

MILITARY SPECIFICATION

PRINTED-WIRING, FLEXIBLE AND RIGID-FLEX

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the requirements for flexible printed-wiring (with or without shield(s) or stiffeners) and rigid and flexible printed-wiring combinations. The rigid and flexible printed-wiring combination hereinafter will be referred to as rigid-flex printed-wiring. In the rigid-flex application, the conductor layers that are in the flexible portion are also a layer in the rigid multilayer board.

1.2 Classification. The flexible and rigid-flex printed-wiring covered by this specification shall be of the following types and classes, as specified.

1.2.1 Types.

Type 1 - Singled-sided flexible material with or without shield(s) or stiffener (one conductor layer).

Type 2 - Double-sided flexible material with or without shield(s) or stiffener (two conductor layers) with plated-through holes.

Type 3 - Multilayer flexible material with or without shield(s) or stiffener (more than two conductor layers) with plated-through holes.

Type 4 - Multilayer rigid and flexible material combinations (more than two conductor layers), with plated-through holes.

Type 5 - Bonded rigid and/or flexible material combinations (more than one conductive layer) without plated-through holes.

1.2.2 Classes.

Class A - Capable of withstanding flexing during installation.

Class B - Capable of withstanding continuous flexing for a number of cycles specified on the master drawing. (Generally not used for more than two conductor layers).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Electronic Systems Command, ATTN: ELEX 8111, Washington, DC 20363, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified (see 6.1), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

- L-P-378 - Plastic Sheet and Strip, Thin Gauge, polyolefin.
- A-A-113 - Tape, Pressure Sensitive Film, Office Use.
- NN-P-71 - Pallet, Material Handling, Wood, Stringer Construction, 2-way and 4-way.
- PPP-B-566 - Boxes, Folding, Paperboard.
- PPP-B-585 - Boxes, Wood, Wirebound.
- PPP-B-601 - Boxes, Wood, Cleated-Plywood.
- PPP-B-621 - Boxes, Wood, Nailed and Lock-corner.
- PPP-B-636 - Boxes, Shipping, Fiberboard.
- PPP-B-676 - Boxes, Setup.
- QQ-A-250 - Aluminum and Aluminum Alloy Plate and Sheet, General Specification For.
- QQ-C-576 - Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed or Machined Edges, (Plate Bar, Sheet and Strip)
- QQ-M-290 - Nickel Plating (electrodeposited).
- QQ-S-571 - Solder; Tin Alloy, Tin/Lead Alloy; and Lead Alloy.
- QQ-S-781 - Strapping, Steel, and Seals.

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- MIL-P-116 - Preservation-Packaging, Methods of.
- MIL-P-13949 - Plastic Sheet, Laminated, Metal-Clad (For Printed-Wiring Boards), General Specification For.
- MIL-F-14256 - Flux, Soldering, Liquid (Rosin Base).
- MIL-C-14550 - Copper Plating (Electrodeposited).
- MIL-B-43014 - Box, Water Resistant Paperboard, Folding, Set-up and Metal Stayed.
- MIL-G-45204 - Gold Plating, Electrodeposited
- MIL-T-45208 - Inspection Systems Requirement
- MIL-I-46058 - Insulating Compound, Electrical (For Coating Printed Circuit Assemblies).
- MIL-P-81728 - Plating, Tin/Lead (Electrodeposited).

STANDARDS

FEDERAL

- FED-STD-356 - Commercial Packaging of Supplies and Equipment.

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- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-130 - Identification Marking of U.S. Military Property.
- MIL-STD-147 - Palletized Unit Loads.
- MIL-STD-202 - Test Methods For Electronic and Electrical Components Parts.
- MIL-STD-794 - Part and Equipment, Procedures For Packaging and Packing of.
- MIL-STD-2118 - Flexible and Rigid-Flex Printed-Wiring for Electronic Equipment.
- MIL-STD-45662 - Calibration Systems Requirements.

(Copies of specification and standards required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer).

