



*The Institute for
Interconnecting
and Packaging
Electronic Circuits*

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Specifications for Assembly of Discrete Wiring

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A standard developed by the Institute for Interconnecting
and Packaging Electronic Circuits

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- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feed back system on use and problems for future improvement

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

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Specifications for Assembly of Discrete Wiring

1.0 SCOPE

1.1 Scope This specification covers the acceptance and test requirements of conformally coated and nonconformally coated discrete wiring assemblies consisting of discrete wiring boards manufactured in accordance with IPC-DW-425 on which separately manufactured electrical and/or mechanical components are mounted

1.2 Classification

1.2.1 Types Discrete wiring assemblies shall be of the types shown in Table 1.

Table 1

Type	Connection
A1	Solderless Wrap
A2	Clip Termination
A3	Insulation Displacement
B1	Wrapped and Soldered
B2	Reflowed Solder
B3	Heat Shrinkage Solder
C1	Plated-Through Hole
C2	Welded Pin
C3	Welded Land

2.0 APPLICABLE DOCUMENTS

2.1 Industrial Documents Unless otherwise specified, the following documents, of the issue currently in effect form a part of this specification to the extent specified herein.

2.1.1 IPC¹

IPC-T-50 Terms and Definitions

IPC-DW-425 Design and End Product Requirements for Discrete Wiring Boards

IPC-A-600 Acceptability of Printed Wiring Boards

IPC-A-610 Acceptability of Printed Wiring Board Assemblies (Guidelines For)

IPC-R-700 Modification and Repair for Printed Boards and Assemblies

IPC-TM-650 Test Methods Manual

IPC-CM-770 Printed Board Component Mounting

IPC-S-805 Solderability Tests for Component Leads and Terminations

IPC-S-815 General Requirements for Soldering Electronic Interconnections

IPC-SF-818 General Requirements for Electronic Soldering Fluxes

IPC-CC-830 Qualification and Conformance of Electrical Insulating Compound for Printed Board Assemblies

IPC-SM-840 Qualification and Performance of Permanent Polymer Coating (Solder Mask) for Printed Circuits

2.1.2 ASTM²

ASTM B-33 Tinned, Soft or Annealed Copper Wire for Electrical Purposes

2.2 Government Documents³ Unless otherwise specified, the following documents, of the issue currently in effect, form a part of this specification to the extent specified herein.

2.2.1 Military Specifications

MIL-P-13949 Plastic Sheet, Laminated, Metal Clad (for Printed Wiring Boards), General Specifications for

MIL-F-14256 Flux Soldering, Liquid (Rosin Base)

MIL-I-22129 Insulation Tubing, Electrical, Polytetrafluoroethylene Nonrigid

MIL-I-43553 Marking Inks

2.2 Military Standards

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-202 Test Methods for Electronic and Electrical Component Parts

MIL-STD-810 Environmental Test Methods

MIL-STD-45662 Calibration Systems Requirements

1. Publication are available from the IPC, 2215 Sanders Road, Northbrook, IL 60062-6135

2. Applications for test copies should be addressed to: American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19130

3. To obtain document, write Naval Publications and Forms Center, 5801 Tabor Road, Philadelphia, PA 19130

2.2.3 Federal

QQ-S-571 Solder, Tin Alloy; Lead Tin Alloy, and Lead Alloy

QQ-W-343 Wire, Electrical (Uninsulated)

3.0 REQUIREMENTS

3.1 General Requirements Discrete wiring assemblies supplied under this specification shall meet the requirements of this specification and the applicable assembly drawing. Design features of the discrete wiring assembly shall meet the requirements of IPC-DW-425, IPC-S-815 and recommended/acceptable component mounting techniques of IPC-CM-770.

3.1.1 Conflict In the event of conflict between documents the following order of precedence shall apply:

1. Purchase order and/or contract
2. Assembly drawing
3. This specification
4. Referenced specifications

3.2 Qualification When first article is required, it must be agreed upon between user and vendor and must be specified on the purchase order and/or contract.

