ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES ®

# IPC-A-610C Amendment 1

## Acceptability of Electronic Assemblies

**IPC-A-610C**
**Amendment 1**
November 2001

A standard developed by IPC

2215 Sanders Road, Northbrook, IL 60062-6135
Tel. 847.509.9700 Fax 847.509.9798
www.ipc.org

In keeping with the U.S. Department of Defense acquisition reform principle of relying on performance requirements whenever practicable, and then relying on contractors to meet those requirements, this standard **has not** been ''adopted.'' However, it is recommended as a reference to be used in the establishment and evaluation of design and process requirements. The adoption notice of the IPC-HDBK-001 is reprinted below to better identify the Department's intent to use ANSI/J-STD-001, IPC-HDBK-001, and IPC-A-610 when evaluating electronic manufacturing strategies, processes, and management.

> ''IPC-HDBK-001, ''Handbook and Guide to the Requirements for Soldered Electrical and Electronic Assemblies to Supplement ANSI/J-STD-001B'' was adopted on July 19, 2001, for use by the Department of Defense (DoD). Department of Defense policy is to rely on performance based requirements whenever practicable and to not require standard management approaches or manufacturing processes in solicitations and contracts. By establishing performance requirements and then relying on contractors to meet those requirements we enable innovation and allow contractors to meet our needs at the lowest cost. Nevertheless Defense program managers and contract oversight personnel must have an understanding of the underlying management, engineering, and manufacturing processes at work so they can evaluate and monitor contractor processes. DoD activities may use this handbook and its associated documents when evaluating electronic manufacturing strategies, processes, and management.''

## The Principles of Standardization

In May 1995 the IPC's Technical Activities Executive Committee adopted Principles of Standardization as a guiding principle of IPC's standardization efforts.

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

**Standards Should Not:**
- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

## Notice

IPC Standards and Publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of IPC from manufacturing or selling products not conforming to such Standards and Publication, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than IPC members, whether the standard is to be used either domestically or internationally.

Recommended Standards and Publications are adopted by IPC without regard to whether their adoption may involve patents on articles, materials, or processes. By such action, IPC does not assume any liability to any patent owner, nor do they assume any obligation whatever to parties adopting the Recommended Standard or Publication. Users are also wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

©Copyright 2001. IPC, Northbrook, Illinois. All rights reserved under both international and Pan-American copyright conventions. *Permission is hereby granted to print and make electronic copies and freely distribute IPC-A-610C Amendment 1.*

# Foreword

### 1.4.5 Electrical Clearance

The minimum spacing between non-common uninsulated conductors (e.g., patterns, materials, hardware, residue) is referred to as "minimum electrical clearance" throughout this document and is defined in the applicable design standard or on the approved or controlled documentation. Insulating material must provide sufficient electrical isolation. In the absence of a known design standard use Appendix A (derived from IPC-2221). **Any violation of minimum electrical clearance as a result of nonconformance to defined criteria of IPC-A-610 is a defect condition.**

# 3.4.1 Handling – Guidelines

Care must be taken during acceptability inspections to ensure product integrity at all times. Table 3-4 provides general guidance.

Moisture sensitive components (as classified by IPC/JEDEC J-STD-020 or equivalent documented procedure) **should be** handled in a manner consistent with J-STD-033 or an equivalent documented procedure.

# 4.2.1 Hardware Mounting – Electrical Clearance **(1.4.5)**

# 4.4.5 Component Mounting – Cable Ties, Tie Wraps, Spot Ties

Figure 4-52

**Defect - Class 1,2,3**

- Cable tied with **improper hitch or knot.** This tie may eventu-
  ally loosen.

## 4.4.7 Component Mounting – Wire Dress for Terminations to Connectors Without Strain/Stress Relief

Figure 4-55

**Acceptable - Class 1,2,3**

- Wires exiting connector are positioned as they would be at installation.
- All wires are dressed with even bends to prevent stress at contact connections.
- Shortest wires are in direct line with center axis of cable.

**Note:** The number of **wires with no slack** is limited to seven or fewer for round or multiple-rowed rectangular connectors and eight or fewer for dual contact-rowed rectangular connectors.