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS

ANSI/IPC-T-50	-	Terms and Definitions.
IPC-CF-150	-	Copper Foil for Printed-Wiring Applications.
IPC-FC-231	-	Flexible Bare Dielectric for use in Flexible Printed-Wiring.
IPC-FC-232	-	Specification for Adhesive Coated Dielectric Films for use as a Cover Sheet for Flexible Printed-Wiring.
IPC-FC-233	-	Flexible Adhesive Bonding Films.
IPC-FC-241	-	Metal Clad Flexible Dielectrics for use in Fabrication of Flexible Printed-Wiring.
IPC-A-600B	-	Acceptability of Printed Wiring Boards. A Compilation of Visual Quality Acceptability Standards for Printed Wiring Boards.
IPC-TM-650	-	Test Methods Manual.
IPC-S-801	-	Edge Dip Solderability Test for Printed-Wiring Boards.
IPC-SM-840	-	Qualification and Performance of Permanent Polymer Coatings (Solder Mask For Printed Boards).
IPC-B-29/50884	-	Master Drawings for Flexible and Rigid-Flex Certification Boards.

(Application for copies should be addressed to the Institute for Interconnecting and Packaging Electronic Circuits, 3451 Church St., Evanston, IL 60203.)

3. REQUIREMENTS

3.1 General requirements. Flexible and rigid-flex printed wiring delivered under this specification shall meet the design features detailed in MIL-STD-2118 and the requirements of the approved master drawing. In the event of conflict between MIL-STD-2118 and the approved master drawing, the master drawing shall govern. The detailed requirements contained in this section, although determined by examination of quality conformance coupons, apply to the deliverable flexible and rigid-flex printed wiring product. Anomalies or defects noted on other than the coupons or sample boards defined in inspection tables VIII thru XIII shall be recorded and the proper corrective action shall be initiated.

3.2 Supplier certification. Flexible and rigid-flex printed-wiring furnished under this specification shall have been fabricated by a supplier who has been certified by inspection in accordance with 4.5 (see 6.5).

3.3 Material. The type of material used for flexible and rigid-flex printed-wiring shall be as specified herein and on the master drawing. Acceptance or approval of any constituent material shall not be construed a guarantee of the acceptance of the finished product.

3.3.1 Metal-clad materials. Metal-clad materials used shall be type GF or GI in accordance with MIL-P-13949. The base material shall be copper clad on one or two sides with the copper foil type and thickness specified on the master drawing. The base material shall have a minimum thickness of 0.002 inch (0.05mm) per sheet plus sufficient prepreg (see 3.3.2) or adhesive (see 3.3.7) to provide for a minimum dielectric layer thickness of .0035 inches, see 3.7.8.1, between consecutive conductor layers.

3.3.2 Preimpregnated bonding material (prepreg). Preimpregnated bonding material (B stage) used shall be type GE, GF, or GI in accordance with MIL-P-13949.

3.3.3 Flexible metal-clad dielectric. Flexible metal-clad dielectric used shall be class 3 in accordance with IPC-FC-241 and table I. The dielectric shall be copper clad on one or two sides with the copper foil type and thickness specified on the master drawing. The dielectric base material shall have a minimum thickness of 0.001 inch (0.03 mm) per sheet plus sufficient coverlayer or adhesive (see 3.3.5 and 3.3.7) to provide for a minimum dielectric layer thickness specified in 3.7.8.2.

3.3.4 Insulation material. The insulation material used for flexible base dielectric material shall be class 3 in accordance with IPC-FC-231 and table II. The insulation material shall have a minimum thickness of 0.001 inch (0.03 mm). The adhesive used for bonding of the insulation material shall be of a type specified in 3.3.7. The adhesive shall meet the requirements of 3.5.8.

3.3.5 Coverlayer. The insulation material used as a coverlayer shall be an adhesive coated dielectric film class 3 in accordance with IPC-FC-232 and table III on types 1 and 2 flexible printed-wiring and the flexible layers of types 3 and 4 flexible and rigid-flex printed-wiring. The coverlayer shall be a minimum thickness of 0.0005 inch (0.013 mm) (base material only).

3.3.6 Shielding. Shielding material, when required, shall be as specified on the master drawing in accordance with the requirements of MIL-STD-2118.

3.3.7 Adhesives. Flexible adhesive bonding films used shall be class 3 in accordance with IPC-FC-233 and table IV.

3.3.8 Stiffeners. Stiffeners, when required, shall be as specified on the master drawing in accordance with the requirements of MIL-STD-2118. The adhesive used for bonding of the stiffener to the flexible material shall be of a type specified in 3.3.2 or 3.3.7. When tested in accordance with 4.8.4.7, the peel strength between the flexible printed-wiring and the stiffener shall be a minimum 3 pounds per inch of width.

