DRAFT FOR DEVELOPMENT

DD IEC/PAS
62588:2008

Marking and labeling of components, PCBs and PCBAs to identify lead(Pb), Pb-free and other attributes

ICS 31.190

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BSI
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A review of this Draft for Development will be carried out not later than three years after its publication.

Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development, will be made in an announcement in the appropriate issue of *Update Standards*. According to the replies received, the responsible BSI Committee will judge whether the validity of the PAS should be extended for a further three years or what other action should be taken and pass their comments on to the relevant international committee.

Observations which it is felt should receive attention before the official call for comments will be welcomed. These should be sent to the Secretary of the responsible BSI Technical Committee at British Standards House, 389 Chiswick High Road, London W4 4AL.

The UK participation in its preparation was entrusted to Technical Committee EPL/501, Electronic assembly technology.

A list of organizations represented on this committee can be obtained on request to its secretary.

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PUBLICLY AVAILABLE SPECIFICATION

Marking and labeling of components, PCBs and PCBAs to identify lead(Pb), Pb-free and other attributes

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ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES®

IPC/JEDEC J-STD-609

Marking and Labeling of Components, PCBs and PCBAs to Identify Lead(Pb), Pb-Free and Other Attributes

A joint standard developed by the Marking, Symbols and Labels for Identification of Assemblies, Components and Devices Task Group (4-34b) and JEDEC Committee JC14.4 Quality Processes and Methods

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

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IPC/JEDEC FOREWORD

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, commonly referred to as the ''RoHS Directive[1]'', and other legislation are driving the electronics industry towards the use of lead free (Pb-free) solders and components with Pb-free 2nd level interconnect terminal finishes and materials.

There are different Pb-free solders being used for the various soldering operations in electronics. Each of these solders may require different processing temperatures for assembly, rework, and repair. Some means of communicating the identity of the Pb-free or Pb-containing solder must be provided so that those performing assembly, rework and repair are aware of the temperature capabilities and limitations of these solders, and are able to distinguish between Pb-free and Pb-containing solders.

Marking of components and/or labeling their shipping containers are needed to identify and distinguish Pb-containing and Pb-free 2nd level interconnect terminal finishes and materials. Labeling electronic assemblies using Pb-free solder materials will facilitate end-of-life recycling of electronic equipment. This standard sets forth minimum requirements and includes options for the provision of additional information.

This paradigm shift to Pb-free electronics has created a need for identification of traditional Pb-containing coatings, finishes and solders. This standard can be utilized to identify the presence of lead (Pb) for those markets as described in Clauses 5 (Marking/Labeling Categories) and 8 (Marking and/or Labeling of Pb-Containing Components, PCBs, and PCB Assemblies). This standard supersedes JESD97 and IPC-1066.

1. The RoHS Directive itself is not a law; rather, it is a direction to the European Union Member States to implement their own laws embodying the requirements of the Directive. These laws were required to be in effect as of July 1, 2006.

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Marking and Labeling of Components, PCBs and PCBAs to Identify Lead(Pb), Pb-Free and Other Attributes

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The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
91/767/PAS	91/783/RVD

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Marking and Labeling of Components, PCBs and PCBAs to Identify Lead (Pb), Pb-Free and Other Attributes

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1 SCOPE

This document applies to components and assemblies that contain Pb-free and Pb-containing solders and finishes. This document describes the marking of components and the labeling of their shipping containers to identify their 2nd level terminal finish or material, and applies to components that are intended to be attached to boards or assemblies with solder or mechanical clamping or are press fit. This document also applies to 2nd level terminal materials for bumped die that are used for direct board attach.

This document applies to boards/assemblies, to identify the type of Pb-free or Pb-containing solder used. This document documents a method for identifying board surface finishes and Printed Circuit Board (PCB) resin systems. This document applies to PCB base materials and for marking the type of conformal coating utilized on Printed Circuit Board Assemblies (PCBAs). Material and their containers previously marked or labeled according to JESD 97 or IPC-1066 need not be remarked unless agreed upon by the supplier and customer.

