and several new procedures for BGAs (including reballing) and flex-print repair. Part 1, General Requirements, includes procedures common to rework, repair and modification. Part 2 is IPC-7711B and procedures that include tools, materials and methods to be used in removing and replacing surface mount and through-hole components. Part 3 is IPC-7721B and includes procedures for modifying assemblies and accomplishing laminate and conductor repairs. This guide is provided in a three-ring binder for easy updating. Change 1 and future updates can be downloaded FREE from [www.ipc.org/downloads](http://www.ipc.org/downloads). Many procedures have color illustrations to help the user understand the guide. Supersedes IPC-7711, IPC-7721 and IPC-R-700. 300 pages. Released November 2007. Languages: English, Chinese, Czech, Danish, French, German, Hungarian, Italian, Korean, Polish, Romanian, Russian, Spanish and Swedish.

Formats: H, C, D, K, S, G

Certification on IPC-7711/21B is available. Visit [www.ipc.org/certification](http://www.ipc.org/certification) for details.

## SOLDERABILITY

### NEW! EIA/IPC/JEDEC J-STD-002D

#### Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires



This standard prescribes test methods, defect definitions, acceptance criteria, and illustrations for assessing the solderability of electronic component leads, terminations, solid wires, stranded wires, lugs and tabs. A test method for the resistance to dissolution/dewetting of metallization is also included in the standard. Intended for use by both vendors and users, J-STD-002D was developed by EIA, IPC and JEDEC. 49 pages. Released June 2013.

Formats: H, C, D, K, S, G



**NEW! IPC J-STD-003C****Solderability Tests for Printed Boards**

J-STD-003C prescribes test methods, defect definitions and illustrations for assessing the solderability of printed board surface conductors, attachment lands and plated-through holes utilizing either tin-lead or lead-free solders. This standard is intended for use by both vendor and user. The objective of the solderability test methods described in this standard is to determine the ability of printed board surface conductors, attachment lands and plated-through holes to wet easily with solder and to withstand the rigors of the printed board assembly processes. This standard describes test methods by which both surface conductors (and attachment lands) and plated-through holes may be evaluated for solderability. Revision "C" contains the latest information about gauge repeatability and reproducibility (GR&R) of solderability tests as well as updated illustrations. 27 pages. Released September 2013.

Formats: H, C, D, K, S, G

**IPC-TR-585****Time, Temperature and Humidity Stress of Final Board Finish Solderability**

54 pages. Released May 2006.

Formats: C, D, S, G

**IPC-TR-461****Solderability Evaluation of Thick and Thin Fused Coatings**

29 pages. Released March 1979.

Format: H

**IPC-TR-462****Solderability Evaluation of Printed Boards with Protective Coatings Over Long-Term Storage**

63 pages. Released October 1987.

Format: H

**IPC-TR-464****Accelerated Aging for Solderability Evaluations**

39 pages. Revised April 1984. Includes seven-page addendum. Released December 1987.

Formats: H, C, D, S, G

**IPC-TR-465-1****Round Robin Test on Steam Ager Temperature Control Stability**

20 pages. Released July 1993.

Format: H

**IPC-TR-465-2****The Effect of Steam Aging Time and Temperature on Solderability Test Results**

51 pages. Released July 1993.

Format: H

**IPC-TR-465-3****Evaluation of Steam Aging on Alternative Finishes, Phase 11A**

15 pages. Released July 1996.

Formats: H, C, D, S, G

**IPC-TR-466****Technical Report: Wetting Balance Standard Weight Comparison Test**

16 pages. Released April 1995.

Format: H

**IPC-WP-001****Soldering Capability White Paper**

35 pages. Released August 1991.

Format: FREE DOWNLOAD

**IPC-WP-005****PWB Surface Finishes**

46 pages. Released April 1997.

Format: FREE DOWNLOAD

**TRAINING & REFERENCE GUIDES**

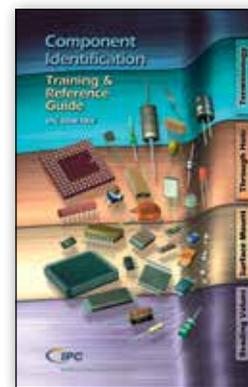
These full-color, 5 x 8-inch, spiral-bound guides make handy look-up and training tools. Although some guides directly reference IPC standards, they should not be used as replacements for them.

**IPC-DRM-SMT-E****Surface Mount Solder Joint Evaluation Training & Reference Guide**

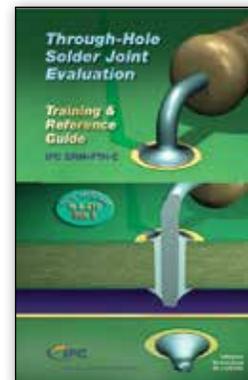
Conforming to Revision E of the IPC-A-610 and J-STD-001 standards, this training and reference guide illustrates critical acceptance criteria for the evaluation of surface mount solder connections. Useful as a training aid in the classroom or on the shop floor, IPC-DRM-SMT-E contains computer-generated color illustrations of chip component, gull wing and J-lead solder joints. Each drawing clearly shows the minimum acceptable condition for each type of component misalignment, and details the specifications for minimum/maximum solder joint size, fillet heights and lengths. A defect solder condition section is also included. 38 pages.

**IPC-DRM-18H****Component Identification Training and Reference Guide**

A valuable tool for employee training and quick reference, this comprehensive component identification resource for electronics assembly operators and inspectors contains color photographs, computer graphics, schematic symbols and detailed descriptions of more than 50 common through-hole and surface mount components used in electronics assembly today. Revision H contains updated information on SSOP, TSOP, QFP, LQFP, PQFP, LCC, QFN and BGA-related packages, including all the variations within those groups. The terminology section has quick facts on polarity, orientation, lead styles and component reference designators (CRDs). The reading component values section has easy-to-use color code charts for resistors and inductors as well as charts for reading numbered capacitor data. 73 pages.

**IPC-DRM-PTH-E****Through-Hole Solder Joint Evaluation Training & Reference Guide**

This training and reference guide conforms to Revision E of the IPC-A-610 and J-STD-001 standards and illustrates critical acceptance criteria for the evaluation of through-hole solder connections. Useful as a training aid in the classroom or on the shop floor, DRM-PTH-E contains computer-generated color illustrations of component, barrel and solder-side perspectives of a plated-through hole. Each drawing clearly shows the minimum acceptable condition for requirements such as land coverage, vertical fill, wetting of lead, land and barrel and contact angle. Includes section on defect solder conditions. 30 pages.



## IPC-DRM-WHA-B

### Wire Harness Assembly Training & Reference Guide

This guide explains all the basic acceptance criteria for wire harness assemblers, crimp operators and even QA personnel. This handy reference and training tool is a great way to help explain the most important requirements from the industry standard on wire harness acceptability, IPC/WHMA-A-620, Rev. B. Using easy-to-understand computer-generated graphics and language geared for basic factory-level employees, this guide will help your staff ensure that your company products meet the required industry standards. DRM-WHA covers: wire types, gauges, insulation stripping, wire tinning, terminals and contact types, coaxial cables, IPC product categories and acceptance criteria, wire preparation, strand and insulation damage, conductor deformations, open and closed barrel crimp definitions and criteria, crimp deformations, cut-off tabs, punctures, insulation support crimps, inspection windows, bellmouth, conductor crimp requirements, conductor brush, closed barrel crimps, insulation damage, ribbon cable, discrete wire, cup terminals and a glossary of related wire harness terminology. 59 pages.

## IPC-DRM-53

### Introduction to Electronics Assembly Training & Reference Guide

A learning resource for new hires, operators, sales, purchasing, human resources, administrative personnel, students or anyone interested in understanding the basic processes of both through-hole and surface mount assembly. The guide explains electronics assembly to the uninitiated, plus includes more than 70 color photographs and drawings to clearly illustrate assembly technologies. Key terms are defined in a glossary to help understand the industry lexicon. The guide also explores how electronics assembly fits into the electronics industry. Each section includes references for additional training and industry specifications that can provide further information. Students can learn at their own pace, study the terminology and see what everything looks like — all from this concise manual. 32 pages.

## COLLECTIONS

### IPC-C-102

#### Flexible Printed Board Standards Collection — includes 15 documents

Manufacturers and designers of flexible printed boards need unique information on materials, manufacturing and design for these specialized interconnections. Put it all at your fingertips with this comprehensive collection of IPC's 15 key documents for flexible printed boards.

Format: H

### IPC-C-105

#### Rigid Printed Board Standards Collection — includes 44 documents

This collection contains the latest standards addressing the dimensioning, tolerancing, qualifying and performance aspects of rigid printed boards. An in-depth focus on solderability testing, plating requirements, conductor thickness and lot acceptance makes this collection an invaluable tool for anyone requiring the design and performance characteristics of rigid printed boards. Includes 44 documents.

Format: H

### IPC-C-107

#### Printed Board Materials Standards Collection — includes 19 documents

With global materials restrictions adding to all the different recipes used in manufacturing board laminate, board specifiers and manufacturers need to have all the tools available. This collection of 19 documents contains the requirements for the various reinforcements, foils, laminates and prepregs.

Format: H

## ACCEPTABILITY

### IPC-6010-SERIES

#### Family of Board Performance Requirements — includes 7 documents

This series includes IPC's current qualification and performance specification standards for all major types of printed boards, including:

- IPC-6011, Generic Performance Specification for Printed Boards
- IPC-6012, Qualification and Performance Specification for Rigid Printed Boards
- IPC-6013, Qualification and Performance Specification for Flexible Printed Boards
- IPC-6015, Qualification & Performance Specification for Organic Multichip Module (MCM-L) Mounting & Interconnecting Structures
- IPC-6017, Qualification and Performance Specification for Printed Boards Containing Embedded Passive Devices
- IPC-6018, Qualification and Performance Specification for High Frequency (Microwave) Printed Boards

See pages 12–13 for complete descriptions of the included documents.