3.3.9 Copper foil. Copper foil used in flexible and rigid-flex printed-wiring shall conform to IPC-CF-150 and the master drawing.

3.3.10 Plated deposit. Unless otherwise specified on the master drawing, plating shall be in accordance with MIL-STD-2118 as follows (see 6.1.2):

- a. Electrodeposited copper plating shall be in accordance with MIL-C-14550.
- b. Gold plating shall be in accordance with MIL-G-45204.
- c. Nickel plating shall be in accordance with QQ-N-290.
- d. Tin/Lead plating (fused) shall be in accordance with MIL-P-81728.

Unless otherwise specified, plating thicknesses shall meet the requirements of 3.7.2.

3.3.11 Solder coating. The solder used for solder coating shall be in accordance with composition Sn60, Sn62, or Sn63 of QQ-S-571. Unless otherwise specified, solder coating thickness shall meet the requirements of 3.7.2.

3.3.12 Solder flux. Solder flux used shall be a liquid flux type R, RA, or RMA in accordance with MIL-F-14256. Solder flux, type RA shall not be used on Army contracts without prior approval by the government procuring activity.

3.3.13 Solder mask. When permanent solder mask coating (rigid laminate of type 4 rigid-flex only) is specified on the master drawing, it shall be a polymer coating conforming to IPC-SM-840, class 3.

3.3.14 Marking ink. Marking ink used shall be a permanent, non-nutrient, and non-conductive polymer ink.

3.3.15 Heat-sinking planes. Heat sinking planes when required shall be as specified on the master drawing. Aluminum cores shall conform to QQ-A-250. Copper cores shall conform to QQ-C-576. The adhesive used for bonding the metal core shall be of a type specified in 3.3.2 or 3.3.7 and shall provide for a minimum dielectric layer thickness specified in 3.7.8.1 between adjacent conductor layers.

TABLE I. Flexible metal-clad dielectric.

Specification sheet	Material identification
IPC-FC-241/1	Copper clad, polyimide with acrylic adhesive
IPC-FC-241/2	Copper Clad, Polyimide with epoxy adhesive
IPC-FC-241/3	Copper clad, fluorinated poly (ethylene-propylene) (FEP) with acrylic adhesive
IPC-FC-241/4	Copper clad, fluorinated poly (ethylene-propylene) (FEP) with epoxy adhesive

TABLE II. Insulation material.

Specification sheet	Material identification
IPC-FC-231/1	Polyimide base dielectric
IPC-FC-231/2	Fluorinated poly (ethylene-propylene) (FEP) base dielectric

TABLE III. Cover layer.

Specification sheet	Material identification
IPC-FC-232/1	Polyimide base dielectric with acrylic adhesive
IPC-FC-232/2	Polyimide base dielectric with epoxy adhesive
IPC-FC-232/3	FEP base dielectric (fluorinated poly (ethylene propylene)) with acrylic adhesive
IPC-FC-232/4	FEP base dielectric (fluorinated poly (ethylene propylene)) with epoxy adhesive

TABLE IV. Adhesives.

Specification sheet	Material identification
IPC-FC-233/1	Acrylic adhesive
IPC-FC-233/2	Epoxy adhesive

3.3.15.1 Heat-sinking plane hole-fill insulation material. The insulation material used for hole-fill dielectric in metal cores shall be as specified on the master drawing.

3.4 Visual requirements.

3.4.1 Edges.

3.4.1.1 Edges of flexible sections. When examined in accordance with 4.8.2.1, the trimmed edge of the flexible section of finished flexible and rigid-flex printed-wiring shall be free of burrs, nicks, tears, or delamination. Discoloration or resin recession along the trimmed edges of the flexible sections following the surface solderability (3.4.6) and thermal stress (3.4.7) tests are acceptable providing the discoloration or resin recession dimension does not exceed the thickness of the adhesive material in the bonding area or reduce the edge spacing below the requirements of this specification and the master drawing.

3.4.1.2 Edges of rigid sections (type 4 and 5). When examined in accordance with 4.8.2.1, burrs, nicks, and haloing along the edges of rigid boards of types 4 and 5 rigid-flex printed wiring shall be acceptable provided the penetration is less than 0.10 inch (.25 mm) and does not reduce the edge spacing 50 percent of the edge spacing specified on the master drawing.