3.2.1 First Article In the event first article is invoked, the discrete wiring assembly furnished under this specification shall be products which have passed the first article inspection specified in Section 4 of this specification. Alternative product, processes of different materials other than those used in the first article shall not be used on production without written authorization from the cognizant procuring activity.

3.3 Terms and Definitions Terms and definitions shall be in accordance with IPC-T-50, IPC-DW-425 and the following: Definitions marked with an asterisk [*] are direct excerpts from IPC-T-50 or IPC-DW-425.

3.3.1 Automated Component Insertion The act or operation of assembling discrete components to discrete wiring boards by means of controlled component insertion equipment.

3.3.2 Buffer Material A resilient material which is used to protect crack-sensitive components from excessive stresses generated by the conformal coating.

3.3.3 Clinched Lead Component leads which extend through the printed board and are formed to effect a spring action, metal-to-metal electrical contact with the conductive pattern prior to soldering.

3.3.4 Component A separate part of a discrete wiring assembly which performs a circuit function (e.g. resistor, capacitor, transistor, transformer, etc.)

3.3.5 Component Mounting The act of mechanically attaching the component to the discrete wiring board, or the manner in which they are attached, or both.

3.3.6 Component Orientation The direction in which the components on a discrete wiring board or other assembly are lined up electrically with respect to the polarity of polarized components and also with respect to one another and to the board.

3.3.7 Cracking* A condition consisting of breaks in metallic or non-metallic coatings or both that extend through to an underlying surface.

3.3.8 Discrete Wiring Assembly* A discrete wiring board on which separately manufactured components and parts have been added.

3.3.9 Discrete Wiring Board* A substrate or base upon which discrete wiring techniques are used to obtain electronic interconnections.

3.3.10 Hard Wiring Electrical wiring that interconnects two or more parts or assemblies into an assembly which is inseparable without the use of specific tools and techniques.

3.3.11 Jumper Wire An electrical connection between two points in an electrical assembly to affect rework, repair or modification to make the assembly functional.

3.3.12 Modifications A revision to the interconnect feature on a discrete wiring assembly accomplished by interrupting conductors, adding/deleting components and/or adding wires. Modification of a discrete assembly is done in lieu of using a new-design assembly with the changes incorporated.

3.3.13 Partially Clinched Lead A lead which is bent with an angle sufficient to retain a device in a mounting hole.

3.3.14 Repair The act of restoring the functional capability of a defective part without necessarily restoring appearance, interchangeability and uniformity.

3.3.15 Rework The procedure of reestablishing functional and physical characteristics of an assembly without deviating from the original design drawing, specifications, or contract requirements. The reworking of defective solder connections or replacement of defective components.

considered to be a modification or repair and is permissible. The replacement of a missing or broken discrete wire shall be permissible unless otherwise specified.

3.3.16 Straight-Through Lead A lead coming through a printed board with an angle of 60 to 90 degrees from the conductive pattern.

3.4 Material Materials furnished as part of the discrete wiring assembly shall be as specified herein and in the applicable assembly drawings. For safety precautions see Paragraph 6.8. The responsibility for inspection of materials quality shall specified in 4.1.

3.4.1 Materials and Process Compatibility It shall be the responsibility of the vendor to select those processes and materials which are compatible with one another and which best suit the end product desired by the contract.

3.4.2 Discrete Wiring Boards Discrete wiring assemblies shall use discrete wiring boards fabricated in accordance with IPC-DW-425.

3.4.3 Component Leads and Wires Incoming inspection should be performed on all component leads and wires per the appropriate component/wire specifications. Prior to component assembly, all component leads and wires shall show evidence of good solderability in accordance with 4.3.1 or shall be tinned. Component leads and wires which were tested for solderability may be used on assemblies within one year of tinning without retest Component leads and wires exceeding the time requirements shown above shall be solderability per the requirements of IPC-S-805 prior to assembly.

3.4.3.1 Component Parts and Wires Component parts and wires shall be as specified on the approved assembly drawing(s) and associated parts list(s).

