Requirements for Soldered Electrical and Electronic Assemblies

A joint standard developed by the IPC J-STD-001 development team including J-STD-001 Task Group (5-22a), J-STD-001 Task Group Asia (5-22aCN) and J-STD-001 Task Group Nordic (5-22aND) of the Assembly and Joining Processes Committees (5-20 and 5-20CN) of IPC

Supersedes:
J-STD-001D - February 2005
J-STD-001C - March 2000
J-STD-001B - October 1996
J-STD-001A - April 1992

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

Contact:
IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, IL 60015-1249
Phone (847) 615-7100
Fax (847) 615-7105
# Table of Contents

## 1 GENERAL

1.1 Scope ............................................................................ 1  
1.2 Purpose .......................................................................... 1  
1.3 Classification .................................................................... 1  
1.4 Measurement Units and Applications .......................... 1  
1.4.1 Verification of Dimensions ............................................ 1  
1.5 Definition of Requirements .............................................. 2  
1.5.1 Hardware Defects and Process Indicators ................. 2  
1.5.2 Material and Process Nonconformance .................... 2  
1.6 General Requirements .................................................. 2  
1.7 Order of Precedence ......................................................... 3  
1.7.1 Conflict ........................................................................ 3  
1.7.2 Clause References ....................................................... 3  
1.7.3 Appendices ................................................................. 3  
1.8 Terms and Definitions ....................................................... 3  
1.8.1 Defect ......................................................................... 3  
1.8.2 Disposition .................................................................. 3  
1.8.3 Electrical Clearance ..................................................... 3  
1.8.4 High Voltage ............................................................. 3  
1.8.5 Manufacturer (Assembler) ............................................. 3  
1.8.6 Objective Evidence ...................................................... 3  
1.8.7 Process Control ........................................................... 4  
1.8.8 Process Indicator .......................................................... 4  
1.8.9 Proficiency ................................................................. 4  
1.8.10 Solder Destination Side ............................................... 4  
1.8.11 Solder Source Side ....................................................... 4  
1.8.12 Supplier .................................................................... 4  
1.8.13 User .......................................................................... 4  
1.8.14 Wire Overwrap ............................................................ 4  
1.8.15 Wire Overlap ............................................................... 4  
1.9 Requirements Flowdown ................................................ 4  
1.10 Personnel Proficiency ...................................................... 4  
1.11 Acceptance Requirements .............................................. 4  
1.12 General Assembly Requirements ............................... 5  
1.13 Miscellaneous Requirements ....................................... 5  
1.13.1 Health and Safety ........................................................ 5  
1.13.2 Procedures for Specialized Technologies ................. 5  

## 2 APPLICABLE DOCUMENTS

2.1 EIA ............................................................................. 5  
2.2 IPC ............................................................................. 5  
2.3 Joint Industry Standards ............................................... 6  
2.4 ASTM ........................................................................ 6  
2.5 Electrostatic Discharge Association ............................. 6  

## 3 MATERIALS, COMPONENTS AND EQUIPMENT REQUIREMENTS

3.1 Materials ................................................................. 6  
3.2 Solder ................................................................. 7  
3.2.1 Solder - Lead Free ...................................................... 7  
3.2.2 Solder Purity Maintenance ...................................... 7  
3.3 Flux ........................................................................ 8  
3.3.1 Flux Application ....................................................... 8  
3.4 Solder Paste .............................................................. 8  
3.5 Solder Preforms ......................................................... 8  
3.6 Adhesives ................................................................. 8  
3.7 Chemical Stripers ....................................................... 8  
3.8 Components ............................................................. 8  
3.8.1 Component and Seal Damage .................................. 8  
3.8.2 Coating Meniscus ..................................................... 8  
3.9 Soldering Tools and Equipment .................................. 8  

## 4 GENERAL SOLDERING AND ASSEMBLY REQUIREMENTS

4.1 Electrostatic Discharge (ESD) ...................................... 8  
4.2 Facilities ...................................................................... 8  
4.2.1 Environmental Controls ........................................... 8  
4.2.2 Temperature and Humidity ...................................... 8  
4.2.3 Lighting ................................................................. 9  
4.2.4 Field Assembly Operations ................................... 9  
4.3 Solderability ............................................................... 9  
4.4 Solderability Maintenance .......................................... 9  
4.5 Removal of Component Surface Finishes .................. 9  
4.5.1 Gold Removal .......................................................... 9  
4.5.2 Other Metallic Surface Finishes Removal .............. 9  
4.6 Thermal Protection ...................................................... 9  
4.7 Rework of Nonsolderable Parts .................................. 9  
4.8 Presoldering Cleanliness Requirements ..................... 10  
4.9 General Part Mounting Requirements ....................... 10  
4.9.1 Stress Relief ............................................................ 10  
4.10 Hole Obstruction ........................................................ 10  
4.11 Metal-Cased Component Isolation ............................. 10  
4.12 Adhesive Coverage Limits ........................................... 10  
4.13 Mounting of Parts on Parts (Stacking of Components) ......................... 10  
4.14 Connectors and Contact Areas ................................ 10  
4.15 Handling of Parts ....................................................... 10  
4.15.1 Preheating ............................................................. 10  
4.15.2 Controlled Cooling .................................................. 10  
4.15.3 Preheating ............................................................. 10  
4.15.4 Controlled Cooling .................................................. 10  