## 5.2.3 Mounting – Horizontal – Radial Leaded

Figure 5-16

**Acceptable - Class 1,2,3**

- Component in contact with board on at least one side and/or surface.

**Note:** When documented on an approved assembly drawing, a component may be either side mounted or end mounted. The side or surface of the body, or at least one point of any irregularly configured component (such as certain pocketbook capacitors), needs to be in full contact with the printed board. The body **should be bonded** or otherwise secured to the board to prevent damage when vibration and shock forces are applied.

## 5.2.6.2 Mounting – Vertical – Radial Leaded – Component Meniscus

Figure 5-32

**Acceptable - Class 1,2**

- Components with a coating meniscus can be mounted with the meniscus into the holes provided they meet the requirements of 6.3.4.3.

**Process Indicator - Class 3**

- Coating meniscus is into the plated-through hole (must meet the requirements of 6.3.4.3).

**Defect - Class 1,2,3**

- **Connection does not meet the requirements of 6.3.4.3 when soldered.**

# 5.3.2.1 Lead Forming – Stress Relief – Supported Holes

Figure 5-54

**Defect - Class 1,2,3**

- No stress relief

~~**Acceptable - Class 1,2,3**~~

~~**• Leads are formed to provide stress relief.**~~

Figure 5-55

**Acceptable - Class 1,2,3**

- **Leads are formed to provide stress relief.**

**Note:** Prepped components such as this one usually cannot meet the maximum spacing requirements of a straight-legged vertical - radial leaded component. See 5.2.6. Maximum space between component and board surface is determined by considering design limitations and product use environments. The component preparation equipment and manufacturer's suggested component lead bend specifications and capabilities determine limitation. This may require change in tooling to meet requirements for end use.

## 5.5.3 Terminals – Stress Relief Lead/Wire Bend

Figure 5-108

**Defect - Class 1,2,3**

A. Wire is stretched taut between the terminals.
B. Does not meet bend radius requirements. **See Table 5-3.**
C. Bends are kinked.

## 6.2 Lead Protrusion

**Table 6-1 Lead Protrusion**

| | Class 1 | Class 2 | Class 3 |
|---|---|---|---|
| (L) min.[1] | End is discernible in solder[2] | | |
| (L) max. | No danger of shorts | 2.5 mm [0.0984 in] | 1.5 mm [0.0591 in] |

**Note 1.** For single-sided boards, lead or wire protrusion (L), is at least 0.5 mm [0.020 in] for Class 1 and 2. There must be sufficient protrusion for Class 3 to clinch.

**Note 2.** For plated-through hole boards greater than 2.3 mm [0.0906 in] thick, components with pre-established lead lengths, (DIPs, sockets), lead protrusion may not be discernible.

## 6.3.4.1 PTH Mounted Components - Solder Conditions

Figure 6-17

**Defect - Class 1,2,3**

- Lead not discernible due to bent lead.
- **Solder not wetted to lead or land.**
- **Solder coverage does not comply with Table 6-2.**

## 6.8.1.2 High Voltage - Terminals - Bottom Terminations

Figure 6-79

**Acceptable - Class 1,2,3**

- Wire/lead outline is discernible with a smooth flow of solder on wire/lead and terminal. Individual strands may be discernible.
- No evidence of sharp edges, solder points, icicles, or inclusions (foreign material).
- Balled solder connection does not exceed specified height requirements and meets all acceptable criteria for ball soldering.

**Defect - Class 1,2,3**

- **Discernable sharp edges, solder points, icicles, or inclusions (foreign material).**
- **Balled solder connection does not comply with height or profile (shape) requirements.**

## 6.8.2.1 High Voltage - Solder Cups - Wires/Leads

Figure 6-82

**Acceptable - Class 1,2,3**

- Solder connection has an egg-shaped, spherical or oval profile that follows the contour of wire wrap.
- No evidence of sharp edges, solder points, icicles, inclusions (foreign material) or wire strands.
- Insulation clearance one wire diameter maximum.
- Balled solder connection does not exceed specified height requirements and meets all acceptable criteria for ball soldering.

