IPC-1066

Marking, Symbols and Labels for Identification of Lead-Free and Other Reportable Materials in Lead-Free Assemblies, Components and Devices

IPC-1066
January 2005
A standard developed by IPC
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<td>• Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)</td>
<td>• Inhibit innovation</td>
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Marking, Symbols and Labels for Identification of Lead-Free and Other Reportable Materials in Lead-Free Assemblies, Components and Devices

Developed by the Marking, Symbols and Labels for Identification of Assemblies, Components Task Group (4-34b) of the Environmental, Health & Safety Steering Committee (4-30) and the Technical Activities Executive Committee (TAEC) of IPC

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

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Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the Marking, Symbols and Labels for Identification of Assemblies, Components Task Group (4-34b) of the Environment, Health & Safety Steering Committee (4-30) and the Technical Activities Executive Committee (TAEC) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

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Marking, Symbols and Labels for Identification of Lead-Free and Other Reportable Materials in Lead-Free Assemblies, Components and Devices

1 SCOPE

This standard establishes the requirements for a distinctive symbol and labels to be used to identify materials that are lead-free (Pb-free) and are capable of providing Pb-free 2nd level interconnects, and for indicating certain types of Pb-free material and the maximum assembly temperature. It also establishes the requirements for labeling a bare board if the base resin is halogen free and the type of conformal coating used after assembly.

This standard shall apply to all electronic components including passives, connectors, solid-state components and other devices that use solder to attach the device/component to the board or assembly.

This standard shall not apply to:

• Lead as an alloying element in steel containing up to 0.35% lead by weight, aluminum containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight.

• Lead in electronic ceramic parts (e.g., piezoelectronic devices).

2 APPLICABLE DOCUMENTS

2.1 IPC

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-CC-830 Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies

2.2 IEC

IEC 61249-2-21 Materials for Interconnection Structures

2.3 European Parliment


2.4 AIM

BC4-1999 International Symbology Specification - Code 128

3 TERMS AND DEFINITIONS

3.1 2nd Level Interconnect The interconnect made by attachment of a device/component to a printed circuit board (see Figure 4-1).

3.2 2nd Level Interconnect Label A label identifying the lowest level shipping container as containing components capable of Pb-free 2nd level interconnects. This includes the Pb-free symbol, Pb-free category and the maximum assembly temperature (see Figure 4-2). If no label or marking is included, a tin-lead finish is assumed.

3.3 Bar Code Label A label that contains machine-readable code consisting of parallel bars and spaces, each of various specific widths, such as to the three-of-nine USS Code 39 standard or Code 128.

NOTE: For the purposes of this standard, the bar code label is on the lowest-level shipping container and includes information that describes the product, e.g., part number, quantity, lot information, supplier identification, moisture-sensitivity level, etc.

3.4 RoHS Acronym for European Directive “Restriction of Hazardous Substances.”

3.5 Halogen-Free Printed board resins plus reinforcement matrix that contain maximum total halogens of 1,500 ppm with less than 900 ppm bromine, and less than 900 ppm chlorine (per IEC 61249-2-21).

NOTE: RoHS prohibited brominated substances (polybrominated biphenyls and polybrominated diphenyl ether) are not generally found in printed wiring board materials. This marking is an aid for recycling end-of-life electronic assemblies.

NOTE: While the above definition includes all halogens, the only specifically identified halogens in the IEC standard are bromine and chlorine. The IEC standard does not
address fluorine as found in substrate materials manufactured with fluorocarbons (e.g., PTFE, FEP, etc.) and in the chemical composition of fiberglass reinforcement.

3.6 **Pb-Free** Electrical and electronic assemblies and components in which the lead level in any of the raw materials and the end product is not greater than 0.1% by weight and also meets any Pb-free requirements/definitions adopted under the RoHS Directive 2002/95/EC.

3.7 **Pb-Free Category** A category assigned to Pb-free components, printed circuit boards, and assemblies indicating the general family of material used for the 2nd level interconnect including solder paste, lead/terminal finish, and terminal material/alloy if not plated or coated.

3.8 **Pb-Free Identification Label** A label that indicates that the enclosed components/devices and/or assemblies do not contain any Pb (i.e., they are Pb-free as defined in RoHS directive 2002/95/EC). It is not applicable to items that contain Pb but are exempt according to the RoHS directive (see Figure 4-3).

3.9 **Pb-Free Symbol** A symbol that can be used in place of the phrase “Pb-free” (see Figure 4-4).