Formats: H, C, D, K, S, G

### IPC-6011

#### Generic Performance Specification for Printed Boards

This specification establishes the general requirements and responsibilities for suppliers and users of printed boards. Serving as the foundation for the IPC-6010 Board Performance Requirements Series, IPC-6011 describes quality and reliability assurance requirements that must be met. For use with IPC-6012 through IPC-6018. 15 pages. Released July 1996. Languages: English, Chinese and German.

Formats: H, C, D, S, G

### IPC-6012C

#### Qualification and Performance Specification for Rigid Printed Boards

This specification covers qualification and performance of rigid printed boards, including single-sided, double-sided, with or without plated-through holes, multilayer with or without blind/buried via, and metal core boards. It addresses final finish and surface plating coating requirements, conductors, holes/vias, frequency of acceptance testing and quality conformance as well as electrical, mechanical and environmental requirements. Revision C incorporates many new requirements in areas such as selection for procurement, new surface finishes, hole plating thickness, measling, weave exposure, copper cap plating of filled holes, laminate cracks and voids, etchback, blind and buried via fill, acceptance testing and frequency, and requirements for thermal stress testing. This revision synchronizes to IPC-A-600H. For use with IPC-6011. 52 pages. Released April 2010. Languages: English, Chinese, French, German, Polish and Russian.

Formats: H, C, D, K, S, G

Certification on IPC-6012C is available. Visit [www.ipc.org/certification](http://www.ipc.org/certification) for details.

### NEW! IPC-6013C

#### Qualification and Performance Specification for Flexible Printed Boards

Covers qualification and performance requirements for flexible printed boards designed to IPC-2221 and IPC-2223. The flexible printed board may be single-sided, double-sided, multilayer or rigid-flex multilayer. All of these constructions may include stiffeners, plated-through holes (PTH) and blind/buried vias. Revision C incorporates updated requirements for final finishes, surface and hole plating, stiffeners, cap plating, smear removal, copper filled microvias, acceptance testing frequency and more. Supersedes IPC-6013B. For use with IPC-6011. 49 pages. Released December 2013.

Formats: H, C, D, K, S, G

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[www.ipc.org/onlinestore](http://www.ipc.org/onlinestore)

**IPC-6015****Qualification and Performance Specification for Organic Multichip Module (MCM-L) Mounting and Interconnecting Structures**

This standard establishes the specific requirements for organic mounting structures used to interconnect chip components which in combination form the completed functional organic single-chip module (SCM-L) or organic multichip module (MCM-L) assembly. Includes the quality and reliability assurance requirements that must be met. For use with IPC-6011. 25 pages. Released February 1998.

Formats: H, C, D, S, G

**IPC-6017****Qualification and Performance Specification for Printed Boards Containing Embedded Passive Devices**

This new standard supplements existing IPC-6010 series specifications with qualification and performance requirements for in-process and finished printed boards containing embedded passive circuitry (distributive capacitive planes and capacitive or resistive components). 10 pages. Released March 2009.

Formats: H, C, D, K, S, G

**IPC-6018B****Qualification and Performance Specification for High Frequency (Microwave) Printed Board**

Establishes requirements for qualification and performance of high frequency (microwave) printed boards. Covers both end-product inspection and test of microwave boards for microstrip, stripline, mixed dielectric and multilayer stripline applications. It addresses final finish and surface plating coating requirements, conductors, holes/vias, and frequency of acceptance and quality conformance testing, as well as electrical, mechanical and environmental requirements. Revision B incorporates many new requirements in areas such as selection for procurement, new surface finishes, microvia requirements including hole plating thickness and copper wrap/cap plating of filled holes, laminate cracks and voids, etchback, PTFE resin smear, and thermal stress testing. 45 pages. Released December 2011.

Formats: H, C, D, K, S, G

**IPC-QE-605A****Printed Board Quality Evaluation Handbook**

52 pages. Released February 1999.

Formats: H, C, D, K, S, G

**IPC-HM-860****Specification for Multilayer Hybrid Circuits**

66 pages. Released January 1987.

Formats: H, C, D, S, G

**IPC-A-600H****Acceptability of Printed Boards**

The definitive illustrated guide to printed board acceptability! This full-color document includes photographs and illustrations of the target, acceptable and nonconforming conditions that are either internally or externally observable on bare printed boards. Make sure your operators, inspectors and engineers have the most current industry consensus information. With more than 90 new or updated photographs and illustrations, revision H provides new coverage on topics such as copper wrap plating, copper cap plating of filled holes, and hole wall/barrel separation along with updated and expanded coverage for measling of printed boards, delamination and haloing, laminate voids/cracks, etchback, blind and buried via fill, and flexible circuits. The document synchronizes to the acceptability requirements expressed in IPC-6012C and IPC-6013B. 157 pages. Released April 2010.

Languages: English, Chinese, French, German, Polish and Swedish.

Formats: H, C, D, K, S, G

Certification on IPC-A-600H is available. Visit [www.ipc.org/certification](http://www.ipc.org/certification) for details.

**IPC-TF-870****Qualification and Performance of Polymer Thick Film Printed Boards**

59 pages. Released November 1989.

Formats: H, C, D, S, G

**IPC-ML-960****Qualification and Performance Specification for Mass Laminated Panels for Multilayer Printed Boards**

21 pages. Released July 1994.

Formats: H, C, D, S, G

**IPC-TR-481****Results of Multilayer Tests Program Round Robin**

86 pages. Released April 1981.

Format: H

**IPC-TR-551****Quality Assessment of Printed Boards Used for Mounting and Interconnecting Electronic Components**

104 pages. Released July 1993.

Format: H

**IPC-TR-579****Round Robin Reliability Evaluation of Small Diameter Plated-Through Holes in PWBs**

80 pages. Released September 1988.

Formats: H, C, D, S, G

**CLEANING****IPC-CH-65B****Guidelines for Cleaning of Printed Boards and Assemblies**

See page 5.

**IPC-5701****Users Guide for Cleanliness of Unpopulated Printed Boards**

6 pages. Released July 2003.

Formats: H, C, D, S, G

**IPC-5702****Guidelines for OEMs in Determining Acceptable Levels of Cleanliness of Unpopulated Printed Boards**

The question of "how clean is clean enough?" is one that has no definitive answer, as there is no "golden number" for board cleanliness. The issue is very complex with many critical considerations, so a single methodology to determine acceptability does not exist. Recognizing this, IPC-5702 has been written to give printed board and printed board assembly professionals guidance on how to correlate cleanliness related data to electrical function and determine "acceptable" cleanliness levels. 15 pages. Released June 2007.

Formats: H, C, D, K, S, G

**IPC-5703****Cleanliness Guidelines for Printed Board Fabricators**

See page 5.

**IPC-5704****Cleanliness Requirements for Unpopulated Printed Boards**

Printed board quality encompasses many parameters, cleanliness being an important one. This document defines the recommended general requirements for the cleanliness of unpopulated (bare) single, double-sided and multilayer printed boards. Coverage is given to ion chromatography (IC) testing and ionic cleanliness testing for process control. 6 pages. Released December 2009.

Formats: H, C, D, K, S, G

**IPC-7526****Stencil and Misprinted Board Cleaning Handbook**

See page 7.

**IPC-WP-008****Setting Up Ion Chromatography Capability**

16 pages. Released December 2005.

Formats: H, C, D, K, S, G

## IPC-TR-583

### An In-Depth Look at Ionic Cleanliness Testing

229 pages. Released July 2002.

Formats: H, C, D, S, G

## EMBEDDED PASSIVES

### IPC-2316

#### Design Guide for Embedded Passive Device Printed Boards

52 pages. Released March 2007.

Formats: H, C, D, K, S, G

### IPC-4811

#### Specification for Embedded Passive Device Resistor Materials for Rigid and Multilayer Printed Boards

This document describes materials that can be used for the fabrication of embedded passive resistor devices within the finished printed board substrate. It provides information on general designations and associated characteristics of embedded passive device (EPD) resistor materials. IPC-4811 is used as a qualification and conformance standard for designers and users when designing or constructing PCBs containing EPD materials. This document contains material designation, conformance (requirements), qualification (characterization) and quality assurance specifications. IPC-4811 should be used in conjunction with both IPC-2220 and IPC-6010 series. 26 pages. Released April 2008.

Formats: H, C, D, K, S, G

### IPC-4821

#### Specification for Embedded Passive Device Capacitor Materials for Rigid and Multilayer Printed Boards

34 pages. Released May 2006.

Formats: H, C, D, K, S, G

### IPC-6017

#### Qualification and Performance Specification for Printed Boards Containing Embedded Passive Devices

See page 13.

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## FABRICATION

### IPC-1601

#### Printed Board Handling and Storage Guidelines

The industry's sole guideline on the handling, packaging and storage of printed boards, this document provides guidelines to protect printed boards from contamination, physical damage, solderability degradation and moisture uptake. Consideration is given to packaging material types and methods, production environment, handling and transport of product, establishing recommended moisture levels, establishing baking profiles for moisture removal and the impact of baking on printed board solderability. 18 pages. Released August 2010. Languages: English, Chinese and German.

Formats: H, C, D, K, S, G

### IPC-4761

#### Design Guide for Protection of Printed Board Via Structures

16 pages. Released July 2006.

Formats: H, C, D, K, S, G

### NEW! IPC-4552-WAM1-2

#### Specification for Electroless Nickel/Immersion Gold (ENIG) Plating for Printed Circuit Boards — with Amendments 1 & 2

Containing full-color photographs, this specification sets the requirements for the use of ENIG as a surface finish for printed boards. It includes requirements for ENIG deposit thicknesses based on performance criteria. It is an invaluable resource for use by suppliers, board fabricators, electronics manufacturing service (EMS) providers and original equipment manufacturers (OEMs). The addition of Amendments 1 & 2 to this document provides for the use of thinner immersion gold, down to 0.04 microns (1.58 microinches), than was previously allowed at 0.05 microns (1.97 microinches). However, such thinner gold can only be utilized when the electrical connection is to be made via soldering. Also, the rules by which rework and/or repair of a printed board's ENIG surface finish are now defined. 33 pages. Released December 2012.

