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# IPC-1066

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

**IPC-1066**

November 2004

A standard developed by IPC

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- Contain simple (simplified) language
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- Focus on end product performance
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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 2<sup>nd</sup> level interconnects, and for indicating certain types of Pb-free materials and the maximum allowable soldering 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

**Reference 1** Directive 2002/95/EC of the European Parliament and of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (“RoHS Directive”).

**Reference 2** Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies, IPC-CC-830B.

**Reference 3** Materials for Interconnection Structures, IEC 61249-2-21.

## 3 TERMS AND DEFINITIONS

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

**3.2 2<sup>nd</sup> Level Interconnect Label** A label identifying the lowest level shipping container as containing components capable of Pb-free 2<sup>nd</sup> 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 1500 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 Teflon substrate materials, and in chemical composition of fiberglass reinforcement.

**3.6 Pb-Free (Lead-Free)** Electrical and electronic assemblies and components in which the lead (Pb) 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, assemblies indicating the general family of material used for the 2<sup>nd</sup> level interconnect including solder paste, lead/terminal finish, 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:

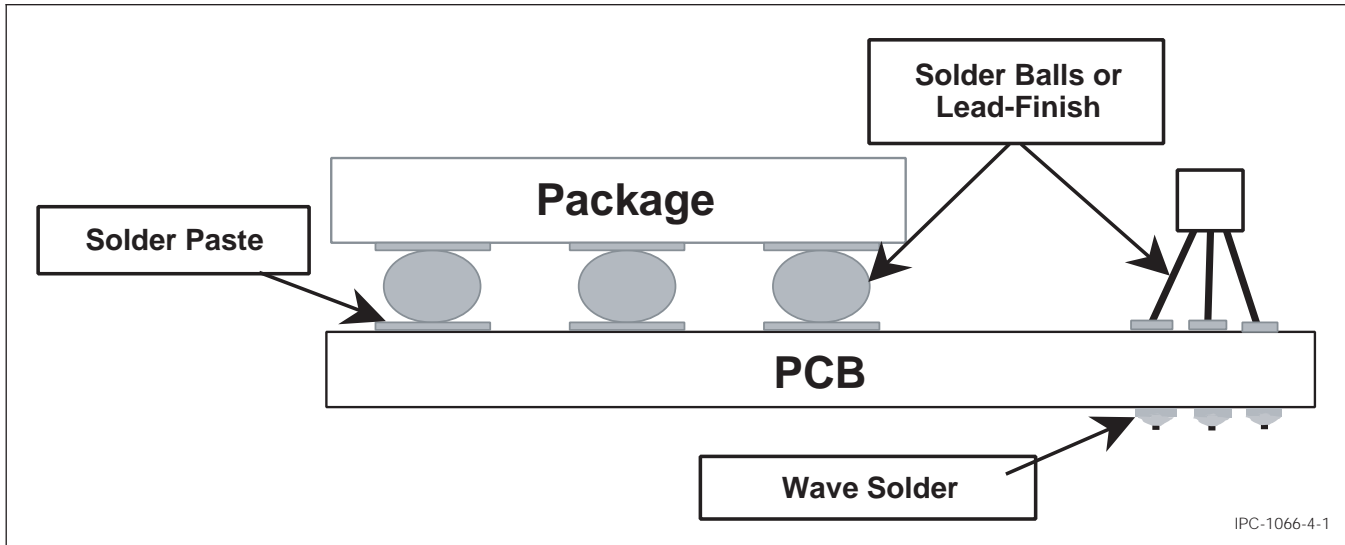


Figure 4-1 2<sup>nd</sup> Level Interconnect

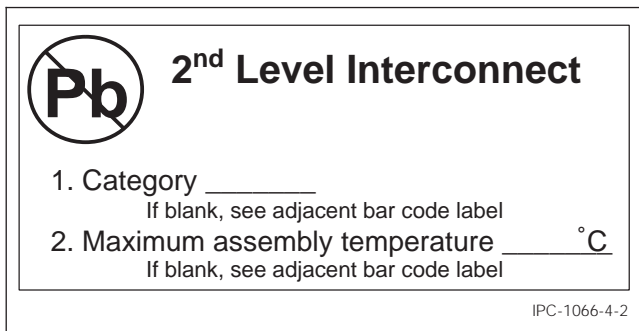


Figure 4-2 2<sup>nd</sup> Level Interconnect Label

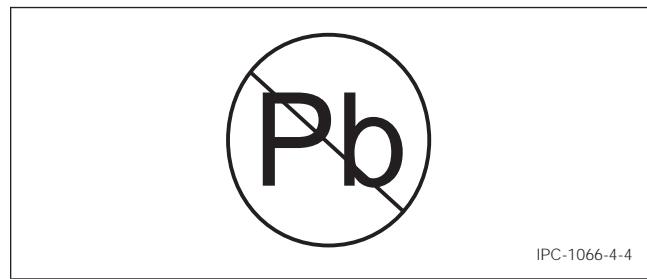


Figure 4-4 Pb-Free Symbol



Figure 4-3 Pb-Free Identification Label

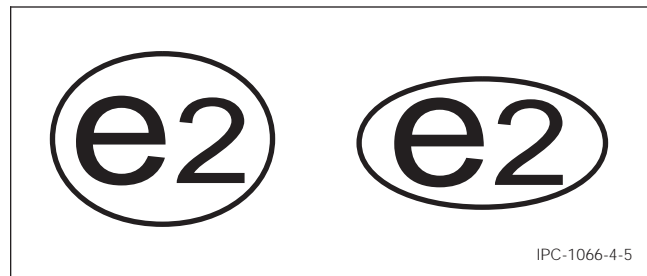


Figure 4-5 Example of Mark Showing Category 2 and Option of Circle or Ellipse