3.4.2 Surface imperfections (laminate). When examined in accordance with 4.8.2.2, surface imperfections (such as weave texture, weave exposure, haloing, scratches, pits, dents, and so forth) shall be acceptable providing the imperfection meets the following:

- a. The laminate fiber is not cut or disturbed.
- b. The imperfection does not bridge between conductors.
- c. The dielectric spacing between the imperfection and a conductor is not reduced below the minimum requirements of 3.5.4.

3.4.3 Subsurface imperfections (laminate). When examined in accordance with 4.8.2.3, subsurface imperfections (such as measling, crazing, blistering, delamination, and so forth) shall be acceptable providing the imperfection meets the following:

- a. Imperfection is non-conductive.
- b. No larger than 0.031 inch (0.79 mm) in any direction.
- c. Does not bridge more than 25 percent of the distance between conductors, plated-through holes, or access holes and no more than one percent of the board area on each side shall be affected.
- d. Does not reduce conductor spacing below the minimum requirements on the master drawing.
- e. Does not propagate as a result of the testing (such as bond strength, rework simulation, thermal stress, or thermal shock). Discoloration or resin recession along the edges of the access holes following the surface solderability (3.4.6) and thermal stress (3.4.7) tests is acceptable providing the discoloration or resin recession dimension does not exceed the thickness of the adhesive material in the bonding area.

3.4.4 Marking. Unless otherwise specified (see 6.1), each certification board, each individual board, and each set of quality conformance test coupons (as opposed to each individual coupon) shall be marked in accordance with the master drawing and MIL-STD-130, with the date and manufacturer's code (Federal Supply Code for Manufacturer's, FSCM). For traceability, each quality conformance test coupon shall be identifiable with the corresponding production boards produced on the panel with the coupon. When there is no production board on the panel (as in certification testing) each individual coupon shall be identifiable with and traceable to the panel of the coupon. The marking shall be produced by the same process used in producing the conductor pattern; by the use of a non-conductive, permanent, fungistatic ink or paint, or by electric pencil marking on a copper pad provided for marking purposes. Etched marking shall not reduce the spacing requirements specified in MIL-STD-2118. All marking shall be compatible with materials and parts, legible after all tests, and in no case affect board performance.

3.4.5 Workmanship. When examined in accordance with 4.8.2.5, flexible and rigid-flex printed-wiring shall be processed in such a manner as to be uniform in quality and show no evidence of dirt, foreign matter, oil, fingerprints, flux residues, and other contaminants. Flexible and rigid-flex printed-wiring shall also be free of defects in excess of those allowed in this specification, including lifting or separation of platings from the surface of the conductor pattern, or of the conductor from the base laminate. There shall be no whiskers of solder or plating on the surface of the flexible and rigid-flex circuit.

3.4.6 Surface solderability. When tested in accordance with 4.8.2.6, the specimens shall exhibit proper wetting of the surface. There shall be no separation or other forms of degradation of the conductive pattern. There shall be no dewetting of lands.

3.4.7 Thermal stress (type 1). When tested as specified in 4.8.2.7 and examined in accordance with 4.8.1, type 1 flexible printed-wiring specimens shall exhibit no cracking, separation of plating and conductors, lifted lands in excess of that allowed in 3.7.13, blistering or delamination in excess of that allowed in 3.4.3.

3.5 Dimensional requirements.

3.5.1 Dimensions. Finished flexible and rigid-flex printed-wiring shall meet the dimensional requirements specified herein and on the master drawing.

3.5.2 Hole pattern accuracy. When examined in accordance with 4.8.3.1, the accuracy of the hole pattern on flexible and rigid-flex printed-wiring shall be as specified on the master drawing.

3.5.3 Bow and twist (type 4 only, rigid area). When the rigid area of type 4 rigid-flex printed-wiring is tested in accordance with 4.8.3.2, the maximum allowable bow and twist shall be 1.5 percent, unless otherwise specified on the master drawing.

3.5.4 Conductor spacing. When examined in accordance with 4.8.3.3, the conductor spacing of flexible and rigid-flex printed-wiring shall be as specified on the master drawing. In the event that nothing is specified, the minimum spacing of non-encapsulated conductors shall not be less than 0.005 inch (0.13 mm) and encapsulated conductors not less than 0.004 inch (0.10 mm). Encapsulated means internal layers and external layers with cover coat only as opposed to conformal coating or solder mask.