**Defect - Class 1,2,3**

- **Discernable sharp edges, solder points, icicles, or inclusions (foreign material).**
- **Insulation clearance greater than one wire diameter.**
- **Balled solder connection does not comply with height or profile (shape) requirements.**

## 6.8.2.2 High Voltage - Solder Cups - Unused

Figure 6-83

**Acceptable - Class 1,2,3**

- Solder connection has an egg-shaped, spherical or oval profile.
- No evidence of sharp edges, solder points, icicles or inclusions (foreign material).
- Balled solder connection does not exceed specified height requirements and meets all acceptable criteria for ball soldering.

**Defect - Class 1,2,3**

- **Discernable sharp edges, solder points, icicles, or inclusions (foreign material).**
- **Insulation clearance greater than one wire diameter.**
- **Balled solder connection does not comply with height or profile (shape) requirements.**

## 6.8.4 High Voltage - Through-Hole Connections

Figure 6-87

**Acceptable - Class 1,2,3**

- All sharp edges of the component lead are completely covered with a continuous smooth rounded layer of solder forming a solder ball.
- Straight-through leads facilitate ball soldering.
- Balled solder connection does not exceed specified height requirements.

**Defect - Class 1,2,3**

- **Discernable sharp edges, solder points, icicles, or inclusions (foreign material).**
- **Balled solder connection does not comply with height or profile (shape) requirements.**

## 6.8.5 High Voltage - Flared Flange Terminals

Figure 6-89

**Acceptable - Class 1,2,3**

- All sharp edges of the terminal's radial split are completely covered with a continuous smooth layer of solder forming a balled solder connection.
- Balled solder connection not exceed specified height requirements.

**Defect - Class 1,2,3**

- **Discernable sharp edges, solder points, icicles, or inclusions (foreign material).**
- **Balled solder connection does not comply with height or profile (shape) requirements.**

## 8.1 Etched Marking (Including Hand Printing)

**Hand printing may include marking with indelible pen or mechanical etcher.**

## 10.3 Flexible and Rigid-Flex Printed Wiring

Figure 10-24

**Acceptable - As agreed by user and supplier**

- When nicks and tears occur as a result of tie-in tabs to facilitate circuit removal, the extent of these imperfections do not exceed the requirements agreed to by user and supplier.

**Defect - Class 1,2,3**

- **Nicks, tears, haloing or imperfections more than 50% of the distance from the edge to the nearest conductor or 2.5 mm [0.0984 in], whichever is less, or in excess of that specified in procurement documentation.**
- **Edge to conductor spacing does not comply with specified requirements.**

## 10.4 Solder Resist Discoloration

Figure 10-25

**Acceptable - Class 1,2,3**

• Slight discoloration

**Note:** Discoloration of the solder resist due to removal/repair of components is acceptable.

**Defect - Class 1,2,3**

• **Solder resist does not comply with 9.2, 9.2.1, 9.2.2, or 9.2.3.**

# 11 Discrete Wiring

## Discrete Wiring Acceptability Requirements

Discrete wiring refers to a substrate or base upon which discrete wiring techniques are used to obtain electronic interconnections.

Separate visual criteria for each type is depicted in this section.

**Discrete Wiring Acceptability Guidelines**

The routing and terminating of discrete wires to form point-to-point electrical connections by use of special machines or tools, may be employed to replace or supplement printed conductors on board assemblies. Application may be in planar, two-dimensional or three-dimensional configurations. A summary of various discrete wiring techniques has been documented in the IPC Technical Report, IPC-TR-474, An Overview of Discrete Wiring Techniques. This subject is also covered by IPC-DW-425, Design and End Product Requirements for Discrete Wiring Boards, and IPC-DW-426, Guidelines for Acceptability of Discrete Wiring Assemblies.

This section defines the criteria for acceptability of interconnections produced by some of the important discrete wiring processes in electronic assemblies. The illustrations are presented to depict particular characteristics of the techniques. They are classified **in the following categories:**

1. **Semi-Permanent Connections**
2. **Permanent Connections**

Further definition of the classification for each discrete wiring technique described herein may be found in the IPC-TR-474.