Formats: H, C, D, K, S, G



### IPC-4553A

#### Specification for Immersion Silver Plating for Printed Boards

This specification sets requirements based on performance criteria for the use of immersion silver (IAG) as a surface finish for printed boards. IAG is a thin immersion deposit over copper. It is a multifunctional surface finish, applicable to soldering. It may also be applicable for some press fit connections and as a contact surface. It has the potential to be suitable for aluminum wire bonding. The immersion silver protects the underlying copper from oxidation over its intended shelf life. Exposure to moisture and air contaminants, such as sulfur and chlorine, may negatively impact the useful life of the deposit. The impact can range from a slight discoloration of the deposit to the pads turning completely black. Proper packaging is a requirement. Note that in this revision both a single thickness range is in place and an upper limit for immersion silver thickness has been established. 36 pages. Released May 2009. Languages: English and Chinese.

Formats: H, C, D, K, S, G

### IPC-4554

#### Specification for Immersion Tin Plating for Printed Circuit Boards — with Amendment 1

A full color document, IPC-4554 sets requirements for performance criteria for the use of immersion tin as a surface finish for printed boards. Immersion tin (ISn) is a metallic finish deposited by a chemical displacement reaction that is applied directly over the base metal of the PCB, eg copper. ISn is primarily used as a solderable surface. It has been used in press fit connections and as the interface for zero insertion force (ZIF) edge connectors. The ISn protects the underlying copper from oxidation over its intended shelf life. The inserted Amendment 1 provides more detail on the solderability of the immersion tin, using both tin-lead as well as "lead-free" solders using appropriate fluxes. 48 pages. Released with Amendment 1 January 2012. Languages: English and German.

Formats: H, C, D, K, S, G

### NEW! IPC-4556

#### Specification for Electroless Nickel/Electroless Palladium/Immersion Gold (ENEPIG) Plating for Printed Circuit Boards

This specification sets the requirements for the use of electroless nickel/electroless palladium/immersion gold (ENEPIG) as a surface finish for printed boards. It establishes requirements for ENEPIG deposit thicknesses for applications including soldering, wire bonding and as a contact finish. It is intended for use by chemical suppliers, printed board manufacturers, electronics manufacturing service (EMS) providers and original equipment manufacturers (OEMs). 82 pages. Released February 2013.

Formats: H, C, D, K, S, G

**IPC-4781**

**Qualification and Performance Specification of Permanent, Semi-Permanent and Temporary Legend and/or Marking Ink**

This specification is the industry's first for the evaluation of a legend and/or marking ink material for the determination of acceptability of use in a standard printed board system. IPC-4781 provides coverage for adhesion, material qualification and testing, resistances to solvents, requirements for resistance to lead-free solders, and electrical requirements. 17 pages. Released May 2008.

Formats: H, C, D, K, S, G

**IPC-DR-572A**

**Drilling Guidelines for Printed Boards**

12 pages. Released March 2007.

Formats: H, C, D, K, S, G

**NEW! IPC-4203A**

**Cover and Bonding Material for Flexible Printed Circuitry**



This standard establishes the classification system and the qualification and quality conformance requirements for dielectric films coated with an adhesive on one or both sides. These materials are to be used as cover material for flexible printed circuitry as well as supported or unsupported adhesive films to be used in the fabrication of flexible printed circuitry. The standard does not address nonflexible adhesives designed to be used in the rigid board areas of rigid flex constructions which are addressed in IPC-4101. Materials such as liquid-applied covercoat are delineated in IPC-SM-840 and are excluded from this document. The requirements herein meet or exceed the requirements for Class 3 which, in turn, meet or exceed conformance to Classes 1 and 2. 44 pages. Released January 2013.

Formats: H, C, D, K, S, G



**IPC-4204A**

**Flexible Metal-Clad Dielectrics for Use in Fabrication of Flexible Printed Circuitry**



This standard establishes the classification system and qualification and quality performance requirements for flexible metal-clad dielectric materials used for flexible printed circuitry and flexible flat cable. It encompasses 12 specification sheets that result from the combinations of various copper foil claddings; a polymer base dielectric selected from at least two polyesters, multiple polyimides or liquid crystal polymers; and at least seven versions of polymer adhesives as well as adhesiveless bonding agents. The results of these material combinations provide the industry with suitable clad, flexible dielectrics for fabricating flexible printed circuitry interconnections. 53 pages. Released October 2011.

Formats: H, C, D, K, S, G

**NEW! IPC-6013C**

**Qualification and Performance Specification for Flexible Printed Boards**

See page 12.

**IPC/JPCA-6202**

**Performance Guide Manual for Single- and Double-Sided Flexible Printed Wiring Boards**

96 pages. Released February 1999.

Formats: H, C, D, S, G

**IPC-FC-234**

**Assembly Guidelines for Single- & Double-Sided Flexible Printed Circuits**

30 pages. Released December 1997.

Formats: H, C, D, S, G

**IPC-FA-251**

**Assembly Guidelines for Single- & Double-Sided Flex Hole Printed Circuits**

30 pages. Released February 1992.

Formats: H, C, D, S, G

**FLEXIBLE CIRCUITS**

**IPC-4202A**

**Flexible Base Dielectrics for Use in Flexible Printed Circuitry**



This document provides comprehensive data to help users determine both material capability and compatibility of flexible base dielectric materials of flexible printed circuitry and flexible flat cables. It includes flexible base material specification sheets that have been updated with the newest properties for specification material types. It establishes the most current classification system, qualification and quality conformance requirements, including high frequency dielectric properties. 27 pages. Released April 2010.

Formats: H, C, D, K, S, G

**GENERAL**

**IPC-D-325A**

**Documentation Requirements for Printed Boards, Assemblies and Support Drawings**

94 pages. Revised May 1995.

Formats: H, C, D, S, G

**IPC-D-326A**

**Information Requirements for Manufacturing Printed Boards and Other Electronic Assemblies**

5 pages. Released January 2004.

Formats: H, C, D, S, G

**IPC-PE-740A**

**Troubleshooting for Printed Board Manufacture and Assembly**

388 pages. Released December 1997.

Formats: H, C, D, K, S, G

**HIGH DENSITY/FINE PITCH**

**IPC/JPCA-4104**

**Specification for High Density Interconnect (HDI) and Microvia Materials**

Developed by IPC and JPCA. 92 pages. Released May 1999.

Formats: H, C, D, S, G

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[www.IPCOutlook.org](http://www.IPCOutlook.org).

## IPC/JPCA-6801

### Terms & Definitions, Test Methods, and Design Examples for Build-Up/High Density Interconnect (HDI) Printed Wiring Boards

Developed by IPC and JPCA. 32 pages. Released January 2000.

Formats: H, C, D, S, G

## MATERIALS/GENERAL

### IPC-MI-660

#### Incoming Inspection of Raw Materials Manual

150 pages. Released February 1984.

Format: H

## IPC-4563

### Resin Coated Copper Foil for Printed Boards Guideline

19 pages. Released November 2007.

Formats: H, C, D, K, S, G

## MATERIALS/FOILS AND LAMINATES

### IPC-4101C

#### Specification for Base Materials for Rigid and Multilayer Printed Boards

This specification covers the requirements for base materials that are referred to as laminate or prepreg. These are to be used primarily for rigid and multilayer printed boards for electrical and electronic circuits. This document contains 66 individual specification sheets that can be searched using keywords. The keywords allow users to find similar materials that may have specific differing properties that fine-tune their laminate and/or prepreg selection needs. This revision's 11 new specification sheets reflect the expanded offerings of current commercially available laminates and prepreps. These specification sheets add laminate and prepreg materials that have improved or additional properties, including one or more of the following: low halogen content, lead-free applications, high thermal performance or high speed/high frequency performance. 137 pages. Released August 2009. **Languages:** English, Chinese and German.

Formats: H, C, D, K, S, G

## IPC-CF-152B

### Composite Metallic Materials Specification for Printed Wiring Boards

39 pages. Released December 1997.

Formats: H, C, D, S, G

## HIGH SPEED/HIGH FREQUENCY

### IPC-2141A

#### Design Guide for High-Speed Controlled Impedance Circuit Boards

53 pages. Released March 2004.

Formats: H, C, D, K, S, G

### IPC-2251

#### Design Guide for the Packaging of High Speed Electronic Circuits

99 pages. Released November 2003.

Formats: H, C, D, S, G

### IPC-2252

#### Design Guide for RF/Microwave Circuit Boards

30 pages. Released June 2002.

Formats: H, C, D, S, G

### IPC-4103A

#### Specification for Base Materials for High Speed/High Frequency Applications

This specification covers the requirements for clad and unclad plastic laminate and bonding layer materials for the fabrication of printed boards for microstrip, stripline and high speed digital electrical and electronic circuits. In addition to providing updated testing parameters, inspection lot requirements and revised visual acceptance criteria, this revision incorporates a new specification sheet format for new materials that provides both mandatory (e.g., Df and Dk) requirements and "loose" requirements (e.g., thermal conductivity and moisture absorption) that can be certified to or called out on fabrication drawings. This new classification format allows for a reduced number of material specification sheets. 56 pages. Released December 2011.

Formats: H, C, D, K, S, G

### IPC-6018B

#### Qualification and Performance Specification for High Frequency (Microwave) Printed Boards

See page 13. 45 pages. Released December 2011.

Formats: H, C, D, K, S, G

## IPC-TR-485

### Results of Copper Foil Rupture Strength Test Round Robin Study

27 pages. Released March 1985.

Format: H

## MATERIALS/REINFORCEMENTS

### NEW! IPC-4412B

#### Specification for Finished Fabric Woven from "E" Glass for Printed Boards



IPC-4412B exhaustively covers the classification and requirements for finished fabrics that are formed by plain woven glass fiber yarns. Simply, these yarns are appropriately sized bundles of continuous filament, electrical-grade ("E" glass) borosilicate glass. Bulk "E" glass, for ease of description, is composed of a blend of raw metal oxides that form a borosilicate glass upon melting. Once melted, the glass formed loses all relation to the raw metal oxides, including the network forming boron oxides or borates. This specification includes two extensive tables of finished fabric glass styles, one in SI (metric) units and the other in U.S. (English) units. 27 pages. Released May 2013.