Labeling of exterior surfaces of finished articles, such as computers, printers, servers, and the like, is outside the scope of this document. However internal PCBs and PCBAs are covered by this document. Labeling of retail packages containing electronic products is also outside the scope of this document.

1.1 Purpose This document provides a marking and labeling system that aids in assembly, rework, repair and recycling and provides for the identification of:

(1) those assemblies that are assembled with Pb-containing or Pb-free solder;

(2) components that have Pb-containing or Pb-Free 2nd level interconnect terminal finishes and materials;

(3) the maximum component temperature not to be exceeded during assembly or rework processing;

(4) the base materials used in the PCB construction, including those PCBs that use halogen-free resin;

(5) the surface finish of PCBs; and

(6) the conformal coating on PCBAs.

2 REFERENCE DOCUMENTS

2.1 IPC[1]

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 (Conformal Coating)

IPC-4101 Specification for Base Materials for Rigid and Multilayer Printed Boards

2.2 JEDEC[2]

JESD88 JEDEC Dictionary of Terms for Solid State Technology

2.3 IEC[3]

IEC 61249-2-21 Materials for printed boards and other interconnecting structures - Part 2-21: Reinforced base materials, clad and unclad - Nonhalogenated epoxide woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad.

2.4 European Parliament[4]

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.

2.5 ANSI[5]

ANSI 17-1981 Character Set for Optical Character Recognition (OCR-A)

3 TERMS AND DEFINITIONS

Other than those terms listed below, the definitions of terms used in this document are in accordance with IPC-T-50 and/or JESD88.

3.1 2D Code Label (Matrix) A label that contains data in two dimensions as either stack or matrix types.

3.2 2 Li (or 2LI) Abbreviation for 2nd level interconnect.

1. www.ipc.org
2. www.jedec.org
3. www.iec.ch
4. www.europa.eu.int/eur-lex/en/index.html
5. www.ansi.org

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3.3 2nd Level Interconnect The connection made by attaching a component to a printed circuit board (see Figure 3-1). This connection is external to the component, not internal.

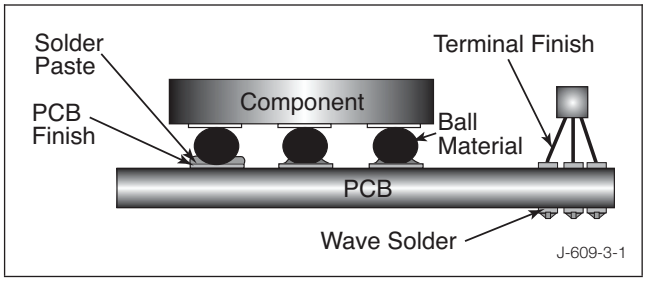

Figure 3-1 Examples of Materials that Comprise the 2nd Level Interconnect

3.4 2nd Level Interconnect Component Label A label placed on boxes and bags that contain components with either Pb-containing or Pb-free terminal materials/finishes. The label includes the material category and maximum component temperature (see 3.12 and 3.13). See Figure 4-3 for label formats for components with Pb-containing finishes/materials and Figures 4-4 and 4-5 for components with Pb-free finishes/materials.

3.5 2nd Level Interconnect Terminal Finish or Material The material at the component 2nd level termination referred to in Figure 3-1. Depending on the component type this material could refer to the terminal finish or ball material.

3.6 Component An individual part such as a connector, capacitor, integrated circuit, socket, multichip module, and hybrid circuits, etc.

3.7 Base Materials Base materials are the laminates and/or the prepregs used to fabricate the PCB.

3.8 Halogen-Free Board 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).

3.9 Homogeneous Material A material of uniform composition throughout that cannot be mechanically disjointed into different materials. Mechanically disjointed means that the materials can, in principle, be separated by mechanical actions such as: unscrewing, cutting, crushing, grinding, and abrasive processes.

3.10 intct (or INTCT) Abbreviation for the word ''interconnect.''

3.11 Linear Bar Code Label A label that gives information in a code consisting of parallel bars and spaces, each of various specific widths.

3.12 Material Category Solder paste, lead/terminal finish, or terminal material/alloy of the solder balls used to make the 2nd level interconnect.