## 5 LABELING CATEGORIES

**5.1 Solder Finish Categories** The following categories are meant to describe the Pb-free 2<sup>nd</sup> 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 have “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/markings “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 – Parylene

## 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 2<sup>nd</sup> 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 **shall** be 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 Safe Assembly Temperature** This temperature **shall** be specified in degrees Centigrade.

## 7 PRINTED CIRCUIT BOARD/ASSEMBLY MARKING

Printed circuit boards/assemblies will be identified as being assembled with Pb-free solders and using components with Pb-free 2<sup>nd</sup> 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) will be shown first and the wave solder category will follow.

**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 **shall** be optional but 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 **shall** follow the production process, i.e., halogen free (if applicable), reflow/wave solder finish, and conformal coating (if applicable).

e.g., 

HF	e1/e1	XY
----	-------	----

 (Sample layout. Boxes not required.)

**7.7 Repair Marking** The Pb-free solder category code **shall** be permanently obscured should any modification or repair with a lead-bearing material be used instead of a lead-free solder during a repair or rework procedure.

## 8 SYMBOL AND LABELS

**8.1 Pb-Free Symbol** This symbol (see Figure 4-4) can be used as an option to replace the phrase “Pb-free” on labels or wherever practical on components/devices, printed circuit boards, 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 2<sup>nd</sup> Level Interconnect Label** This label (see Figure 4-2) indicates that the 2<sup>nd</sup> 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 2<sup>nd</sup> 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 “2<sup>nd</sup> level interconnect,” legible to corrected, unmagnified vision, then the use of the 2<sup>nd</sup> level interconnect label is optional. If the enclosed components/devices or assemblies are Pb-free, then the words “2<sup>nd</sup> 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 will be black letters/symbols on a white background.



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Term	Definition

If space not adequate, use reverse side or attach additional sheet(s).