Formats: H, C, D, K, S, G

### IPC-4121

#### Guidelines for Selecting Core Constructions for Multilayer Printed Wiring Board Applications

12 pages. January 2000.

Formats: H, C, D, S, G

### IPC-4562A

#### Metal Foil for Printed Board Applications



This specification covers metal foils supported by carrier films and unsupported foils suitable for subsequent use in only printed boards. It also addresses the requirements for procurement of these same metal foils. Unless otherwise agreed upon between user and supplier (AABUS), metal foils shall be considered acceptable as long as the requirements in this specification are met. 27 pages. Released April 2008. **Languages:** English and Chinese.

Formats: H, C, D, K, S, G



**IPC-4110**  
**Specification & Characterization Methods for Nonwoven Cellulose Based Paper for Printed Boards**

11 pages. Released August 1998.  
Formats: H, C, D, S, G

**IPC-4130**  
**Specification & Characterization Methods for Nonwoven "E" Glass Mat**

14 pages. Released September 1998.  
Formats: H, C, D, S, G

**IPC-4411A**  
**Specification and Characterization Methods for Nonwoven Para-Aramid Reinforcement**

22 pages. Released November 2003.  
Formats: H, C, D, S, G

**IPC-SG-141**  
**Specification for Finished Fabric Woven from "S" Glass for Printed Boards**

 12 pages. Released February 1992.  
Formats: H, C, D, S, G

**IPC-A-142**  
**Specification for Finished Fabric Woven from Aramid for Printed Boards**

9 pages. Released June 1990.  
Formats: H, C, D, S, G

**IPC-QF-143**  
**Specifications for Finished Fabric Woven from Quartz (Pure Fused Silica) for Printed Boards**

13 pages. Released February 1992.  
Formats: H, C, D, S, G

**PRINTED ELECTRONICS**

**NEW! IPC/JPCA-2291**  
**Design Guideline for Printed Electronics**

Developed by IPC and Japan Electronics Packaging and Circuits Association (JPCA), this guideline provides an overview of the design process flow for printed electronics based devices, modules and units, and final products. The intent of IPC/JPCA-2291 is to establish a design process flow that will facilitate and improve the practice of printed electronics design. IPC/JPCA-2291 identifies documents such as standards that can be used to assist during the design process flow. 24 pages. Released June 2013.  
Formats: H, C, D, K, S, G



**NEW! IPC/JPCA-4921**  
**Requirements for Printed Electronics Base Materials (Substrates)**

This document provides comprehensive data to help users more easily determine both material capability and compatibility for flexible and rigid base dielectric materials for manufacture of printed electronics. It includes base material specification sheets that have been updated with the newest properties for the specification material types. It establishes the most current classification system, qualification and quality conformance requirements, including those raw material properties of particular interest to the printed electronics designer, fabricator, or user. This standard is a joint standard published by IPC and Japan Electronics Packaging and Circuits Association (JPCA). 26 pages. Released June 2012.

Formats: H, C, D, K, S, G



**NEW! IPC/JPCA-4591**  
**Requirements for Printed Electronics Functional Conductive Materials**

This document provides comprehensive data to help users more easily determine material performance, capabilities, and compatibility of functional conductive materials for the manufacture of printed electronics. It includes: classification schemes based on composition, conductor type and post-processing structure; functional conductive material specification sheets to present properties for the different conductive material types; and the most current classification system, qualification and quality conformance requirements, including those raw material properties of particular interest to the printed electronics designer, fabricator or other user. Developed by IPC and Japan Electronics Packaging and Circuits Association (JPCA). 21 pages. Released December 2012.

Formats: H, C, D, K, S, G



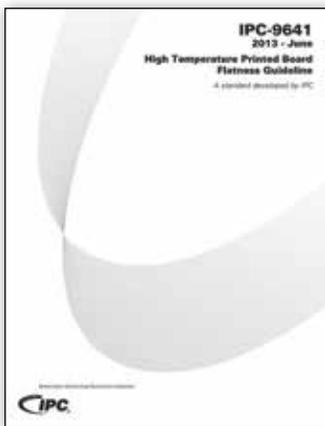
## QUALITY AND TEST

### NEW! IPC-9641

#### High Temperature Printed Board Flatness Guideline

Printed board flatness is largely affected by a change in intrinsic properties through exposure to variances in temperature. The worst case deviation of the printed board from flatness may be at room temperature, peak temperature during reflow, or at any temperature in between. Printed board flatness must therefore be characterized during the entire reflow thermal cycle, and not solely at room temperature at the beginning and end of the assembly process. This document aims to provide guidance on methods and procedures for critically evaluating the relative change in shape (printed board flatness) of local areas of interest (e.g., BGA land area) during a simulated temperature reflow cycle. 20 pages. Released June 2013.

Formats: H, C, D, K, S, G



### IPC-9631

#### Users Guide for IPC-TM-650, Method 2.6.27, Thermal Stress, Convection Reflow Assembly Simulation

IPC-9631 addresses concerns and considerations related to IPC-TM-650, Method 2.6.27, Thermal Stress, Convection Reflow Assembly Simulation. This document describes how the test method is intended for use and the rationale behind some of the protocols and requirements. This document was developed with the understanding that the test method will require special equipment and the proper set-up and calibration of that equipment. 11 pages. Released December 2010. Languages: English and German.

Formats: H, C, D, K, S, G

### IPC-9691A

#### User Guide for the IPC-TM-650, Method 2.6.25, Conductive Anodic Filament (CAF) Resistance Test (Electrochemical Migration Testing)

23 pages. Released August 2007.

Formats: H, C, D, K, S, G

### IPC-2524

#### PWB Fabrication Data Quality Rating System

16 pages. Released February 1999.

Format: FREE DOWNLOAD

### IPC-9151D

#### Process Capability, Quality and Relative Reliability (PCQR2) Benchmark Test Standard and Database

8 pages. Released May 2012.

Format: FREE DOWNLOAD

### IPC-9191

#### General Guidelines for Implementation of Statistical Process Control (SPC)

 43 pages. Released November 1999.

Formats: H, C, D, S, G

### IPC-9194

#### Implementation of Statistical Process Control (SPC) Applied to Printed Board Assembly Manufacture Guideline

36 pages. Released September 2004.

Formats: H, C, D, K, S, G

### IPC-9199

#### Statistical Process Control (SPC) Quality Rating

41 pages. Released September 2002.

Formats: H, C, D, S, G

### IPC-9252A

#### Requirements for Electrical Testing of Unpopulated Printed Boards



IPC-9252 defines levels of appropriate testing and assists in the selection of the test analyzer, test parameters, test data and fixturing required to perform electrical test(s) on unpopulated printed boards and innerlayers. Revision A provides expanded coverage of adjacency concepts for isolating testing, as well as new requirements for resistive and indirect continuity and isolating testing. 13 pages. Released November 2008. Languages: English and Chinese.

Formats: H, C, D, K, S, G

### IPC-MS-810

#### Guidelines for High Volume Microsection

31 pages. Released October 1993.

Formats: H, C, D, S, G

### IPC-QL-653A

#### Certification of Facilities that Inspect/Test Printed Boards, Components & Materials



15 pages. Revised November 1997.

Formats: H, C, D, S, G

### IPC-TR-483

#### Dimensional Stability Testing of Thin Laminates — Report on Phase 1 & 2 International Round Robin Test Programs

74 pages. Revised March 1991.

Format: H

### IPC-TR-486

#### Report on Round Robin Study to Correlate Interconnect Stress Test (IST) with Thermal Stress/Microsectioning Evaluations for Detecting the Presence of Inner-Layer Separations

51 pages. Released July 2001.

Formats: H, C, D, S, G



## COLLECTIONS

**IPC-C-106****Printed Board Design Standards Collection — includes 23 documents**

For the designer considering physical design principles, customer reliability requirements and surface mount and high-speed logic design, this new collection provides an excellent compilation of standards essential to your library. Sharp focus is brought to bear on such aspects of printed board technology as high density interconnects, flexible printed board design, controlled impedance and design for reliability (DFR) procedures. Includes 23 documents.

Format: H

## DATA TRANSFER

**NEW! IPC-2581B****Generic Requirements for Printed Board Assembly Products Manufacturing Description Data and Transfer Methodology**

This standard specifies the XML schema that represents the intelligent data file format used to describe printed board and printed board assembly products with details sufficient for tooling, manufacturing, assembly, and inspection requirements. This format may be used for transmitting information between a printed board designer and a manufacturing or assembly facility. The data is most useful when the manufacturing cycle includes computer-aided processes and numerical control machines. The B revision enhances the methodology of specifying performance requirements and covers legal compliance with international environmental regulations. 229 pages. Released September 2013.

Formats: H, C, FREE DOWNLOAD, K, S, G

**IPC-2501****Definition for Web-Based Exchange of XML Data (Message Broker)**

32 pages. Released July 2003.

Formats: H, FREE DOWNLOAD

**IPC-2531****SMEMA Standard Recipe File Format Specification**

125 pages. Released March 1999.

Formats: H, FREE DOWNLOAD

**IPC-2541****Generic Requirements for Electronics Manufacturing Shop-Floor Equipment Communication Messages (CAMX)**

175 pages. Released October 2001.

Formats: H, FREE DOWNLOAD

**IPC-2546****Sectional Requirements for Shop-Floor Equipment Communication Messages (CAMX) for Printed Circuit Board Assembly — with Amendments 1 & 2**

131 pages. Released January 2005.

Formats: H, FREE DOWNLOAD

**IPC-2547****Sectional Requirements for Shop Floor Equipment Communication Messages (CAMX) for Printed Circuit Board Test, Inspection and Rework**

52 pages. Released January 2002.

Formats: H, FREE DOWNLOAD

**IPC-2571****Generic Requirements for Electronic Manufacturing Supply Chain Communication — Product Data eXchange (PDX)**

43 pages. Released November 2001.

Formats: H, FREE DOWNLOAD

**IPC-2576****Sectional Requirements for Electronics Manufacturing Supply Chain Communication of As-Built Product Data — Product Data eXchange (PDX)**

9 pages. Released November 2001.

Formats: H, FREE DOWNLOAD

**IPC-2578****Sectional Requirements for Supply Chain Communication of Bill of Material and Product Design Configuration Data — Product Data eXchange**

34 pages. Released November 2001.