3.4.3.2 Gold-Plated Leads and Wires All gold-plated leads and wires shall be treated in accordance with the tinning requirements of IPC-S-815.

3.4.4 Solder The solder used shall be in accordance with the solder specified in IPC-S-815.

3.4.5 Soldering Flux Soldering shall be as specified in IPC-S-818. Type H flux shall not be used on stranded wire or assemblies where flux entrapment cannot be removed by cleaning or detected through testing techniques.

3.4.6 Conformal Coating Conformal coating material shall be as specified on the assembly drawing and shall be in accordance with IPC-C-830. When conformal coating is required, it shall be so stated on the assembly drawing.

3.4.7 Buffer Material When required in accordance with the assembly drawing, the buffer material shall be a thin, pliant material such as polyvinylidene fluoride, polyethylene terephthalate, or silicone rubber, and be nonreactive with the conformal coating material and all parts with which it comes in contact. The buffer material shall be fungus and flame resistant, and clear or transparent so markings on the components are visible.

3.4.8 Hard Wires (Jumper, Jumper Wires) Jumpers shall be as specified on the approved assembly drawing.

3.5 Design Principles and Production Criteria Part mounting and attachment shall be in accordance with this specification, and the approved assembly drawing or other documents referenced. The requirements of 3.5.1 through 3.5.9 shall apply to the mounting of parts on the discrete wiring assembly. Interconnection of parts to the discrete wiring assembly shall be per one of the methods described in Paragraph 3.6.

3.5.1 Part Location Parts shall be mounted so as to avoid the occurrence of moisture traps.

3.5.2 Conductive Areas When conformal coating is specified, the part shall be mounted so that conformal coating will seal the part with a continuous film. When conformal coating will not encase conductive areas under the part, the conductive areas may be insulated and protected against moisture entrapment by applying and curing a resin coating, laminating low flow prepreg material in accordance with MIL-P-13949, or by a solder mask coating in accordance with IPC-SM-840 over the area or by selective conformal coating of the area prior to mounting of the parts. Any materials used shall meet the requirements of 3.4.1. When conformal coating is required, it shall be stated so on the assembly drawing.

3.5.3 Part Spacing

3.5.3.1 Physical Spacing Parts shall be mounted and spaced so that any part can be removed from the discrete wiring board without having to remove any other part unless otherwise specified on the approved assembly drawing.

3.5.3.2 Electrical Spacing The minimum spacing between component leads, uninsulated wires not supplied on the original discrete wired board, conductor patterns and other conductive material (such as conductive markings or mounted hardware) shall be in accordance with Table 2.

3.5.4 Alignment of Parts Leads Axial parts shall be mounted to the respective specified attachment area. The part leadmay overhang the specified attachment area.

Table 2 Conductor Spacing

Voltage between conductors DC or AC peak (volts)	Minimum spacing	
	Surface layers	Internal layers
0 - 100	0.005 inch (0.13 mm)	0.004 inch (0.10 mm)
101 - 300	0.015 inch (0.38 mm)	0.008 inch (0.20 mm)
301 - 500	0.030 inch (0.76 mm)	0.010 inch (0.253 mm)
Greater than 500 ¹	0.00012 inch (.00305 mm) per volt	0.0001 inch (.0025 mm) per volt

¹ For reference only, voltages greater than 500 should be evaluated for the specific design application

theresultant electrical spacing between adjacent conductors meets the requirements specified in Table 2.

3.5.5 Stress Relief Bends Parts shall be mounted or provided with stress relief bends in such a manner that leads cannot overstress the part-lead interface when subjected to the conditions of 3.9.3 through 3.9.6. The straight lead length adjacent to the component body shall be in accordance with Figure 1.

Note: For solder in the stress relief bend of axial-leaded parts see 3.5.7.1.

3.5.5.1 Lead Bend Radius Minimum bend radius for leads shall be in accordance with IPC-A-610.

3.5.6 Lead Formation

3.5.6.1 Leads on Standoff Terminals Part attachment to standoff terminals shall be in accordance with the requirements of IPC-S-815.