3.5.5 Conductor pattern. When flexible and rigid-flex printed-wiring is examined as specified in 4.8.3.4, the conductor pattern shall have no tears or cracks. Any combination of edge roughness, nicks, pinholes, and scratches exposing the base material shall not reduce the conductor width more than 20 percent of the minimum specified on the master drawing. There shall be no more than five occurrences of the 20 percent reductions per conductor layer. Edge roughness up to a maximum of 0.005 inch (0.13 mm) (peak to valley) is permissible over any 0.500 inch (13.0 mm) of conductor length.

3.5.6 Layer to layer registration. Unless otherwise specified on the master drawing, layer to layer conductor pattern misregistration, when measured in accordance with 4.8.3.5, shall not exceed 0.014 inch (0.36 mm). Determination of misregistration shall be made using "registration coupons" (design optional) incorporated by the manufacturer into the fabricated panel. As an alternate, misregistration may be determined using hole pattern accuracy (see 3.5.2) as basic location and evaluating land to hole relationship, minimum annular ring measurements, or through microsection measurements in accordance with 4.8.3.5.

3.5.7 Annular ring (external). When evaluated in accordance with 4.8.3.6, the minimum external annular ring shall be in accordance with the following. A 20 percent reduction of the minimum annular ring specified in 3.5.7.1 and 3.5.7.2, due to defects such as pits, dents, nicks, pinholes or splay in the annular ring of isolated areas is acceptable.

3.5.7.1 Annular ring (unsupported hole). The minimum annular ring for an unsupported hole shall be 0.015 inch (0.38 mm). The annular ring may be less than the minimum providing the land is anchored by the use of anchoring spurs or if the land is elongated providing an equivalent soldering surface.

3.5.7.2 Annular ring (plated-through hole). The minimum annular ring for a plated-through hole in type 2, and external layers of type 3 and type 4 shall be 0.005 inch (0.13 mm). The minimum annular ring for functional internal lands on type 3 and type 4 shall be 0.002 inch (0.051 mm).

3.5.8 Adhesive on lands. Unless otherwise specified (see 6.1), extruded adhesive on lands, when examined in accordance with 4.8.3.7, shall not be within either 0.005 inch (0.13 mm) (for plated-through holes) or 0.010 inch (0.25 mm) (for unsupported holes) of the component hole (see figure 1).

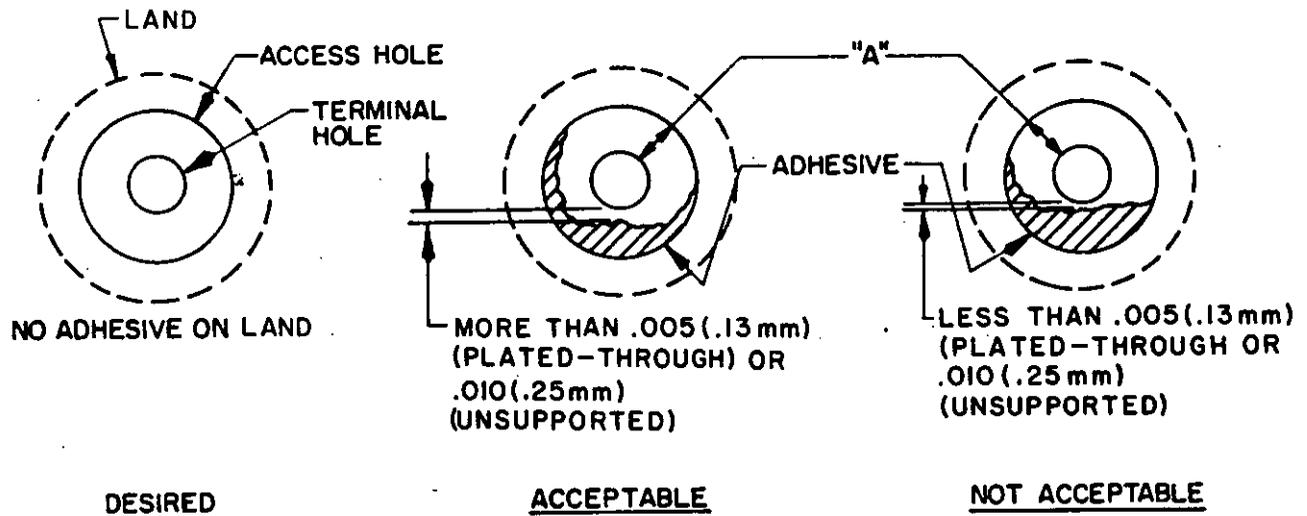


FIGURE 1. Adhesive on land.