4 **LABELS AND SYMBOLS**
The following labels and symbols are used in this standard:

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![Figure 4-1 2nd Level Interconnect](IPC-1066-4-1)

![Figure 4-2 2nd Level Interconnect Label](IPC-1066-4-2)

![Figure 4-3 Pb-Free Identification Label](IPC-1066-4-3)
5 LABELING CATEGORIES

5.1 Solder Finish Categories The following categories are meant to describe the Pb-free 2nd level interconnect (see Figure 4-5) terminal finish/material of components and/or the solder paste/solder used in assembly.

- **e1** – SnAgCu
- **e2** – Other Sn alloys (ie. SnCu, SnAg, SnAgCuX, etc.) (No Bi or Zn)
- **e3** – Sn
- **e4** – Precious metals (ie. Ag, Au, NiPd, NiPdAu, but no Sn)
- **e5** – SnZn, SnZnX (no Bi)
- **e6** – Contains Bi
- **e7** – Low temperature solder (<150°C) containing indium but no bismuth
- **e8, e9** symbols are unassigned categories at this time.

Tin-lead soldered printed circuit boards and components shall have no assigned label. However, manufacturers who desire to label lead-bearing solder shall use “Pb” as the marking code.

**NOTE:** It is recognized that some manufacturers use “PB” or “pb” in certain part numbers.

5.2 Resin Category If the base resin and reinforcement matrix used in making the bare printed board is halogen free, the label/marking “HF” shall be noted on the bare printed circuit board identification label. If no “HF” is present, a halogen-containing base resin and reinforcement matrix is assumed.

5.3 Conformal Coating Categories When conformal coatings are applied, and if assembly-marking space permits, or if contractually required by purchasing agreement, coatings may be labeled/marked per IPC-CC-830B as follows:

- **ER** – Epoxy Resin
- **UR** – Urethane Resin
- **AR** – Acrylic Resin
- **SR** – Silicone Resin
- **XY** – Paraxylylene

6 COMPONENT MARKING

If space permits the individual device/component shall be marked with the category designation enclosed within a circle/ellipse (see Figure 4-5). If the individual component cannot be marked, the category shall be indicated on the lowest-level shipping container utilizing the 2nd Level Interconnect Label (see Figure 4-2) and/or bar code label as noted in 3.3.

6.1 Size The size and location of the mark is optional but shall be legible to corrected, unmagnified vision.

6.2 Color The color for the ‘e’ and category number should be selected to provide sufficient contrast to be legible to corrected, unmagnified vision.

6.3 Font The font should be “Arial” or equivalent and the font style shall be regular.

6.4 Maximum Assembly Temperature This temperature shall be specified in degrees Centigrade.

7 PRINTED CIRCUIT BOARD/ASSEMBLY MARKING

Printed circuit boards/assemblies shall be identified as being assembled with Pb-free solders and using components with Pb-free 2nd level interconnect leads/terminals by marking with the words “Pb-free” or the Pb-free symbol shown in Figure 4-4. In addition, the category (with or without the circle or ellipse), as defined in 5.1, shall be shown on the board/assembly. If no circle or ellipse is used, the marking shall clearly define the category. (e.g., Category = e2) The assembler shall have the prime responsibility to mark the assembly with the bare printed circuit board finish and assembly solder used. If printers used to produce labels or markings do not have graphic capability, the parenthesis may be used in place of the circle/ellipse.

7.1 Category Hierarchy If two or more solder alloys are used (i.e., reflow and wave solder use different category solder alloys) the category of the reflow(s) should be shown first and with the wave solder category following.

7.2 Location The preferred location for marking of the categories is on printed circuit board layer 1 (topside) at the lower right hand segment.
7.3 **Color** The color for the ‘e’ and category number should be selected to provide sufficient contrast to be legible to corrected, unmagnified vision. The font should be “Arial” or equivalent and the font style shall be regular.

7.4 **Size** The size of the mark is optional but shall be legible to corrected, unmagnified vision.

7.5 **Method** The method, e.g., screen print, etch, etc., for marking of the printed circuit board is optional but it shall be legible to corrected, unmagnified vision.

7.6 **Marking Sequence** The sequence of marking should follow the production process, i.e., halogen-free (if applicable), reflow/wave solder finish, and conformal coating (if applicable).

8 **SYMBOL AND LABELS**

8.1 **Pb-Free Symbol** This symbol (see Figure 4-4) may be used as an option to replace the phrase “Pb-free” on labels or wherever practical on components/devices, printed circuit boards, and assemblies, etc.