3.5.6.2 Clinched Leads Clinched leads shall be in accordance with the requirements of IPC-S-815. Leads are clinched in unsupported & supported (plated through) holes as shown in Figure 2.

3.5.6.3 Straight-Through, Partially Clinched, or Swagged Leads Straight-through, partially clinched or swagged leads shall be in accordance with the requirements of IPC-S-815. Straight-through, partially clinched or swagged leads are permitted in unsupported or supported (land and landless) plated-through holes. (See Figure 3).

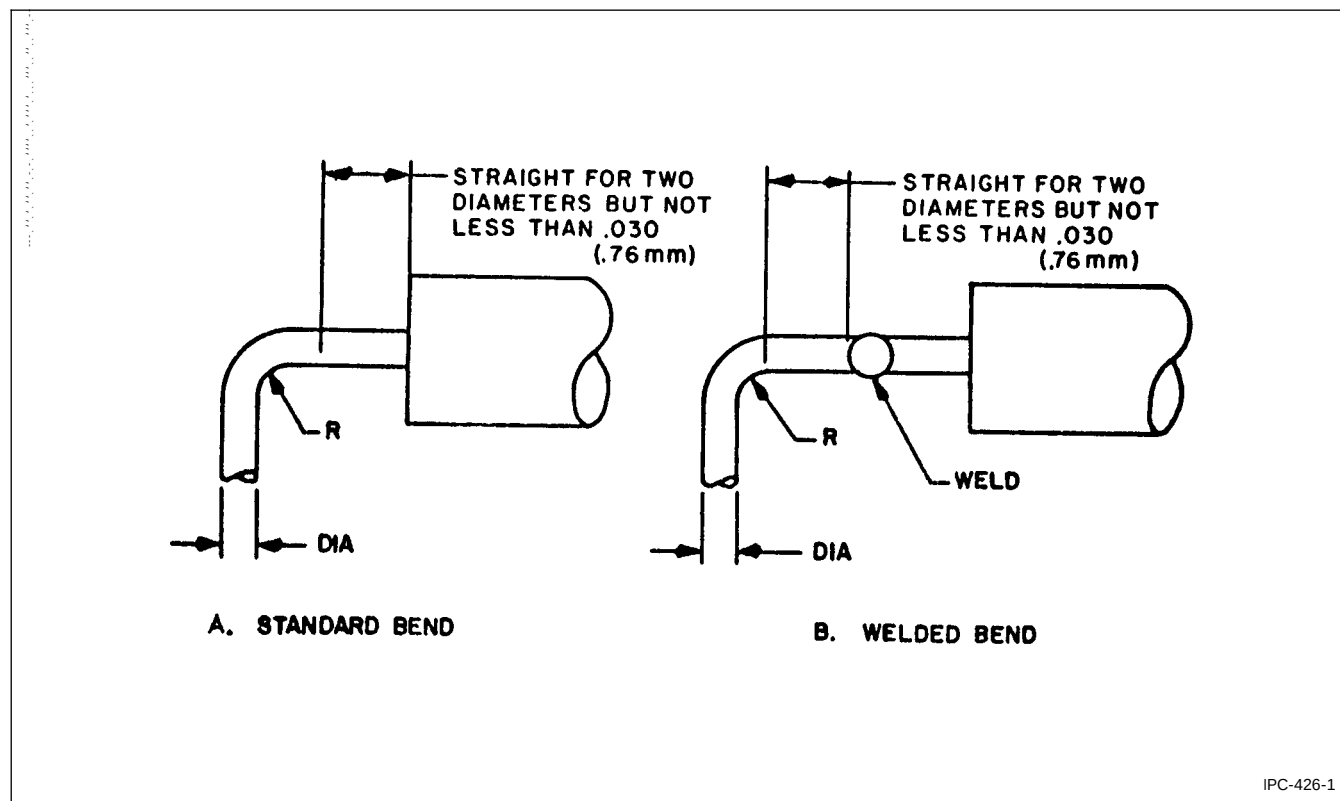


Figure 1 Lead bend

IPC-426-1