April 2010  
IPC J-STD-001E-2010  
vii
Tables

Table 1-1 Design and Fabrication Specification .............. 3
Table 3-1 Maximum Limits of Solder Bath Contaminant .... 7
Table 5-1 Allowable Strand Damage ............................ 13
Table 5-2 Terminal Soldering Requirements ..................... 15
Table 5-3 Turret and Straight Pin Wire Placement ............ 16
Table 5-4 AWG 30 and Smaller Wire Wrap Requirements ........ 17
Table 5-5 Bifurcated Terminal Wire Placement - Side Route ........................................ 17
Table 5-6 Staking Requirements of Side Route Straight Through Connections - Bifurcated Terminals .......................... 17
Table 5-7 Bifurcated Terminal Wire Placement - Bottom Route ........................................... 18
Table 5-8 Hook Terminal Wire Placement .................... 18
Table 5-9 Pierced/Perforated Wire Placement .............. 19
Table 5-10 Solder Requirements Wire to Post .......... 19
Table 6-1 Lead Bend Radius ........................................... 20
Table 6-2 Protrusion of Leads in Supported Holes .......... 21
Table 6-3 Protrusion of Leads in Unsupported Holes .......... 21
Table 6-4 Supported Holes with Component Leads, Minimum Acceptable Conditions .......................... 22
Table 6-5 Unsupported Holes with Component Leads, Minimum Acceptable Conditions .......................... 22
Table 7-1 SMT Lead Forming Minimum Lead Length ........ 23
Table 7-2 Surface Mount Components .......................... 25
Table 7-3 Dimensional Criteria - Bottom Only Terminations ........................................ 26
Table 7-4 Dimensional Criteria - Rectangular or Square End Chip Components - 1, 3 or 5 Side Termination ................................. 27
Table 7-5 Dimensional Criteria - Cylindrical End Cap Terminations ........................................ 28
Table 7-6 Dimensional Criteria - Castellated Terminations ........................................ 29
Table 7-7 Dimensional Criteria - Flat Gull Wing Leads .... 30
Table 7-8 Dimensional Criteria - Round or Flattened (Coined) Gull Wing Leads ................................. 31
Table 7-9 Dimensional Criteria - “J” Leads ..................... 32
Table 7-10 Dimensional Criteria - Butt/I Connections ..... 33
Table 7-11 Dimensional Criteria - Flat Lug Leads .......... 34
Table 7-12 Dimensional Criteria - Tall Profile Components Having Bottom Only Terminations ........................................ 35
Table 7-13 Dimensional Criteria - Inward Formed L-Shaped Ribbon Leads ................................ 36
Table 7-14 Dimensional Criteria - Ball Grid Array Components with Collapsing Balls .......................... 37
Table 7-15 Ball Grid Array Components with Noncollapsing Balls ........................................ 38
Table 7 16 Column Grid Array ........................................ 38
Table 7-17 Dimensional Criteria - BTC .......................... 39
Table 7-18 Dimensional Criteria - Bottom Thermal Plane Terminations ........................................... 40
Table 7-19 Dimensional Criteria Flattened Post Connections ........................................... 41
Table 8-1 Designation of Surfaces to be Cleaned ............ 42
Table 8-2 Cleanliness Testing Designators ..................... 42
Table 10-1 Coating Thickness .......................................... 45
Table 11-1 Magnification Aid Applications for Solder Connections ........................................ 48
Table 11-2 Magnification Aid Applications - Other ........... 48
Requirements for Soldered
Electrical and Electronic Assemblies

1 GENERAL

1.1 Scope  This standard prescribes practices and requirements for the manufacture of soldered electrical and electronic assemblies. Historically, electronic assembly (soldering) standards contained a more comprehensive tutorial addressing principles and techniques. For a more complete understanding of this document’s recommendations and requirements, one may use this document in conjunction with IPC-HDBK-001, IPC-A-610 and IPC-HDBK-610.

1.2 Purpose  This standard describes materials, methods and acceptance criteria for producing soldered electrical and electronic assemblies. The intent of this document is to rely on process control methodology to ensure consistent quality levels during the manufacture of products. It is not the intent of this standard to exclude any procedure for component placement or for applying flux and solder used to make the electrical connection.

1.3 Classification  This standard recognizes that electrical and electronic assemblies are subject to classifications by intended end-item use. Three general end-product classes have been established to reflect differences in producibility, complexity, functional performance requirements, and verification (inspection/test) frequency. It should be recognized that there may be overlaps of equipment between classes.

The user (see 1.8.13) is responsible for defining the product class. The product class should be stated in the procurement documentation package.

CLASS 1  General Electronic Products
Includes products suitable for applications where the major requirement is function of the completed assembly.

CLASS 2  Dedicated Service Electronic Products
Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically the end-use environment would not cause failures.

CLASS 3  High Performance Electronic Products
Includes products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

1.4 Measurement Units and Applications  All dimensions and tolerances, as well as other forms of measurement (temperature, weight, etc.) in this standard are expressed in SI (System International) units (with Imperial English equivalent dimensions provided in brackets). Dimensions and tolerances use millimeters as the main form of dimensional expression; micrometers are used when the precision required makes millimeters too cumbersome. Celsius is used to express temperature. Weight is expressed in grams.

1.4.1 Verification of Dimensions  Actual measurement of specific part mounting and solder fillet dimensions and determination of percentages are not required except for referee purposes. For the purposes of determining conformance to this specification, all specified limits in this standard are absolute limits as defined in ASTM E29.