## 11.1.1 Solderless Wrap – Number of Turns

Figure 11-1

**For this requirement, countable turns are those turns of bare wire in intimate contact with the corners of the terminals starting at the first contact of bare wire with a terminal corner and ending at the last contact of bare wire with a terminal corner (see Table 11-1).**

**A modified wrap is required for Class 3. It has an additional amount of insulated wire wrapped to contact at least three corners of the terminal.**

Target - Class 1,2,3

- **One half (50%) more turn than the minimum shown in Table 11-1.**

Acceptable - Class 1,2

- **Countable turns meet the requirements of Table 11-1.**

Acceptable - Class 3

- **Countable turns meet the requirements of Table 11-1 and there is an additional amount of insulated wire wrapped to contact at least three corners of the terminal.**

Table 11-1 Minimum Turns of Bare Wire

| Wire Gauge | Turns |
|---|---|
| 30 | 7 |
| 28 | 7 |
| 26 | 6 |
| 24 | 5 |
| 22 | 5 |
| 20 | 4 |
| 18 | 4 |

~~The target condition is a half (50%) turn more than that shown in the table. A modified wrap is required for Class 3. It has an additional amount of insulated wire wrapped to contact at least three corners of the terminal.~~

~~Maximum turns of bare and insulated wire is governed only by tooling configuration and space available on the terminal.~~

**Note: Maximum turns of bare and insulated wire is governed only by tooling configuration and space available on the terminal.**

Defect - Class 1,2,3

- **Number of countable turns does not comply with Table 11-1.**

# 11.2.2.1 Jumper Wires - Wire Routing - Component Side

Figure 11-25

**Target - Class 1,2,3**

- Wire routed shortest route.
- Wire does not pass over or under component.
- Wire does not pass over land patterns or vias used as test points.

**Acceptable - Class 1**
**Process Indicator - Class 2,3**

- **Insufficient slack** in wire to allow relocation from lands during component replacement.

# 12.2.1.6 Chip Components – Bottom Only Terminations, Minimum Fillet Height (F)

Figure 12-9

Minimum fillet height (F) requirements are not specified for Class 1,2,3. However, a properly wetted fillet is evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

# 12.2.1.7 Chip Components – Bottom Only Terminations, Solder Thickness (G)

Figure 12-10

**Acceptable - Class 1,2,3**

- Properly wetted fillet evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.2.4 Chip Components - Rectangular or Square End Components - 1, 3 or 5 Side Termination, Side Joint Length (D)

Figure 12-23

**Target - Class 1,2,3**

- Side joint length equals length of component termination.

**Acceptable - Class 1,2,3**

- Side joint length is not required. However, a properly wetted fillet is evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.2.7 Chip Components - Rectangular or Square End Components - 1, 3 or 5 Side Termination, Solder Thickness (G)

Figure 12-29

**Acceptable - Class 1,2,3**

- Properly wetted fillet evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.3.4 Cylindrical End Cap Termination, Side Joint Length (D)

Figure 12-40, Figure 12-41

**Target - Class 1,2,3**

- Side joint length (D) is equal to the length of component termination (T) or land length (S), whichever is less.

**Acceptable - Class 1**

- Side joint length (D) exhibits a properly wetted fillet.

**Acceptable - Class 2**

- Side joint length (D) is minimum 50% length of component termination (T) or land length (S), whichever is less.

**Acceptable - Class 3**

- Side joint length (D) is minimum 75% length of component termination (T) or land length (S), whichever is less.

**Defect - Class 1**

- Side joint length (D) does not exhibit a properly wetted fillet.

**Defect - Class 2**

- Side joint length (D) is less than 50% length of component termination (T) or land length (S), whichever is less.

**Defect - Class 3**

- Side joint length (D) is less than 75% length of component termination (T) **or land length (S)** whichever is less.

## 12.2.3.7 Cylindrical End Cap Termination, Solder Thickness (G)

Figure 12-46

**Acceptable - Class 1,2,3**

- Properly wetted fillet evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.4.6 Leadless Chip Carriers with Castellated Terminations, Minimum Fillet Height (F)

Figure 12-54

**Acceptable - Class 1**

- A properly wetted fillet is evident.

**Acceptable - Class 2,3**

- Minimum fillet height (F) is the solder thickness (G) **(not shown)** plus 25% castellation height (H).

Figure 12-55

**Defect - Class 1**

- A properly wetted fillet is not evident.