8.2 **Pb-Free Identification Label** This label (see Figure 4-3) shall only be used when the components/devices and/or board assemblies are Pb-free, according to the definitions in 3.6 and 3.8, and should be affixed to the lowest level shipping containers, or other containers that are not otherwise identified as Pb-free.

8.2.1 **Size** It is recommended the label be a minimum of 22 mm x 25 mm with the minimum diameter of the circle = 18 mm.

**8.2.2 Color** The background shall be white and the symbol and letters shall be of a contrasting color. The color red should be avoided as red suggests a personal hazard.

8.3 **2nd Level Interconnect Label** This label (see Figure 4-2) indicates that the 2nd level interconnect terminal finish/material of components and/or the solder paste/solder used in board assembly is Pb-free, per the categories defined in 5.1. It shall be placed/printed on the lowest level shipping container and any “ESD” or “Dry pack” bag/box, excluding tubes, trays or other carriers, within the lowest level shipping container. This label affirms the Pb-free content of the 2nd level interconnects only, and does not indicate that the components/devices or assemblies are Pb-free. If all of the information on the label including the “Pb-free” symbol, or the words “Pb-free” are included on a bar code label in conjunction with the words “2nd level interconnect,” legible to corrected, unmagnified vision, then the use of the 2nd level interconnect label is optional. If the enclosed components/devices or assemblies are Pb-free, then the words “2nd level interconnect” may be omitted from the bar code label.

8.3.1 **Components** If the label is affixed to containers holding components/devices the category field describes the terminal finish/material and the “maximum assembly temperature” indicates the maximum temperature the component/device should obtain during assembly.

8.3.2 **Assemblies** If the label is affixed to containers holding printed circuit boards/assemblies the category field describes the solder paste/solder used in the board assembly. The “maximum assembly temperature” field, if blank, does not apply.

8.3.3 **Size** It is recommended that the Pb-free label be a minimum of 75 mm by 50 mm.

8.3.4 **Color** The label shall be black letters/symbols on a white background.
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847-597-2886    847-597-2898
MaryMacKinnon@ipc.org    AliciaBalonek@ipc.org

How to Get Involved
The first step is to join IPC. An application for membership can be found in the back of this publication. Once you become a member, the opportunities to enhance your competitiveness are vast. Join a technical committee and learn from our industry’s best while you help develop the standards for our industry. Participate in market research programs which forecast the future of our industry. Participate in Capitol Hill Day and lobby your Congressmen and Senators for better industry support. Pick from a wide variety of educational opportunities: workshops, tutorials, and conferences. More up-to-date details on IPC opportunities can be found on our web page: www.ipc.org.

For information on how to get involved, contact:
Jeanette Ferdman, Membership Director
tel: 847-597-2809    fax: 847-597-7105
e-mail: JeanetteFerdman@ipc.org    www.ipc.org
Thank you for your decision to join IPC, Association Connecting Electronics Industries. IPC membership is site specific, which means that benefits of IPC membership are extended only to employees at the site that is designated on this application.

To help IPC serve your member site in the most effective manner possible, please tell us what work is being done at your site by choosing the most appropriate member category. (Check one box only.)

- INDEPENDENT PRINTED CIRCUIT BOARD MANUFACTURER
  This facility manufactures, and sells to other companies, printed wiring boards (PWB's) or other electronic interconnection products on the merchant market.  
  **What products do you make for sale?**
  - [ ] One- and two-sided rigid, multilayer printed boards
  - [ ] Flexible printed boards
  - [ ] Other interconnections

  **Site General Manager**
  Name ____________________________ Title ____________________________

- EMSI COMPANY - Independent Electronics Assembly
  This facility assembles printed wiring boards, on a contract basis, and may offer other electronic interconnection products for sale.

  **Site General Manager**
  Name ____________________________ Title ____________________________

- OEM - Original Equipment Manufacturer
  This facility purchases and/or manufactures printed wiring boards or other interconnection products for use in a final product, which we manufacture and sell.  
  **What is your company's primary product line?**

  **Site General Manager**
  Name ____________________________ Title ____________________________

- INDUSTRY SUPPLIER
  This facility supplies raw materials, machinery, equipment, or services used in the manufacture or assembly of electronic interconnection products.  
  **What products or services does your company supply?** (50 word limit, please)
  The information that you provide here will appear in the next edition of the IPC Membership Directory.

  Our company supplies:

  _________________________________________________________________
  _________________________________________________________________
  _________________________________________________________________

- GOVERNMENT AGENCY/ACADEMIC TECHNICAL LIAISON
  This government agency or accredited university, college or technical training school is directly concerned with design, research and utilization of electronic interconnection devices. (Must be a non-profit or not-for-profit organization.)