3.5.9 Coverlayer.

3.5.9.1 Coverlayer separation (see figure 2). When flexible and rigid-flex printed-wiring is examined in accordance with 4.8.3.8, there shall be no coverlayer separation in excess of that allowed in the following:

- a. At random locations away from conductors if each separation is no larger than 0.010 square inch (0.65 sq mm) (approximately 0.100 inch diameter), and is not within 0.040 inch (1.0 mm) of the board edge or on access hole edge. The total number of the above separations shall not exceed three in any one square inch of coverlayer surface area.
- b. Along conductor edges, providing, the total separation does not exceed either 0.02 inch (0.051 mm) in width or 20 percent of the spacing between adjacent conductors, whichever is smaller.
- c. There shall be no coverlayer delamination along the outer edges of the coverlayer (see 3.4.1)

3.5.9.2 Coverlayer wrinkles. Wrinkles in the coverlayer, when examined in accordance with 4.8.3.9, shall be acceptable provided the requirements of 3.5.9.1 are met.

3.5.9.3 Coverlayer access holes. When individual access holes through the insulating cover at each component hole location are specified, registration shall be such that the diameter of the access hole, when measured in accordance with 4.8.3.10, shall not reduce the minimum annular ring below the limits specified in 3.5.7 (see figure 3). In those cases where anchoring spurs are attached to the land, they shall be lapped by the coverlayer. When anchoring spurs are not used with unsupported holes, the coverlayer shall overlap the land a minimum at .010 inch.