**Defect - Class 2,3**

- Minimum fillet height (F) is less than solder thickness (G) **(not shown)** plus 25% castellation height (H).

## 12.2.4.7 Leadless Chip Carriers with Castellated Terminations, Solder Thickness (G)

Figure 12-56

**Acceptable - Class 1,2,3**

- Properly wetted fillet evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.5.7 Flat Ribbon, L, and Gull Wing Leads, Solder Thickness (G)

Figure 12-81

**Acceptable - Class 1,2,3**

- Properly wetted fillet evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.6.7 Round or Flattened (Coined) Leads, Solder Thickness (G)

Figure 12-88

**Acceptable - Class 1,2,3**

- Properly wetted fillet evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.7.7 J Leads, Solder Thickness (G)

Figure 12-110

**Acceptable - Class 1,2,3**

- Properly wetted fillet evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.8.7 Butt/I Joints, Solder Thickness (G)

Figure 12-117

**Acceptable - Class 1,2**

- Properly wetted fillet evident.

**Defect - Class 1,2,3**

- **No properly wetted fillet.**

## 12.2.9 Flat Lug Leads

Joints formed to the leads of power dissipating components with flat lug leads must meet the dimensional requirements of Table 12-9 and Figure 12-119. The design should permit easy inspection of wetting to the wettable surfaces. **Nonconformance to the requirements of Table 12-9 is a defect.**

Table 12-9 Dimensional Criteria - Flat Lug Leads

| Feature | Dim. | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Side overhang | A | 50% (W) Note[1] | 25% (W) Note[1] | Not permitted |
| Toe overhang (not shown) | B | Note[1] | Not permitted | Not permitted |
| Minimum end joint width | C | 50% (W) | 75% (W) | (W) |
| Minimum side joint length | D | Note[3] | (L)-(M), Note[4] | (L)-(M), Note[4] |
| Maximum fillet height | E | Note[2] | Note[2] | **(G) + (T) + 1.0 mm [0.039 in]** |
| Minimum fillet height | F | Note[3] | Note[3] | (G) + (T) |
| Solder fillet thickness | G | Note[3] | Note[3] | Note[3] |
| Maximum land protrusion | K | Note[2] | Note[2] | Note[2] |
| Lead length | L | Note[2] | Note[2] | Note[2] |
| Maximum gap | M | Note[2] | Note[2] | Note[2] |
| Land width | P | Note[2] | Note[2] | Note[2] |
| Lead thickness | T | Note[2] | Note[2] | Note[2] |
| Lead width | W | Note[2] | Note[2] | Note[2] |

**Note 1.** **Must not** violate minimum electrical clearance.
**Note 2.** Unspecified parameter or variable in size as determined by design.
**Note 3.** Properly wetted fillet **must** be evident.
**Note 4.** Where the lug is intended to be soldered beneath the component body and the land is designed for the purpose, the lead **shall** show evidence of wetting in the gap M.

## 12.2.10 Tall Profile Components Having Bottom Only Terminations

Joints formed to the termination areas of tall profile components having bottom only terminations must meet the dimensional requirements of Table 12-10 and Figure 12-120. If the height of the component exceeds the thickness of the component, the component should not be used in products subject to vibration and/or shock unless an appropriate adhesive is used to reinforce the component mounting. **Nonconformance to the requirements of Table 12-10 is a defect.**

**Table 12-10 Dimensional Criteria - Tall Profile Components Having Bottom Only Terminations**

| Feature | Dim. | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Side overhang | A | 50% (W); Notes[1,4] | 25% (W); Notes[1,4] | Not permitted; Notes[1,4] |
| End overhang | B | Notes[1,4] | Not permitted | Not permitted |
| Minimum end joint width | C | 50% (W) | 75% (W) | (W) |
| Minimum side joint length | D | Note[3] | **50% (S)** | **75% (S)** |
| Solder fillet thickness | G | Note[3] | Note[3] | Note[3] |
| Land length | S | Note[2] | Note[2] | Note[2] |
| Land width | W | Note[2] | Note[2] | Note[2] |

**Note 1.** **Must not** violate minimum electrical clearance.
**Note 2.** Unspecified parameter or variable in size as determined by design.
**Note 3.** Properly wetted fillet **must** be evident.
**Note 4.** As a function of the component design, the termination may not extend to the component edge, and the component body may overhang the PWB land area. The component solderable termination area **must not** overhang PWB land area.