3.13 Maximum Component Temperature The temperature that a component should not exceed during assembly as measured on the topside of the component body.

3.14 ''Pb-Free'' Having a concentration of lead (Pb) with a maximum concentration value of 0.1% by weight in each homogeneous material.

Note: Component and end product suppliers may desire to clarify this important distinction (between 0% and 0.1% lead (Pb)) with their customers.

3.15 Pb-Free Symbol A symbol that can be used in place of the phrase ''Pb-free'' (see Figure 4-2).

4 SYMBOLS, LABELS AND MARKS

4.1 Material Category Symbol This symbol (see Figure 4-1) is used to identify a terminal finish or material listed in 5.3.

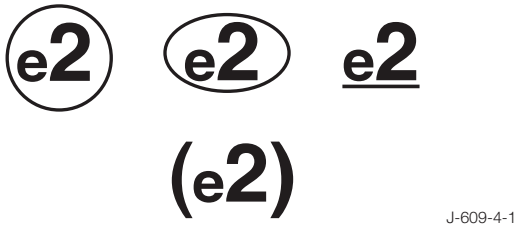

Figure 4-1 Example of Mark Indicating Material Category e2 and the Optional Circle, Ellipse, Underline or Parentheses

Note 1: If the Materials Category is used without a circle, ellipse, parentheses or underline, it must be made clear that the marking defines the category [e.g. ''Category = e2'', or ''Solder = e2'']

Note 2: The letter ''e'' would be replaced with a ''b'' for identifying surface finish material listed in 5.2 for PCBs.

4.1.1 Size and Location The size and location are discretionary, but **shall** be legible to corrected, unmagnified vision.

4.1.2 Color The color for the 'e' and category number should be selected to provide sufficient contrast to be legible to corrected, unmagnified vision. The color red should be avoided as red suggests a personal hazard.

4.1.3 Font The font style should be ''Arial,'' ''OCR-A'' or equivalent.

4.2 Pb-Free Symbol This symbol (see Figure 4-2) can be used in addition to, or instead of, the phrase ''Pb-free.''

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Figure 4-2 Pb-Free Symbol

2nd Level Interconnect

1. Category e0
   If blank, see adjacent bar code label
2. Maximum component temp _____ °C
   If blank, see adjacent label

J-609-4-3

Figure 4-3 Example of 2nd Level Interconnect Component Label Indicating a Pb-Containing Material

2nd Level Interconnect

1. Category e2
   If blank, see adjacent bar code label
2. Maximum component temp 260 °C
   If blank, see adjacent label

J-609-4-4

Figure 4-4 Example of 2nd Level Interconnect Component Label Indicating a Pb-Free e2 Material with a Maximum Component Temperature of 260°C

2nd Level Interconnect is Pb

1. Category _____
   If blank, see adjacent bar code label
2. Maximum component temp _____ °C
   If blank, see adjacent label

J-609-4-5

Figure 4-5 Example of 2nd Level Interconnect Component Label Utilizing the Lead Free Symbol Indicating Both Pb-Free Material with Category and Maximum Component Temperature Indicated on an Adjacent Label

4.3 2nd Level Interconnect Component Label This label (see Figures 4-3, 4-4, and 4-5) is used to indicate the 2nd level interconnect terminal finish or material category (Clause 5) and maximum component temperature. The lead free (Pb-free) symbol (see 4.2) may be appended after the terms ''2nd Level Interconnect'' as indicated in Figure 4-5. This use of the Pb-free symbol applies only to the 2nd level interconnect and should not be interpreted as an indication that any other part of the component is Pb-free.

This label, if used, is placed/printed on the lowest level shipping container and any ''ESD,'' ''Dry pack,'' or other bag/box, excluding tubes, trays, reels or other carriers, within the lowest level shipping container.

4.3.1 Size It is recommended that the label be a minimum of 75 mm by 50 mm.

4.3.2 Color The label **shall** be black letters/symbols on a white or contrasting background.

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5 MARKING/LABELING CATEGORIES

These categories are for the technical purposes of this document and are not to be used for determining regulatory compliance.