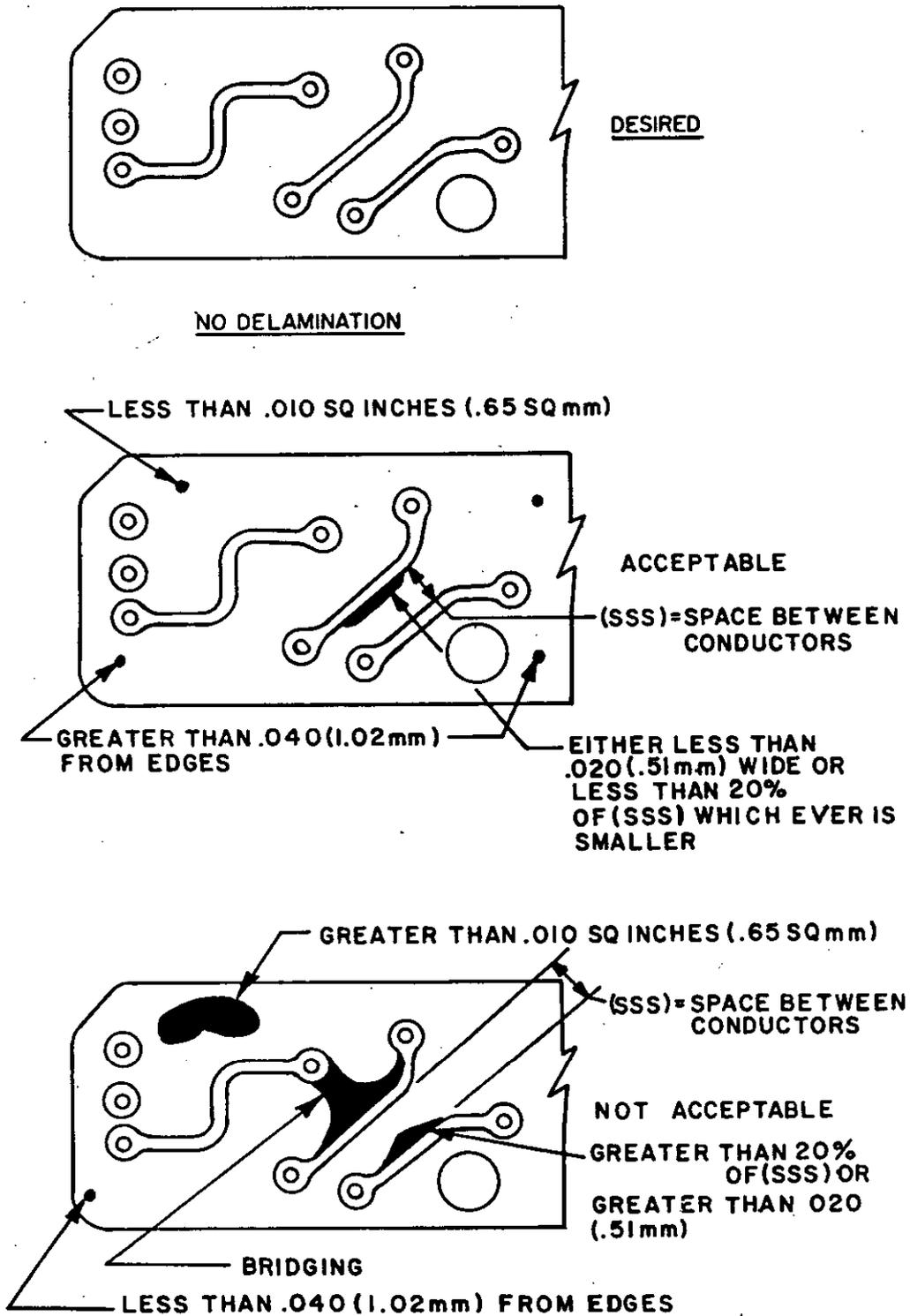


FIGURE 2. Separation.

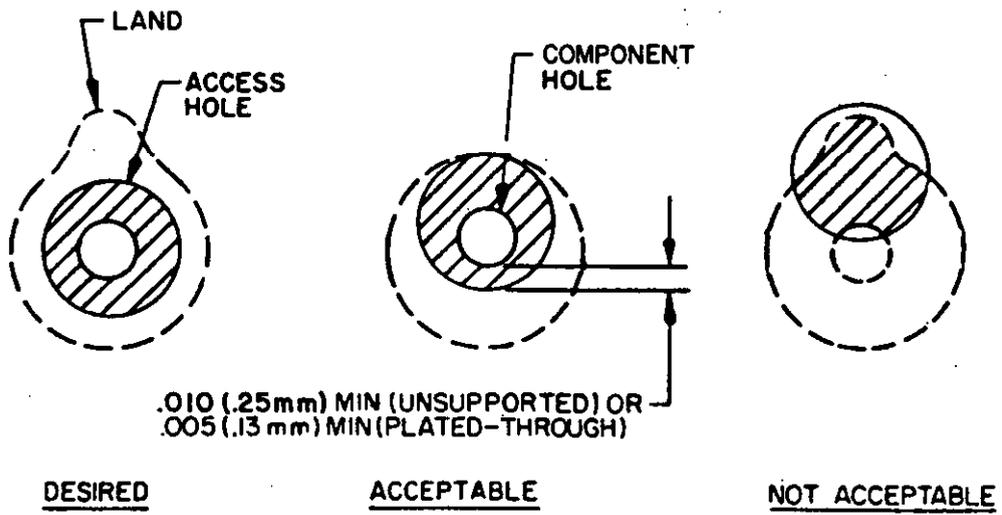


FIGURE 3. Access hole location.

3.6 Physical requirements.

3.6.1 Solder mask cure and adhesion. When tested in accordance with 4.8.4.1; the cured solder mask coating shall not exhibit tackiness, blistering or delamination, and the maximum percentage of cured solder mask lifted from the surface of the base material, conductors, and lands of the coated printed board shall be in accordance with table V.

TABLE V. Adhesion to rigid areas of type 4 boards. 1/

MATERIAL	MAXIMUM PERCENTAGE OF LIFTING	
	NON-MELTING METALS	MELTING METALS
Bare copper	5	---
Gold or Nickel	10	5
Tin/Lead Plating	---	10
Reflowed Tin/Lead	---	10
Base laminate	5	0

1/ Test coupon or production board.

3.6.2 Plating adhesion. When tested as specified in 4.8.4.2, there shall be no particles or conductor patterns removed from the board except for overhang allowed by 3.6.3.