## 12.2.11 Inward Formed L-Shaped Ribbon Leads

Joints formed to components having inward formed L-shaped lead terminations shall meet the dimensional and solder fillet requirements of Table 12-11 **and Figure 12-123.** The design should permit easy inspection of wetting to the wettable surfaces. **Nonconformance to the requirements of Table 12-11 is a defect.**

**Table 12-11 Dimensional Criteria - Inward Formed L-Shaped Ribbon Leads[5]**

| Feature | Dim. | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Maximum side overhang | A | 50% (W) Notes[1,5] | 50% (W) Notes[1,5] | 25% (W) or 25% (P) whichever is less; Notes[1,5] |
| Maximum toe overhang (not shown) | B | Note[1] | Not Permitted | Not Permitted |
| Minimum end joint width | C | 50% (W) | 50% (W) | 75% (W) or 75% (P), whichever is less |
| Minimum side joint length | D | Note[3] | 50% (L) | 75% (L) |
| Maximum fillet height | E | (H) + (G) Note[4] | (H) + (G) Note[4] | (H) + (G) Note[4] |
| Minimum fillet height | F | Note[3] | (G) + 25% (H) or (G) + 0.5 mm [0.0197 in], whichever is less | (G) + 25% (H) or (G) + 0.5 mm [0.0197 in], whichever is less |
| Solder fillet thickness | G | Note[3] | Note[3] | Note[3] |
| Lead height | H | Note[2] | Note[2] | Note[2] |
| Minimum land extension | K | **Note[2]** | **Note[2]** | 50% (H) or 0.5 mm [0.0197 in], whichever is less |
| Lead length | L | Note[2] | Note[2] | Note[2] |
| Pad width | P | Note[2] | Note[2] | Note[2] |
| Land length | S | Note[2] | Note[2] | Note[2] |
| Lead width | W | Note[2] | Note[2] | Note[2] |

**Note 1.** **Must not** violate minimum electrical clearance.
**Note 2.** Unspecified parameter or variable in size as determined by design.
**Note 3.** Properly wetted fillet **must** be evident.
**Note 4.** Solder **shall not** contact the component body on the inside of the lead bend.
**Note 5.** Where a lead has two prongs, the joint to each prong **shall** meet all the specified requirements.

# 12.4.10 SMT Soldering Anomalies – Solder Balls/Solder Fines

Figure 12-152

**Acceptable - Class 1**
**Process Indicator - Class 2,3**

- More than five solder balls/splashes (0.13 mm [0.00512 in] or less) **per 600 $mm^2$ [0.93 $in^2$].**

**Defect - Class 1,2,3**

- Solder balls violate minimum electrical clearance.
- Solder balls not entrapped or encapsulated (e.g., no-clean residue, conformal coating), or not attached to a metal surface.

**Note:** Entrapped/encapsulated/attached is intended to mean normal service environment of the product will not cause a solder ball to become dislodged.

## APPROVED IPC-A-610 TRAINING AND CERTIFICATION CENTERS

Contact any of the approved IPC-A-610 Certification Centers listed below for course locations, times and fees.

**ACME, INC.**
Constantino J. Gonzalez
513 Cleveland St., Suite # 300
Rapid City, SD 57701 USA
(P) (605) 381-5963
(F) (605) 341-4261

**Advanced Rework Technology - A.R.T.**
Throws Farm, Stebbing, Dunmow,
Essex CM6 3AQ
England
(P) +44 1371 856050
(F) +44 1371 856037

**Alenia Marconi Systems**
Kelvin Building
Hillend Industrial Park
Hillend by Dunfermline
Fife Scotland
KY11 9JE
(P) +44 (0) 1383 836179
(F) +44 (0) 1383 824401

**ATTEC Australia**
52 Curzon Street
Camden Park S.A 5038
Australia
(P) +61-8-8295-3476
(F) +61-8-8376-1154
www.attecaustralia.com
Contact: Lyn Dayman