Formats: H, FREE DOWNLOAD

**IPC-2511A****Generic Requirements for Implementation of Product Manufacturing Description Data and Transfer Methodology**

182 pages. Released March 2000.

Formats: H, FREE DOWNLOAD

**IPC-2512A****Sectional Requirements for Implementation of Administrative Methods for Manufacturing Data Description**

18 pages. Released November 2000.

Formats: H, FREE DOWNLOAD

**IPC-2513A****Sectional Requirements for Implementation of Drawing Methods for Manufacturing Data Description**

26 pages. Released November 2000.

Formats: H, FREE DOWNLOAD

**IPC-2514A****Sectional Requirements for Implementation of Printed Board Fabrication Data Description**

23 pages. Released November 2000.

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**IPC-2515A****Sectional Requirements for Implementation of Bare-Board Product Testing Data Description**

20 pages. Released November 2000.

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**IPC-2516A****Sectional Requirements for Implementation of Assembled Board Product Manufacturing Data Description**

19 pages. Released November 2000.

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**IPC-2517A****Sectional Requirements for Implementation of Assembly In-Circuit Test Data Description**

24 pages. Released November 2000.

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**IPC-2518A****Sectional Requirements for Implementation of Parts List Product Manufacturing Data Description**

18 pages. Released November 2000.

Formats: H, FREE DOWNLOAD

**IPC-D-356B****Bare Substrate Electrical Test Data Format**

 61 pages. Released October 2002.

Formats: H, C, D, S, G

### Download these Data Transfer Documents for FREE!

- **IPC-2511B**, Generic Requirements for Implementation of Product Manufacturing Description Data and Transfer XML Schema Methodology
- **IPC-2582**, Sectional Requirements for Implementation of Administrative Methods for Manufacturing Data Description
- **IPC-2583**, Sectional Requirements for Implementation of Design Characteristics for Manufacturing Data Description
- **IPC-2584**, Sectional Requirements for Implementation of Printed Board Fabrication Data Description
- **IPC-2588**, Sectional Requirements for Implementation of Part List Product Data Description

### IPC-2611 Generic Requirements for Electronic Product Documentation

This standard establishes the generic requirements for a document set describing electronic products, and the methodology used for revision control and configuration management of the information. The generic descriptions apply to the entire document set and are used to define and maintain the electronic product. The methodology permits different grades of completeness of the documentation, as well as identifying the various products, packaging and interconnection techniques for which unambiguous documentation is required. The requirements pertain to both hard copy and electronic data descriptions. 26 pages. Released March 2010.

Formats: H, C, D, K, S, G

### IPC-2612 Sectional Requirements for Electronic Diagramming Documentation (Schematic and Logic Descriptions)

This standard establishes the requirements for the documentation of electronic diagrams used as the foundation for defining the electrical interconnectivity of electronic products. The description pertains to either schematic diagrams, logic diagrams or Boolean truth tables and includes methodology for defining circuit flow, electrical or functional restrictions, or maintenance test procedures used to design or maintain the electronic product. The requirements pertain to hard copy, electronic copy or electronic data descriptions. 26 pages. Released March 2010.

Formats: H, C, D, K, S, G

### IPC-2612-1 Sectional Requirements for Electronic Diagramming Symbol Generation Methodology

This standard establishes the requirements for generation of electronic symbols used in the documentation of electronic diagrams that define the electrical interconnectivity of electronic products. The descriptions pertain to schematic symbols, logic symbols or Boolean truth tables required to define the circuit configuration. Where appropriate, the standard also includes methodology for defining circuit flow, electrical or functional restrictions, or maintenance test procedures used to design or maintain the electronic product. The requirements pertain to both hard copy and electronic data descriptions. 31 pages. Released March 2010.

Formats: H, C, D, K, S, G

### IPC-2614 Sectional Requirements for Board Fabrication Documentation

This standard establishes the requirements for the documentation of printed board fabrication, and identifies the physical attributes and performance requirements of the unpopulated product. The descriptions apply to rigid, flexible, inorganic substrates or any combination thereof. The construction may be single, double, multilayered, or HDI technology and may include embedded (integrated) components. The requirements pertain to both hard copy and electronic data descriptions. 59 pages. Released March 2010.

Formats: H, C, D, K, S, G

#### GUIDELINES

### IPC-2152 Standard for Determining Current Carrying Capacity in Printed Board Design



The sole industry standard for determining appropriate internal and external conductor sizes on printed boards as a function of the current carrying capacity required and the acceptable conductor temperature rise. This document provides guidance on how thermal conductivity, vias, copper planes, power dissipation and printed board material and thickness all factor into the relationship between current, conductor size and temperature. 97 pages. Released August 2009. Languages: English and German.

Formats: H, C, D, K, S, G

Visit the IPC online store  
for current pricing.

[www.ipc.org/onlinestore](http://www.ipc.org/onlinestore)

### IPC/JPCA-2315 Design Guide for High Density Interconnects & Microvias

Developed by IPC and JPCA. 33 pages. Released June 2000.

Formats: H, C, D, S, G

### IPC-2615 Printed Board Dimensions and Tolerances



66 pages. Released July 2000.

Formats: H, C, D, S, G

### IPC-A-311 Process Controls for Phototool Generation and Use

6 pages. Released March 1996.

Formats: H, C, D, S, G

### IPC-D-279 Design Guidelines for Reliable Surface Mount Technology Printed Board Assemblies

137 pages. Released July 1996.

Formats: H, C, D, K, S, G

### IPC-D-310C Guidelines for Phototool Generation and Measurement Techniques

68 pages. Revised June 1991.

Formats: H, C, D, S, G

### IPC-D-322 Guidelines for Selecting Printed Wiring Board Sizes Using Standard Panel Sizes



4 pages. Reaffirmed September 1991.

Formats: H, C, D, S, G

### IPC-D-422 Design Guide for Press Fit Rigid Printed Board Backplanes

17 pages. Revised September 1982.

Formats: H, C, D, S, G

## REQUIREMENTS

## IPC-2220

## Family of Design Documents



The series is built around IPC-2221, *Generic Standard on Printed Board Design*, the base document that covers all generic requirements for printed board design, regardless of materials. From there, the designer chooses the appropriate sectional standard for a specific technology. All five sectional standards are included with the series: IPC-2222, *Sectional Design Standard for Rigid Organic Printed Boards*; IPC-2223, *Sectional Design Standard for Flexible Printed Boards*; IPC-2225, *Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies*; and IPC-2226, *Sectional Design Standard for High Density Interconnect (HDI) Printed Boards*.

Formats: H, C, D, K, S, G

**NEW!** IPC-2221B

## Generic Standard on Printed Board Design

IPC-2221B is the foundation design standard for all documents in the IPC-2220 series. It establishes the generic requirements for the design of printed boards and other forms of component mounting or interconnecting structures, whether single-sided, double-sided or multilayer. Among the many updates to Revision B are new criteria for conductor characteristics, surface finishes, via protection, board electrical test, dielectric properties, board housings, thermal stress, compliant pins, panelization and internal and external foil thicknesses. Appendix A provides new test coupon designs used for lot acceptance and quality conformance testing. 170 pages. Released November 2012. Languages: English and German.

Formats: H, C, D, K, S, G

## IPC-2222A

## Sectional Design Standard for Rigid Organic Printed Boards

Used in conjunction with IPC-2221, IPC-2222 establishes the specific requirements for the design of rigid organic printed boards and other forms of component mounting and interconnecting structures. This standard applies to single-sided, double-sided or multi-layered boards. Key concepts in this document are: rigid laminate properties, design requirements for printed board assembly and design requirements for holes/ interconnections. Revision A provides new design guidance and requirements for dielectric spacing, lead-free laminate materials, scoring and routing parameters, printed board thickness tolerance, nonfunctional lands, hole aspect ratios and clearance areas in planes. 33 pages. Released December 2010. Languages: English, Chinese and German.

Formats: H, C, D, K, S, G

## IPC-2223C

## Sectional Design Standard for Flexible Printed Boards



Used in conjunction with IPC-2221, IPC-2223 establishes the specific requirements for the design of flexible printed boards and forms of component mounting and interconnecting structures. The flexible materials used in the structures are comprised of insulating films, reinforced and/or non-reinforced dielectric in combination with metallic materials. Revision C provides new design guidance and requirements for bends, folds and creases, staggered flexible layer bands and strain relief fillets. Also included is a new design tutorial providing guidance on material selection, size and shape of flexible circuits and fabrication allowances. 39 pages. Released November 2011. Languages: English and German.

Formats: H, C, D, K, S, G

## IPC-2225

## Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies

44 pages. Released May 1998.

Formats: H, C, D, S, G

## IPC-2226

## Sectional Design Standard for High Density Interconnect (HDI) Printed Boards



49 pages. Released May 2003.

Formats: H, C, D, S, G

## IPC-7351B

## Generic Requirements for Surface Mount Design and Land Pattern Standard

IPC-7351B includes both the standard and an IPC-7351B land pattern calculator on CD-ROM for accessing component and land pattern dimensional data. The calculator includes the document's mathematical algorithms so users can build a land pattern for a corresponding surface mount part quickly and accurately. The tool also allows for modification of dimensional attributes of IPC approved land patterns. This popular document covers land pattern design for all types of passive and active components, including resistors, capacitors, MELFs, SOPs, QFPs, BGAs, QFNs and SONs. The standard provides printed board designers with an intelligent land pattern naming convention, zero component rotations for CAD systems and three separate land pattern geometries for each component that allow the user to select a land pattern based on desired component density. Revision B includes land pattern design guidance and rules for component families such as resistor array packages, aluminum electrolytic capacitors, column and land grid arrays, flat lead devices (SODFL and SOTFL) and dual flat no-lead (DFN) devices. The revision also discusses the usage of thermal tabs and provides a new padstack naming convention that addresses the shape and dimensions of lands on different layers of printed boards. 102 pages. Released June 2010. Languages: English and German.

Formats: H, C, D, K, S, G

## IPC-D-859

## Design Standard for Thick Film Multilayer Hybrid Circuits

80 pages. Released December 1989.