  _________________________________________________________________
  _________________________________________________________________

Please proceed to page 2 to complete the membership application.
Application for IPC Site Membership

**Site Information:** (Please print or type)

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<thead>
<tr>
<th>Company Name</th>
<th>Street Address</th>
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<th>Website URL</th>
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<tr>
<th>Name of Primary Contact for all IPC matters</th>
<th>Title</th>
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Please designate your site’s Technical Representatives:

For PWB/PWA design-related information and activities:

<table>
<thead>
<tr>
<th>Contact Name</th>
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For PCB fabrication-related information and activities:

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For Electronics Assembly-related information and activities:

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Please designate your site’s Management Representatives:

For PWB/PWA design-related information and activities:

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<th>Contact Name</th>
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For PCB fabrication-related information and activities:

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For Electronics Assembly-related information and activities:

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Please attach business card of primary contact here.

Please proceed to page 3 to complete the membership application.
MEMBERSHIP DUES SCHEDULE

Please check one:

- $1,000.00 – Annual dues for Primary Site Membership
  Twelve months of IPC membership begins from the time the application and payment are received at the IPC office.

- $800.00 – Annual dues for Additional Facility Membership
  An additional membership for a site within an organization where there already is a current Primary Site IPC membership.

- $600.00** – Annual dues for an independent PCB/PWA fabricator or independent EMSI provider with annual sales of less than $1,000,000.00. USD
  ** Please provide proof of annual sales.

- $250.00 – Annual dues for Government Agency or Academic Technical Liaison Membership. Must be not-for-profit organization.

TMRC MEMBERSHIP

- Please send information on participation in the Technology Market Research Council (TMRC) program.
  Only current IPC member sites are eligible to participate in this calendar year program, which is available for an additional fee.

- Yes, sign up our site now:
  - $950.00 - Primary TMRC member site
  - $400.00 - Additional facility TMRC member. Another site within our organization is already a TMRC program participant.

Name of Primary Contact for all TMRC matters:

Phone
Fax
E-Mail

PAYMENT INFORMATION

Enclosed is our check/money order for $________________________

Mail application with check or money order to:
IPC
3491 Eagle Way
Chicago, IL 60678-1349

Fax or mail application with credit card payment to:
IPC
*3000 Lakeside Drive, Suite 309S
Bannockburn, IL 60015-1249
Tel: 847-615-7100
Fax: 847-615-7105
* Overnight deliveries to this address only

Please bill my credit card (circle one) for $________________________

- MasterCard
- American Express
- Visa
- Diners Club

Account No
Expiration Date

Name of Card Holder

Authorized Signature

Phone Number

QUESTIONS?

Call the IPC Member Services Department in Bannockburn, Illinois, at 847-597-2809 or 847-597-2872, or fax us at 847-615-7105.
E-mail: JeanetteFerdman@ipc.org SusanStorck@ipc.org

Please proceed to page 4 to complete the membership application.
INFORMATION DISTRIBUTION

IPC has significant member benefits available to a wide range of individuals within your organization. To ensure that your facility takes advantage of these benefits, please provide the name of the individual responsible for each of the functional areas listed below. If one person has multiple responsibilities, please list that person's name as many times as necessary.

Chief Executive:

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<td>Human Resources</td>
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<td>Environmental/Safety</td>
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<td>Design/Artwork</td>
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IPC REVIEW SUBSCRIPTION LIST

One of the many benefits of IPC membership is a subscription to the IPC Review, our monthly magazine. Please list below the names of individuals who would benefit from receiving our magazine, which provides information about the industry, IPC news, and other items of interest. A subscription for the IPC Primary Contact person is entered automatically.

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# Standard Improvement Form

The purpose of this form is to provide the Technical Committee of IPC with input from the industry regarding usage of the subject standard.

Individuals or companies are invited to submit comments to IPC. All comments will be collected and dispersed to the appropriate committee(s).

If you can provide input, please complete this form and return to:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, IL 60015-1219
Fax 847 615.7105
E-mail: answers@ipc.org

<table>
<thead>
<tr>
<th>1. I recommend changes to the following:</th>
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<tbody>
<tr>
<td>___ Requirement, paragraph number ________</td>
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<tr>
<td>___ Test Method number ________, paragraph number ________</td>
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The referenced paragraph number has proven to be:

___ Unclear  ___ Too Rigid  ___ In Error

___ Other ____________________________

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<th>2. Recommendations for correction:</th>
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<th>3. Other suggestions for document improvement:</th>
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Submitted by:

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