5.1 PCB Base Material Categories The PCB base materials may be identified by using the classification system found in IPC-4101, where a unique Specification Sheet (''slash-sheet'') number identifies a specific grade of material. Some of the common base materials expected to be used on PCBs are shown here. However, other grades of base materials are possible. These base materials have an epoxy resin system with woven-glass reinforcement, plus distinguishing properties.

a) /92: Phosphorous flame retardant; T_g 110 to 150°C
b) /95: Aluminum Hydroxide flame retardant; T_g 150 to 200°C
c) /99: Bromine flame retardant; contains inorganic fillers; T_g 150°C min.
d) /126: Bromine flame retardant; contains inorganic fillers; T_g 170°C min.

For PCBs made with more than one grade of materials, mark or label the slash-sheet of the material with the lowest temperature rating.

5.1.1 Halogen-Free Base Material If the base materials used in making the bare printed board are halogen-free, the label/marking ''HF'' **shall** be noted on the bare printed circuit board. If no ''HF'' is present, a halogen-containing base resin and reinforcement matrix are assumed. This marking applies only to the PCB base material and is not to be interpreted as an indication of a halogen-free (HF) assembly.

5.2 PCB Surface Finish Categories The following categories describe the predominant surface finish on the bare board (prior to assembly).

5.2.1 Pb-Containing

b0 – contains lead (Pb), traditional tin-lead (SnPb), hot air solder level (HASL) or solder reflow

5.2.2 Pb-Free

b1 – lead (Pb) free HASL [tin (Sn) alloys with no bismuth (Bi) nor zinc (Zn)]
b2 – immersion silver (Ag)
b3 – tin (Sn) (electrolytic or immersion)
b4 – gold (Au) (immersion or electrolytic), electroless nickel immersion gold (ENIG), nickel gold (NiAu)
b5 – screened carbon (carbon ink)
b6 – organic solderability preservative (OSP)
b7, b8 and b9 – unassigned

5.3 2nd Level Interconnect Categories The following categories describe the 2nd level interconnect (see Figure 3-1) terminal finish or solder ball material of components or the solder paste/solder used in board assembly.

5.3.1 Pb-Containing

e0 – contains intentionally added lead (Pb)[6]

5.3.2 Pb-Free

e1 – tin-silver-copper (SnAgCu)
e2 – tin (Sn) alloys with no bismuth (Bi) nor zinc (Zn), excluding tin-silver-copper (SnAgCu)
e3 – tin (Sn)
e4 – precious metal [e.g., silver (Ag), gold (Au), nickel-palladium (NiPd), nickel-palladium-gold (NiPdAu) (no tin (Sn)]
e5 – tin-zinc (SnZn), tin-zinc-other (SnZnX) [all other alloys containing tin (Sn) and zinc (Zn) and not containing bismuth (Bi)]
e6 – contains bismuth (Bi)
e7 – low temperature solder (≤150°C) containing indium (In) [no bismuth (Bi)]
e8 and e9 symbols – unassigned

5.4 Conformal Coating Categories The following categories (per IPC-CC-830) **shall** describe the conformal coating, if used:

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

6 COMPONENT MARKING AND LABELING

6.1 Component Marking If space permits, the individual component **shall** be marked (per 5.3) on its topside with the Material Category designation enclosed within a circle, ellipse, underlined, or in parentheses (see 4.1). See Figure 6-1 for an example.

If the 2nd level interconnect termination finish or material is removed and replaced on a component, the original 'e' code marking on that physical component **shall** be obliterated and the component **shall** be remarked with the applicable 'e' code in accordance with this document.

6.2 Lowest Level Shipping Container Labeling The Material Category and the maximum component body temperature **shall** be indicated on the lowest level shipping container utilizing the 2nd level interconnect component

6. For Pb-containing 2nd level interconnect terminal finishes and materials, the lead (Pb) content for e0 is typically greater than or equal to 3% by weight. For Pb-containing solder, solder paste, and wave solder alloy, the lead (Pb) content is typically greater than 3% by weight and usually is 37% by weight.

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Figure 6-1 Example of Component Marking

label (see 4.3). The use of the 2nd level interconnect component label is not required if the following information is included in human readable form on the bar code (linear or 2D) label or other nearby label:

a) the words ''2nd level interconnect'' or equivalent abbreviation;

b) the appropriate materials category from 5.3; and

c) the maximum component body temperature.