Formats: H, C, D, S, G

**IPC Designer Certification (CID) and IPC Advanced Designer Certification (CID+)**

The IPC Designer Certification or CID (Certified Interconnect Designer) is the industry's premier professional development program focused on PCB design philosophy and requirements. If your passion is the transformation of electrical schematics and descriptions into works of art that can be manufactured, assembled and tested, this program is for you.

Taught by recognized industry professionals from EPTAC, this program enhances your experience by exposing you to IPC Certified Instructors that have a broad expertise and appreciation for the process. This course is also an excellent course for anyone involved in the development, design and fabrication, at any level from sales, management, procurement, or quality in printed circuit board production.

Upon successful completion of the course and exam, you will receive a certification that is recognized throughout the industry, bringing additional credentials to your technical expertise.

**Already CID Certified? Go Advanced NOW!**

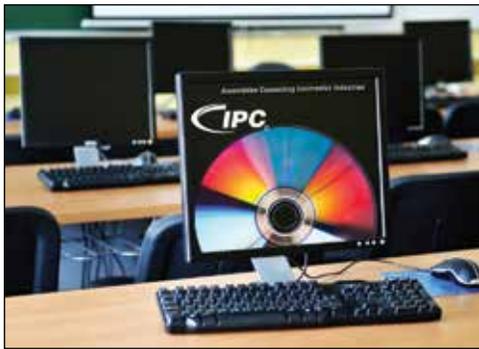
Continuing the educational series for PCB Design, the IPC Advanced Designer Certification or CID+ (Advanced Certified Interconnect Designer) is the ultimate professional industry certification for a designer looking to obtain what we would consider a Masters in PCB Design. This certification gains you instant recognition in the industry as a designer that has obtained, executed and applied the concepts of design from schematic capture to production of a final product rolling out the door. This course is open to anyone who has earned the IPC Designer Certification CID.

For more information, visit [www.ipc.org/designer-certification](http://www.ipc.org/designer-certification).

## MULTIMEDIA TRAINING

IPC has been producing industry-approved, commercial-free training videos for more than 30 years ... covering electronics assembly acceptance standards, hand soldering, lead free, repair and rework, ESD control, component ID, cable/wire harness assemblies and circuit board fabrication. IPC also provides a line of reference guides and visual learning aids, as well as network and Web-based automated training programs.

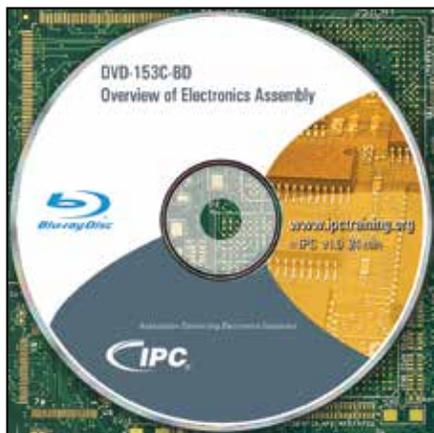
For the complete catalog of DVD and computer-based video training resources, reference guides, wall posters and image sets go to [www.ipctraining.org](http://www.ipctraining.org).



## DVD — BLU-RAY

**NEW!** IPC's newest training programs are now available in high-definition, Blu-ray format. All IPC DVDs have the advantage of high-resolution, close-up digital video, along with optional subtitles for the hearing-impaired and ESL students. Additionally, special dual-language discs (e.g., Spanish/English, Chinese/English) provide for an even wider audience.

DVDs work well in group or individual training sessions, and come with support materials such as user guides, tests and certificates of completion — all of which are available for FREE download with DVD purchase. DVD users can even take their exams online with IPC's instant auto-testing feature.



## ONLINE VIDEO TRAINING RESOURCES

IPC now offers two platforms for computer-based video training and automated testing:

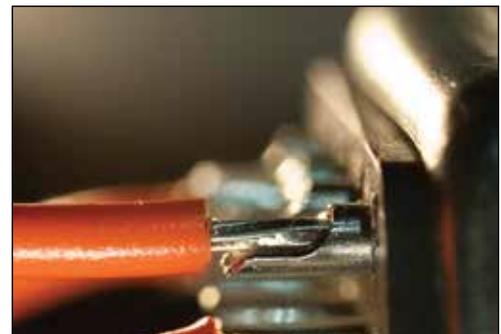
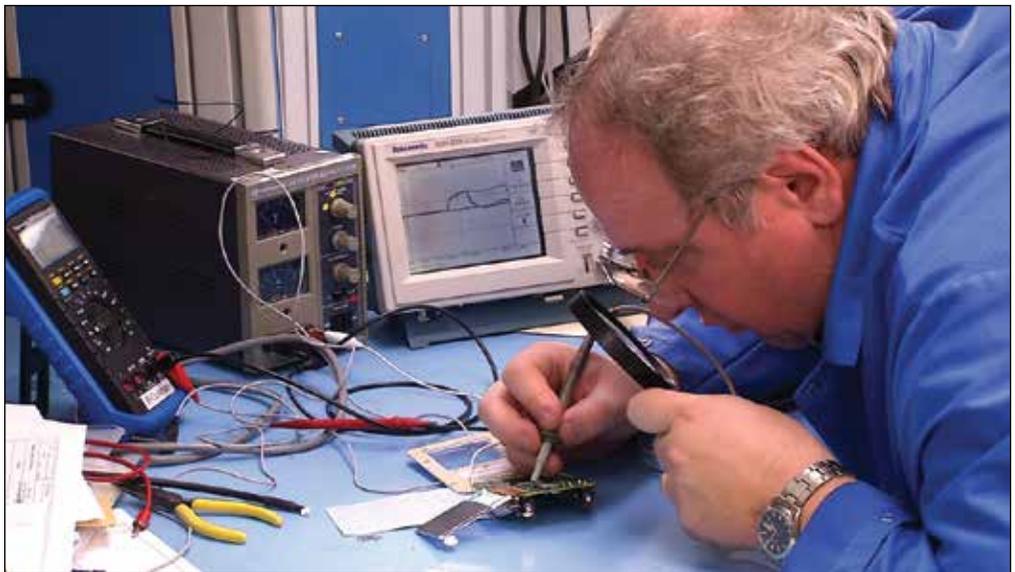
1) **NEW!** **IPC Host/OTL — Online Training Library:** IPC's entire collection of electronics assembly videos is now available through the Internet. With the purchase of a one-year license, your company will gain complete online access to these training videos using high-resolution video streaming — as well as all of the automated testing programs found on the IPC website. No costly IT implementation, or complicated installations. Includes automatic certificate-generation for students with passing scores and e-mail notification of test results to an e-mail address input by the student. Site or Global licenses available.

Visit [www.ipctraining.org/html/IPChost.htm](http://www.ipctraining.org/html/IPChost.htm) for more information.

2) **You Host/OVT — Online Video Training:** Mount one, several or the complete collection of IPC's electronics assembly video training and automated testing programs on your own server, for delivery over a learning network/intranet or even through your LMS (learning management system). These customizable programs have the same great video training as found in our DVDs, but have built-in automated testing, scoring, e-mail notification and certificate-generation. If running within your LMS, the OVT program automatically captures student test data in your employee training database. Be safe behind your own firewall. Site or Global licenses available.

Visit [www.ipctraining.org/html/YOUhost.htm](http://www.ipctraining.org/html/YOUhost.htm) for more information.

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**EDUCATIONAL COURSEWARE —  
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Each course in our educational courseware features targeted learning modules focusing on a common topic. Use the courseware on DVD in a classroom setting or deliver it via OVT (Online Video Training) across your learning network or learning management system. Students who pass all seven modules of the course receive a certificate of completion, demonstrating mastery of the topic.

- **EDU-101**, Intro to Electronics Assembly
- **EDU-102**, Surface Mount Assembly
- **EDU-103**, Through Hole Assembly
- **EDU-104**, Advanced Electronics Assembly
- **NEW! EDU-105**, Cable & Wire Harness Assembly

**TRANSLATIONS — INCLUDING SPANISH  
AND CHINESE**

Many topics are available on dual-language DVDs. Languages include Spanish, Chinese, French, Swedish, Vietnamese, German and Russian. Each dual-language DVD comes with the original English language as an optional audio track.

Request a FREE demo DVD that includes complete reviews of all IPC multimedia training resources at [www.ipctraining.org](http://www.ipctraining.org). The same reviews are available for immediate viewing or download online.

**TRAINING & REFERENCE GUIDES**

Handy and portable 5 x 8-inch, spiral-bound reference guides cover surface mount and through hole solder joint acceptability, component identification, wire prep/crimp acceptability and basic electronics assembly. See pages 11-12 for descriptions.



**IMAGE RESOURCES**

IPC offers clip art from IPC-A-610E — sold individually, by chapter or as a complete set. Also available: A lead-free solder joint image library and the complete set of images from IPC/WHMA-A-620B. Everything is photographed in extreme microscopic detail. Create your own learning tools using these graphic resources. For unrestricted, in-house use.

**WALL POSTERS**

Make a “big” impression with these surface mount and through hole solder joint evaluation posters. Through hole and SMT evaluation posters contain the critical acceptance criteria from IPC-A-610E and IPC J-STD-001E for solder connections, and are laminated for easy display.

**P-SMT2-E  
Surface Mount Solder Joint Evaluation Wall Posters (Set of 3) — Class 2**

What better way to demonstrate to your employees that “inspection is everyone’s job,” than our surface mount evaluation wall posters. Using the graphics and Class 2 acceptability criteria from IPC-A-610E and J-STD-001E, these 20" x 28" laminated posters serve as a constant reminder that quality is job number one. This three-poster set includes one poster each for chip, gull wing and J-lead component types.

**P-SMT3-E  
Surface Mount Solder Joint Evaluation Wall Posters (Set of 3) — Class 3**

Class 3 version of P-SMT2-E (three-poster set).