**B E S T Inc.**
3603 Edison Place
Rolling Medows, IL 60008
(P) (847) 797-9250
(F) (847) 797-9255

**Blackfox Training Institute, LLC**
455 Weaver Park Road, Suite 400
Longmont, CO 80501
(P) (888) 837-9959
(F) (303) 682-0094

**DELTA Quality & Certification**
Venlighedsvej 4
DK-2970 Hoersholm
Denmark
(P) +45 45 86 77 22
(F) +45 45 86 15 96

**EMPF/ACI**
International Plaza One, Suite 600
Philadelphia, PA 19113
(P) (610) 362-1200
(F) (610) 362-1290

**Ensil Canada Ltd.**
205 Torbay Road
Markham, ON L3R 3W4
Canada
(P) (800) 265-0009
(F) (800) 565- 5329

**EPTAC Corporation**
71 Route 101A, Unit 1
Amherst, NH 03031
(P) (603) 673-7822 / (800) 643-7822
(F) (603) 673-8787

**Hong Kong Productivity Council**
HKPC Building, 3rd Floor
78 Tat Chee, Yau Yat Cheun
Kowloon, Hong Kong
(P) +852 2 788 5678
(F) +852 2 788 5405

**HYTEK**
Dannesbrogsgade 58
DK-9000 Aalborg
Denmark
(P) +45 9811 7003
(F) +45 9816 4795

**Keystone International**
1006 E. Yager Lane, Suite 110
Austin, TX 78753
(P) (512) 339-2030
(F) (512) 339-2121

**Manufacturing Technology**
Training Center (MTTC)
603 Graaf Street
Ridgecrest, CA 93555
(P) (760) 446-5571
(F) (760) 446-4337

**Omni Training Corp.**
9513 Business Center Drive, Suite J
Rancho Cucamonga, CA 91730-4500
(P) (909) 945-9495
(F) (906) 945-9459

**PIEK International Education Center**
(I.E.C.) B.V.
Schelsberg 111-113
6413 AC HEERLEN
The Netherlands
(P) +31 45 570 3333
(F) +31 45 570 3320

**Quality Technology Company**
635 E. Remington Rd., Suite D
Schaumburg, IL 60173
(P) (847) 884-1900
(F) (847) 884-7280

**Sincotron Sverige AB**
Box 137
Stormbyvagen 2-4
S-163 29 Spσnga
Sweden
(P) +46 8 795 24 00
(F) +46 8 795 24 10

**Soldering Technology International**
102 Tribble Drive
Madison, AL 35758
(P) (800) 858-0604
(F) (256) 461-9566

**Solder School Europe**
Oriel Training Services
Telford Road
Eastfield Industrial Estate
Glenrothes, Fife KY7 4NX
Scotland
(P) +44 1592 632 209
(F) +44 1592 631 340

**The Surface Mount & Circuit Board**
Association Inc
PO Box 3140
MURRUMBEENA VIC 3163
Australia
(P) 61 - 3 - 9568 0599
(F) 61 - 3 - 9568 0622

**TCS**
P.O. Box 5313
Manchester, NH 03108
(P) (800) 955-4842
(F) (603) 627-0423

**Teamsource, Inc.**
2320 Donley Drive, Suite A
Austin, TX 78758
(P) (800) 489-0585
(F) (512) 834-9693

**ZVE**
6, Argelsrieder Feld
D-82234 Oberpfaffen Wessling,
Germany
(P) +49 8153 403 21
(F) +49 8153 403 15

This Page Intentionally Left Blank

ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES ®

# Standard Improvement Form

## IPC-A-610C

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
2215 Sanders Road
Northbrook, IL 60062-6135
Fax 847 509.9798


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 ______________________________

2. Recommendations for correction:

______________________________

______________________________

______________________________

______________________________

3. Other suggestions for document improvement:

______________________________

______________________________

______________________________

______________________________

Submitted by:

Name ______________________ Telephone ______________________

Company ______________________ E-mail ______________________

Address ______________________

City/State/Zip ______________________ Date ______________________

ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES ®

ISBN #1-580982-94-8

2215 Sanders Road, Northbrook, IL 60062-6135
Tel. 847.509.9700 Fax 847.509.9798
www.ipc.org