The 2nd level interconnect component label applies only to components.

7 PCB/ASSEMBLY MARKING AND LABELING

7.1 PCB Marking Any printed circuit board surface finish with lead (Pb) >0.1% **shall** be marked with the lead (Pb) category b0 (see 5.2.1).

Space permitting, the printed circuit board finish may be marked with the material categories defined in 5.2.2.

In addition, the base PCB material may also be marked with the material categories defined in 5.1. If specified by the purchaser, the PCB fabricator may be required to mark the PCB with the applicable category for solders (see 5.3) and/or conformal coating (see 5.4) to be used by the assembler.

7.1.1 PCB Shipping Container Labeling The label on the lowest level PCB shipping container **shall** contain the information that is applicable to the bare board marking.

7.2 Assembly Marking The solder paste/solder used **shall** be identified on an assembly, as defined in 5.3. If used, the conformal coating used **shall** be identified on an assembly, per 5.4. If the PCB was previously marked with the applicable category for solders (see 5.3) and/or conformal coating (see 5.4) and the sequence written does not match the materials used during assembly, the PCBA **shall** be remarked in accordance with 7.10.

7.2.1 Assembly Shipping Container Labeling The label on the lowest assembly level shipping container **shall** contain the information applicable to the assembly marking.

7.3 Solder Category Marking Sequence If two or more solder alloy categories are used the category of the solders used **shall** be shown in the following sequence: Reflow, wave and other. For repair materials, refer to 7.10.

7.4 Location The preferred location for marking the material categories on the board/assembly is on PCB layer 1 (topside) at the lower right-hand segment or next to the part/serial number on the board, or next to the company logo. The marking sequence **shall** be clearly identifiable and separate from other board markings. For instance, the marking sequence may be entirely within brackets or parentheses. See example in Figure 7-1. Alternative locations may be specified in procurement documentation.

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

7.6 Color The color for the 'e' and category number **shall** be selected to provide sufficient contrast to be legible to corrected, unmagnified vision.

7.7 Font The font style should be ''Arial,'' ''OCR-A'' or equivalent.

7.8 Method The methods for marking of the board (e.g., screen print, etch, laser, label, modification of existing bar code, etc.) are optional but **shall** be legible to corrected, unmagnified vision.

7.9 Marking Sequence The sequence of marking, as required, **shall** be as follows:

a) base material slash sheet number (see 5.1)

b) halogen-free (see 5.1.1)

c) PCB surface finish (see 5.2)

d) reflow, wave and other solders (see 5.3)

e) conformal coating (if applicable, see 5.4)

Figure 7-1 shows an example of board/assembly markings.

Examples:

Multifunctional epoxy, halogen-free FR-4 laminate PCB with immersion silver (Ag) surface finish; assembly used tin-silver-copper (SnAgCu) solder for reflow and a tin (Sn)

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alloy with no bismuth (Bi) or zinc (Zn) excluding SnAgCu for wave attachment; no conformal coating.

/95 HF b2 e1 e2 or /95-HF-b2-e1-e2 or /95/HF/b2/e1/e2

Halogen containing epoxy FR-4 laminate PCB with Pb-containing surface finish; assembled with Pb-containing solder; epoxy conformal coating.

/99 b0 e0 ER or /99-b0-e0-ER or /99/b0/e0/ER

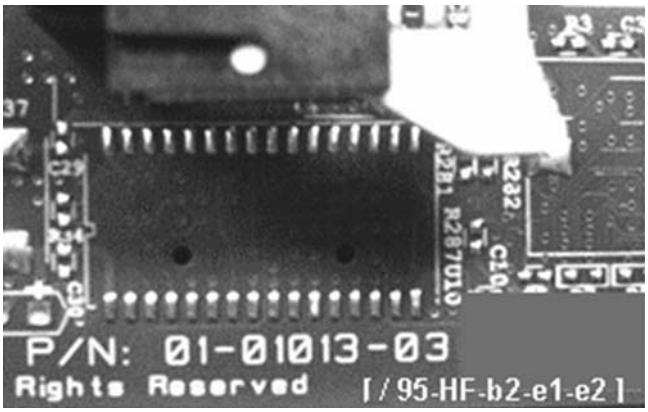

Figure 7-1 Example of Board/Assembly Markings

7.10 Re-Marking Changes in PCBA Materials If changes, rework, or repair to assemblies are made with a material finish category code different than marked, then the marking sequence in 7.3 **shall** be appended with the material code (see 7.3) for the rework or repair solder and/or conformal coating used.