**P-PTH2-E  
Through-Hole Solder Joint Evaluation Wall Poster — Class 2**

Full-color, 20" x 28" laminated wall poster visually defines minimum/maximum Class 2 through-hole solder joint acceptability requirements from IPC-A-610E and J-STD-001E in high-quality graphics. This poster depicts complex through-hole solder joint requirements so all operators and inspectors can easily understand and apply this important criteria. Bring technically accurate, industry-consensus acceptability standards to your training room or inspection area. One poster for Class 2.

**P-PTH3-E  
Through-Hole Solder Joint Evaluation Wall Posters — Class 3**

Class 3 version of P-PTH (one poster).

**Target Condition** **Chip Components • Class 2**

This photo represents an **ideal** surface mount solder joint for any class of rectangular chip component.

The following illustrations show the **limits** of component misalignment and solder joint size. Solder joints that **do not meet** any of these conditions for 1, 3 or 5-sided terminations should be considered **unacceptable**.

**Notes:** Solder joints are semi-transparent to show relationship between land and termination. Minimum side joint length, dimension (D), is not required for chip, only a properly wetted fillet.

---

**Acceptability Requirements**

|  |   |  |   |
|--|---|--|---|
| <b>Side Overhang (A)</b><br>The component may overhang the side of the land a <b>maximum</b> of 50% of the width of the component termination (W), or 50% of the width of the land (P), whichever is less. | <b>End Overhang (B)</b><br>Any part of the component termination extending beyond the land is <b>unacceptable</b> . | <b>End Joint Width (C)</b><br>The width of the solder joint at its narrowest point must be a <b>minimum</b> of 20% the width of the component termination (W), or 50% of the width of the land (P), whichever is less. | <b>Fillet Height (E)</b><br>The solder may overhang the land, and extend onto the top of the termination, but <b>not touch</b> the top of the component body as a <b>maximum</b> fillet height. |
|--|---|--|---|

---

**Acceptability Requirements**

|  |  |  |
|--|--|--|
| <b>Fillet Height (F)</b><br>Wetting is evident on termination's vertical surfaces as a <b>minimum</b> fillet height. | <b>Solder Thickness (G)</b><br>The <b>minimum</b> distance between the land and component termination is <b>not specified</b> . Only a properly wetted fillet must be evident. | <b>End Overlap (J)</b><br>Some amount of overlap between the component termination and the land is <b>required for minimum</b> acceptance. |
|--|--|--|

References: IPC-A-610E and IPC J-STD-001E

**Minimum Through-Hole Solder Joint Requirements • Class 2**

Shown below are the minimum acceptable conditions for a Class 2 Plated Through Hole Solder Joint. All of the illustrations show the same solder connection from three different views: top, barrel (cutaway), and bottom.

Any Class 2 solder connection failing to meet these minimum requirements should be considered unacceptable.

References: IPC-A-610E and IPC J-STD-001E

|  |   |
|--|---|
| <b>Wetting of component side</b><br><b>fillet = 0%</b><br>A properly wetted solder joint on the top or component side land is not required.                            | <b>Vertical fill of barrel = 75%</b><br>Solder must fill at least 75% or 3/4 the height of the hole.  |
| <b>Wetting of component side lead &amp; barrel = 180°</b><br>A properly wetted solder fillet must circle at least 180° (or 1/2) of the way around the lead and barrel. | <b>Wetting of solder side lead, land &amp; barrel = 270°</b><br>A properly wetted fillet must extend at least 270° (or 3/4) of the way around the lead, land and barrel on the bottom or solder side of the barrel. |

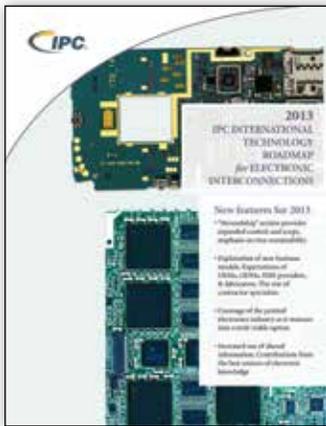
For technical or sales-related questions, please contact IPC Training at +1 847-597-2940 or e-mail [trainingsupport@ipc.org](mailto:trainingsupport@ipc.org).

## MANAGEMENT

### **NEW! IPC-ROADMAP-13** **IPC International Technology Roadmap for Electronic Interconnections 2013**

The International Technology Roadmap provides vision and direction for product development, process development and services required to satisfy the current and future needs of companies that design, build, buy, or specify electronic equipment and materials for global customer requirements. The Roadmap is a valuable resource for companies throughout the global electronic equipment manufacturing industry and can be used for business, technology, and strategic planning for the near and long term. Technical presentations made by industry experts are included as a special resource section used by the roadmap developers to provide predictions and visionary descriptions. A feature of the roadmap is the inclusion of software as a technical driver comparison tool. Long-range planners can compare the technical descriptions of their own companies' products with emulator information published in the Roadmap. 680 pages. Released February 2013.

Format: C, S, G



## MARKET RESEARCH STUDIES

### **NEW! IPC-ONSHOR-13** **On-Shoring in the Electronics Industry: Trends and Outlook for North America — 2013 Update**

Information about actual and planned on-shoring activity was collected from North American electronics manufacturers, including OEMs and all segments of the electronic interconnect supply chain, in 2012 and 2013 surveys. The findings show what types of electronics industry operations were returned from overseas since the beginning of 2012 and what types of new and returning operations these manufacturers are planning to locate in North America through the end of 2014, including the value of those operations and the impact on jobs. The findings also address trends in domestic versus international sourcing. The analysis covers recent on-shoring activities by high-profile companies in the news and how the cost gap between North America and low-labor-cost regions is narrowing. It ends with a concise look at the status of on-shoring in North America and the outlook for the future. 42 pages. Released September 2013.

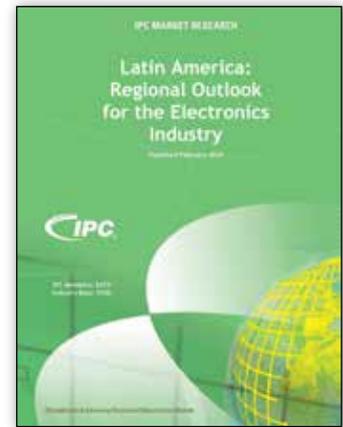
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### **NEW! IPC-MR-LATINAMER13** **Latin America: Regional Outlook for the Electronics Industry**

This report examines Latin America's electronics industry in light of its industrial development, vertical markets and economic growth, which is attracting investors from global electronics companies. The report focuses on the major markets of Brazil, Mexico, Argentina, Chile, Colombia, Venezuela, Peru and Ecuador which, as a group, represent three-quarters of Latin America's gross domestic product (GDP). The information in this report is based on reliable secondary sources, including research organizations, government agencies and trade associations. 41 pages. Released January 2013.

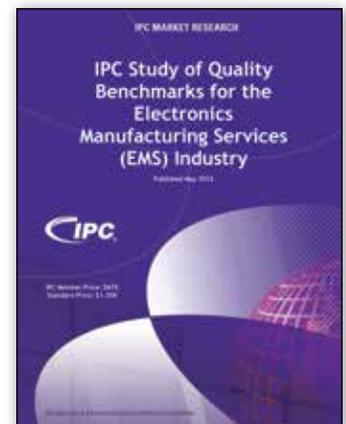
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### **NEW! IPC-BENCHE-13** **Study of Quality Benchmarks for the Electronics Manufacturing Services (EMS) Industry**

This survey-based study covers production data, assembly attributes, yields, defect rates (DPMO), customer returns, supplier performance, customer satisfaction and certification data. This report enables EMS companies to compare their performance to industry averages. The survey sample includes 41 EMS companies from North America, Europe and Asia with total sales revenue ranging from under \$10 million to more than \$500 million. 68 pages. Released May 2013.

Formats: D, S, G



### **IPC-1071** **Best Industry Practices for Intellectual Property Protection in Printed Board Manufacturing**

This standard assists printed board manufacturers in the development of requirements for the protection of intellectual property (IP) for their customers in commercial, industrial, and military and other high reliability markets. This standard focuses on protection of the inherent IP designed into the printed board such that IP flows from the customer to the printed board manufacturer and IP that is incorporated into the printed board is protected. Patent and other such "forever protection" of the manufactured product is beyond the scope of this document. 15 pages. Released December 2010.

Formats: H, C, D, K, S, G

#### **Download these Management Reports for FREE!**

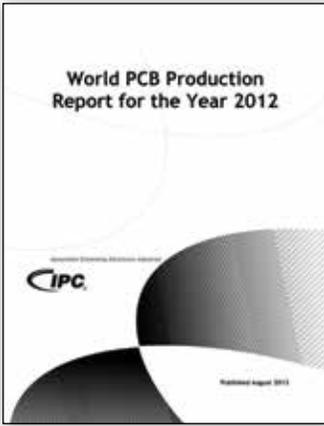
- **IPC-1710A**, OEM Standard for Printed Board Manufacturer's Qualification Profile (MQP)
- **IPC-1720A**, Assembly Qualification Profile Languages: English and Chinese
- **IPC-1730A**, Laminator Qualification Profile
- **IPC-1731**, Strategic Raw Materials Supplier Qualification Profile

**NEW! IPC-2012WORLDPCB**

**World PCB Production Report for the Year 2012**

IPC's World PCB Production Report offers consensus estimates of PCB production value by country and by product type, commentary on global and regional PCB industry trends, special sections on specialty laminates and metal-clad PCBs, and historical data on regional PCB production trends. The estimates are developed by a team of the world's leading industry analysts. 46 pages. Released August 2013. Languages: English and Chinese.

Formats: D, S, G

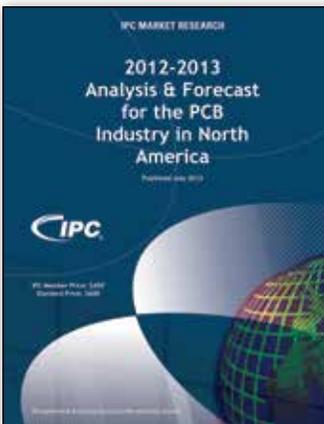


**NEW! IPC-MR-PCB13**

**Analysis & Forecast for the PCB Industry in North America**

This survey-based study covers data and analysis on trends in the North American PCB industry, including market size estimate, sales history, trends in materials, sales by product type, product mix (high-volume vs. quick turn vs. prototype), revenue trends from value-added services, financial metrics, vertical markets, U.S. imports and exports and forecasts for PCB production in North America and the world through 2016. The survey sample includes 31 PCB manufacturers with total sales (includes some overseas sales) of \$1.6 billion, representing approximately 44 percent of the North American PCB market. 78 pages. Released July 2013.