Artwork:  Not Applicable    Required    To be supplied

Included: Electronic File Name: \_\_\_\_\_

Document(s) to which this term applies: \_\_\_\_\_

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For more information on IPC Video/CD Training, contact Mark Pritchard

tel: 505/758-7937 ext. 202              fax: 505/758-7938  
e-mail: [markp@ipcvideo.org](mailto:markp@ipcvideo.org)              <http://training.ipc.org>

## IPC Printed Circuits Expo, APEX and the Designers Summit



This yearly event is the largest electronics interconnection event in North America. With technical paper presentations, educational courses, standards development meetings networking opportunities and designers certification, there's something for everyone in the industry. The premier technical conference draws experts from around the globe. 500 exhibitors and 6,000 attendees typically participate each year. You'll see the latest in technologies, products and services and hear about the trends that affect us all. Go to [www.GoIPCShows.org](http://www.GoIPCShows.org) or contact [shows@ipc.org](mailto:shows@ipc.org) for more information.

### Exhibitor information:

Mary Mac Kinnon	Alicia Balonek
Director, Show Sales	Director, Trade Show Operations
847-597-2886	847-597-2898
<a href="mailto:MaryMacKinnon@ip.c.org">MaryMacKinnon@ip.c.org</a>	<a href="mailto:AliciaBalonek@ipc.org">AliciaBalonek@ipc.org</a>

## 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](http://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](mailto:JeanetteFerdman@ipc.org)              [www.ipc.org](http://www.ipc.org)

# Application for IPC Site Membership



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.)

# Application for IPC Site Membership



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

Company Name			
Street Address			
City	State	Zip/Postal Code	Country
Main Switchboard Phone No		Main Fax No.	
Company E-Mail Address		Website URL	
Name of Primary Contact for all IPC matters		Title	Mail Stop
Phone No.	Fax No	E-Mail	
Name of Senior Management Contact:		Title:	Mail Stop
Phone No	Fax No	E-Mail	

Please attach business card of primary contact here.

**Please designate your site's Technical Representatives:**

For PWB/PWA design-related information and activities:

Contact Name	Title	Phone	Fax	E-mail
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For PCB fabrication-related information and activities:

Contact Name	Title	Phone	Fax	E-mail
--------------	-------	-------	-----	--------

For Electronics Assembly-related information and activities:

Contact Name	Title	Phone	Fax	E-mail
--------------	-------	-------	-----	--------

**Please designate your site's Management Representatives:**

For PWB/PWA design-related information and activities:

Contact Name	Title	Phone	Fax	E-mail
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For PCB fabrication-related information and activities:

Contact Name	Title	Phone	Fax	E-mail
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For Electronics Assembly-related information and activities:

Contact Name	Title	Phone	Fax	E-mail
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# Application for IPC Site Membership



## 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

# Application for IPC Site Membership



## 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:

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Sales/Marketing:

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Finance (CFO)

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Human Resources

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Environmental/Safety

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Design/Artwork

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Product Assurance

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Manufacturing

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Training

Name	Title/Mail Stop	Phone	Fax	E-mail
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### Purchasing

Name	Title/Mail Stop	Phone	Fax	E-mail
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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.

Name	Title/Mail Stop
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Name	Title/Mail Stop
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Name	Title/Mail Stop
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Name	Title/Mail Stop
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Name	Title/Mail Stop
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Name	Title/Mail Stop
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ASSOCIATION CONNECTING  
ELECTRONICS INDUSTRIES®

# Standard Improvement Form

IPC-1066

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

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1. I recommend changes to the following:

Requirement, paragraph number \_\_\_\_\_  
 Test Method number \_\_\_\_\_, paragraph number \_\_\_\_\_

The referenced paragraph number has proven to be:

Unclear  Too Rigid  In Error  
 Other \_\_\_\_\_

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2. Recommendations for correction:

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3. Other suggestions for document improvement:

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Submitted by:

Name \_\_\_\_\_ Telephone \_\_\_\_\_

Company \_\_\_\_\_ E-mail \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_ Date \_\_\_\_\_

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