8 MARKING AND/OR LABELING OF LEAD (Pb)-CONTAINING COMPONENTS, PCBs, AND PCB ASSEMBLIES

The use of any markings, labels, or symbols that contain the phrase ''Pb-free'' or the Pb-free symbol shown in Figure 4-2 for this clause is prohibited.

8.1 Marking and Labeling of Components Suppliers whose customers require labeling and marking to indicate lead (Pb) content in 2nd level interconnect finishes and materials **shall** utilize the Material Category code established in 5.3.1 (e0). The alternate 2nd level interconnect component label as shown in Figure 4-3 **shall** be used unless the following information is included on the bar code (2D or linear) or other nearby label, in human readable form:[7]

a) the words ''2nd level interconnect'' or equivalent abbreviation;

b) the appropriate materials category from 5.3.1; and

c) the maximum component body temperature.

The 2nd level interconnect component label applies only to components.

8.2 Marking and Labeling of PCBs Suppliers whose customers require labeling and marking of PCBs to indicate lead (Pb) content in PCB surface finishes **shall** utilize the Material Category code(s) as established in 5.2.1 (b0). Solders to be used in assembly may be marked with category code (e0) on the PCB if specified by purchaser.

8.3 Marking and Labeling of PCB Assemblies Suppliers whose customers require labeling and marking of the PCB assembly to indicate lead (Pb) content in assembly solders **shall** utilize the Material Category code(s) as established in 5.3.1 (e0).

7. If the required information is included on another label, the use of the 2nd level interconnect label becomes optional.

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9 SUMMARY OF MARKING AND LABELING REQUIREMENTS

Table 9-1 summarizes the marking and labeling requirements detailed previously in this document.

Table 9-1 Marking and Labeling Summary

Item	Preferred Location	Marking or Labeling Content Requirements		
		Required	Optional	Comments
Component Marking (Clause 6)	Component body, topside	– Material category for component terminal finish or material (5.3)	– Maximum component body temperature (3.13)	Space permitting
Component Container Label (Clause 6)	Lowest level shipping container AND any "ESD," "Dry Pack" or other bag or box within the shipping container	– Material category for component terminal finish or material (5.3) – Maximum component body temperature (3.13)	– Pb-free symbol or the phrase 'Pb-free' (4.2) – 2nd Level Interconnect Component Label (4.3)	
PCB Marking (7.1)	Topside, lower right-hand corner; or next to part/serial number or company logo	– PCB surface finish containing lead (Pb) (5.2.1), if applicable – Halogen-free mark [HF] if applicable (5.1.1) – Solders and conformal coating to be used by assembler if specified by purchaser	– IPC 4101 slash-sheet number (5.1) – Pb-free PCB surface finish	Sequence: Slash-sheet, [HF], PCB finish, solders, [conformal coating] (7.9)
PCB Container Label (7.1.1)	Lowest level container holding PCBs	Mark or label with the information applicable to the PCB	Halogen-free mark [HF] if applicable (5.1.1)	
PCBA Marking (7.2)	Topside, lower right-hand corner; or next to part/ serial number, or company logo	– Mark with material category for assembly solder type(s) used (5.3) in the order of application (7.3) – Conformal Coating, if any (5.4)		Pb-free symbol marking or label cannot be used on PCBA if any component is not lead-free (Pb-free)
PCBA Container Label (7.2.1)	Lowest level container holding PCBAs	Mark or label with the information applicable to the PCBA		

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Annex A
(informative)

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 and Devices Task Group (4-34b) are sshown below, it is not possible to include all of those who assisted in the evolution of this document. To each of them, the members of the IPC extend their gratitude.

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