Formats: D, S, G



**IPC-MR-FLEX12**

**2011–2012 Analysis and Forecast for the Flexible Circuit Industry in North America**

44 pages. Released August 2012.

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**2012–2013 Analysis and Forecast for the Global Electronics Manufacturing Services (EMS) Industry**

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44 pages. Released August 2012.

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**IPC-TECHTR-11E**

**PCB Technology Trends 2011**

53 pages. Released April 2012. Languages: English and Chinese.

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**Where in the World? A Regional Strategy Roadmap for Electronics Manufacturers**

A comprehensive new study on geographic trends in the electronics industry will be published by IPC in early 2014. A joint project of BPA Consulting and IPC, the report will be a valuable and up-to-date reference guide to information electronics companies need to know when making decisions about where to locate operations or target specific country markets.

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**IPC Executive Compensation Study for the North American Electronics Industry 2011–2012**

This survey-based study provides comprehensive data on executives' base salaries, bonuses and other forms of compensation and benefits. It covers 12 key executive positions. The results are reported by type of company, industry segment, region and company size. The survey sample includes 41 electronics companies from North America. 77 pages. Released March 2013.

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**Wage Rate and Salary Study for the North American Electronics Industry 2013**

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**North American PCB Market Report**

This monthly report provides timely data on PCB market size, sales and order growth, book-to-bill ratios and near-term forecasts. Data are reported for rigid PCBs and flexible circuits separately. The rigid PCB data are further segmented by company size tiers, and flex data includes trends in bare circuit versus assembly revenue sources. Trends in sales of boards to the military and medical markets are reported for both rigid and flex, as well as trends in prototype sales. The report includes updated data on U.S. imports and exports by product type and trading partner. Each monthly report is more than 100 pages.

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**North American EMS Market Report**

This monthly report offers a timely update on EMS market size, sales and order growth, book-to-bill ratios and near-term forecasts. Sales growth is reported for PCB assembly, box build and other types of production. Trends in the industry's direct labor and direct materials costs as percentages of each month's sales are also reported. Confidence indices show the industry's 90-day and 12-month sales outlook. The approximately 25-page reports are available monthly.

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**Global EMS Business Report**

This quarterly report provides insight into global EMS industry business metrics and growth. The report includes estimates of total market size by region and forecasts of current-year growth, as well as quarterly sales and bookings growth data and regional book-to-bill ratios. Average business performance data from the participating companies covers cost of goods sold; sales, general and administrative costs, and return on value added as percentages of quarterly sales; profit margins; cash-to-cash cycle time; days sales outstanding; standard credit terms; days of supply in inventory; and capacity utilization by region. Data are additionally broken out by company size tier for North America. The reports are also available in Mandarin Chinese.

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## ENVIRONMENT, HEALTH AND SAFETY

### IPC-1331

#### Voluntary Safety Standard for Electrically Heated Process Equipment

Released March 2000

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### IPC-WP/TR-584A

#### IPC White Paper and Technical Report on the Use of Halogenated Flame Retardants in Printed Circuit Boards and Assemblies (Correcting the Misunderstandings on "Halogen-Free")

33 pages. Released August 2007.

Formats: H, C, D, K, S, G

## MATERIALS DECLARATION

### IPC-1065

#### Material Declaration Handbook

72 pages. Released January 2005.

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### IPC-JIG101ED4

#### Joint Industry Guide on Materials Composition Declaration for Electrotechnical Products

48 pages. Released September 2011.

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### **NEW!** IPC-1751A

#### Generic Requirements for Declaration Process Management – Includes Amendment 1

Amendment 1 to IPC-1751A provides the principles and details for declarations necessary between members of a supply chain relationship. This standard contains general information and is supplemented by sectional standards requiring more detailed information such as material declarations. 42 pages. Released November 2012.

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### **NEW!** IPC-1752A

#### Materials Declaration Management – Includes Amendment 1

Amendment 1 to IPC-1752A establishes a standard reporting format for material declaration data exchange between supply chain participants and supports reporting of bulk materials, components, printed boards, sub-assemblies and products. Third-party solution providers have developed tools that are compatible with IPC-1752A. Revised standard does not support the old PDF forms. 43 pages. Released November 2012.

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### IPC-1758

#### Declaration Requirements for Shipping, Pack and Packing Materials

This standard addresses the industry need for exchange of information regarding the materials used to protect products during shipment between supply chain partners. This standard is one of several in the 175x series of standards that permits segmentation of declaration details based on the subject and scope of the declaration. This standard describes essential information exchange content with respect to packing, supplemented by regulation references for materials, marking, recycling information and recycled content that may be desired to complete the data package. 27 pages. Released May 2012.

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## REGULATORY COMPLIANCE

### **NEW!** IPC-CMPROCEEDINGS-2013 2013 Conflict Minerals Conference Proceedings

View the proceedings of IPC's 2013 Conflict Minerals Workshop and Conference on DVD. Topics include: regulatory overview, audits, data exchange and management, due diligence, and company compliance programs. The presentations provide perspectives from nearly a dozen leading manufacturing companies. DVD includes slide presentations with sequenced audio for most presentations. Released July 2013. **PLEASE NOTE:** This disc contains only data and it will only run on a computer.

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### IPC-A-22

#### UL Recognition Test Pattern

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### IPC-A-24-G

#### Surface Insulation Resistance

Includes master drawing and aperture list in hardcopy.

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### IPC-A-25A-G-KIT

#### Multipurpose 1 Sided Test Pattern

Includes master drawings and data files (Gerber).

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### IPC-A-36

#### Cleaning Alternatives Artwork

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### IPC-A-42

#### Double Sided Artwork

Includes master drawings and data files (Gerber).

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### IPC-A-43

#### Ten-Layer Multi Artwork

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### IPC-A-47

#### Composite Test Pattern Ten-Layer Phototool

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### IPC-A-50

#### Surface Insulation Resistance Phoenix Board

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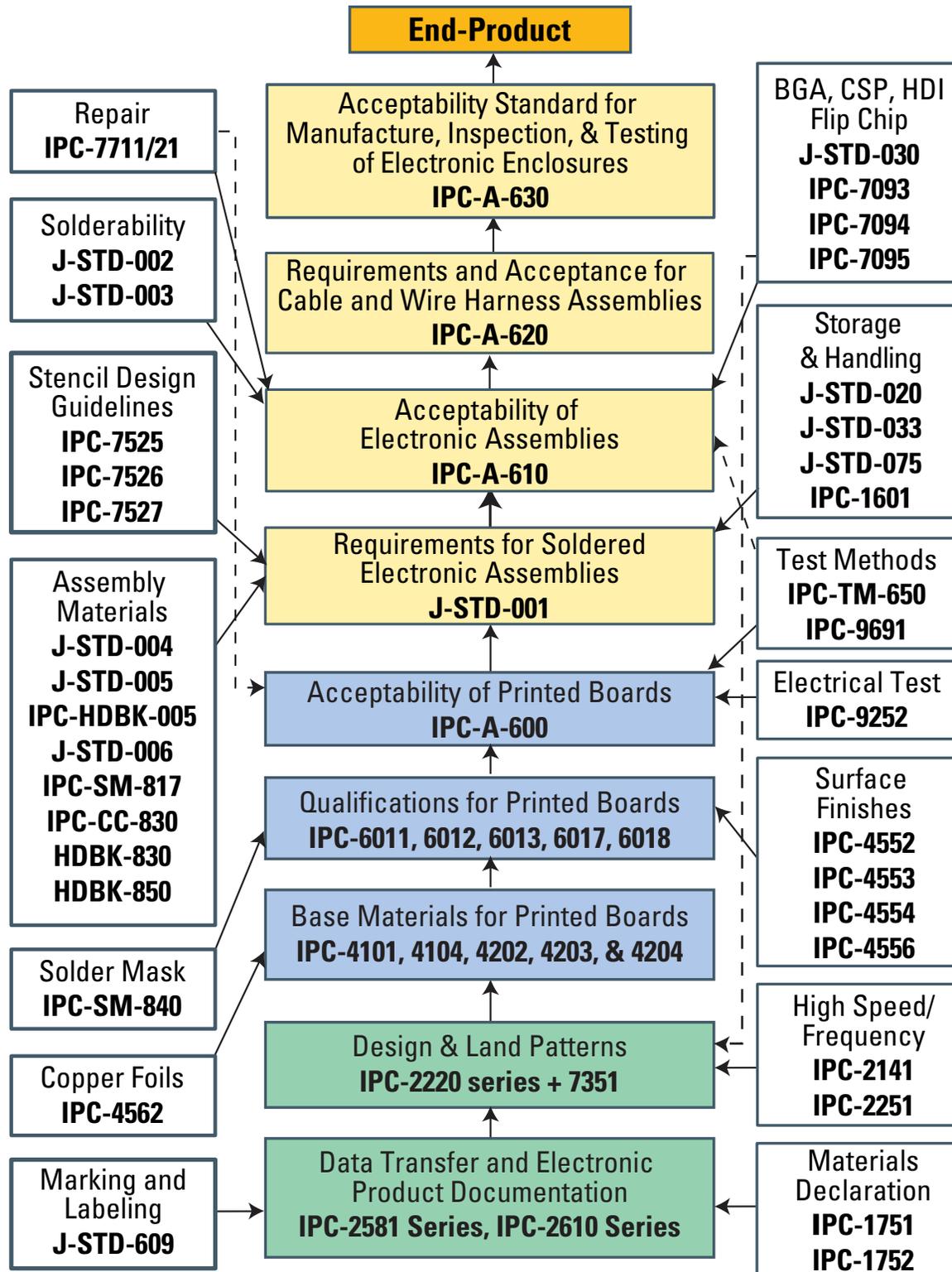
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