3.6.3 Conductor edge overhang. When boards are tested in accordance with 4.8.4.3, there shall be no overhang on conductor edges plated with fused tin/lead alloy or solder coating. Conductors plated with other than these metals may have a maximum of 0.001 inch (0.3 mm) of overhang.

3.6.4 Bond strength (unsupported holes). When type 1 flexible printed-wiring is tested in accordance with 4.8.4.4, the unsupported land shall withstand five pounds pull or 500 PSI, whichever is less, after subjection to five cycles of soldering and unsoldering.

3.6.5 Folding flexibility.

3.6.5.1 Folding (certification). When flexible and rigid-flex printed-wiring is tested in accordance with 4.8.4.5, the coupon shall withstand 25 cycles of fold. There shall be no evidence of degradation or rejectable delamination. After completion of the folding test, the coupon shall be tested for electrical defects in accordance with 3.8.3. (see 3.5.9.1 and 3.5.9.2)

3.6.5.2 Folding (group B for types 1 and 2, group C for types 3, 4 and 5). When flexible and rigid-flex printed-wiring is tested in accordance with 4.8.4.5, the board shall withstand a number of folding cycles specified on the master drawing. There shall be no evidence of degradation or rejectable delamination. After completion of the folding test, the board shall be tested for electrical defects in accordance with 3.8.3 (see 3.5.9.1 and 3.5.9.2). Separation shall not occur after exposure to the folding flexibility test specified in 4.8.4.5. There shall be no propagation of the separation in the continuous flex area after exposure. The number of folding cycles shall be 25 cycles when not specified on the master drawing. The mandrel size for types 1 and 2 shall be twelve times the sum of the total ply thickness reduced to the nearest 1/8 inch. The mandrel size for types 3, 4, and 5 shall be twenty-four times the sum of the total ply thickness reduced to the nearest 1/8 inch. The mandrel shall not be less than 1/8 inch.

3.6.6 Flexibility endurance.

3.6.6.1 Endurance (certification). When flexible printed-wiring is tested in accordance with 4.8.4.6, the coupon shall endure 100,000 cycles. There shall be no evidence of electrical discontinuity, short circuits, degradation or rejectable delamination. After completion of the endurance test, the coupon shall be tested for electrical defects in accordance with 3.8.3. (see 3.5.9.1 and 3.5.9.2)

3.6.6.2 Endurance (group B for types 1 and 2, group C for types 3, 4, and 5). When flexible printed-wiring is tested in accordance with 4.8.4.6, there shall be no evidence of electrical discontinuity, short circuits, degradation, or rejectable delamination. The number of flexing cycles, flexing rate, and points of application of the flexing shall be specified on the master drawing. After completion of the endurance test, the board shall be tested for electrical defects in accordance with 3.8.3. (see 3.5.9.1 and 3.5.9.2) The number of flexing cycles shall be 100,000 cycles when not specified on the master drawing. The mandrel size for types 1 and 2 shall be twelve times the sum of the total ply thickness reduced to the nearest 1/8 inch. The mandrel size for types 3, 4, and 5 shall be twenty-four times the sum of the total ply thickness reduced to the nearest 1/8 inch. The mandrel shall not be less than 1/8 inch.

3.7 Construction integrity through microsection examination.

3.7.1 Plated-through hole. The three plated-through holes shall be examined in the vertical cross-section in accordance with 4.8.5.1. Figure 4 shows the plated-through hole structure evaluation zones; the three zone A areas shall be used to evaluate plating integrity and related measurements, the two zone B areas shall be used to evaluate laminate integrity and related measurements. Layer to layer misregistration shall not exceed the limits specified in 3.5.6. There shall be no cracks in the conductive surfaces, resin smear (types 3 and 4 only), or separation of conductor interfaces (see figure 5). The extremities of nail-heading (including foil) shall not exceed one and one-half times the foil thickness (see figure 5). Modules, plating folds, or plated glass fiber protrusions in the plated-through hole shall be considered acceptable provided the hole diameter and plating thickness is not reduced below the minimum requirements of the master drawing. Plating shall conform to the thickness requirements of 3.7.2, and shall be continuous, except for allowable plating voids (see 3.7.3). Laminate voids (see figure 8) shall not exceed the limits specified in 3.7.9. Resin recession noted after thermal stress (see figure 4) shall not be cause for rejection. Prior to thermal stress, resin recession shall not exceed the limits specified in 3.7.9.

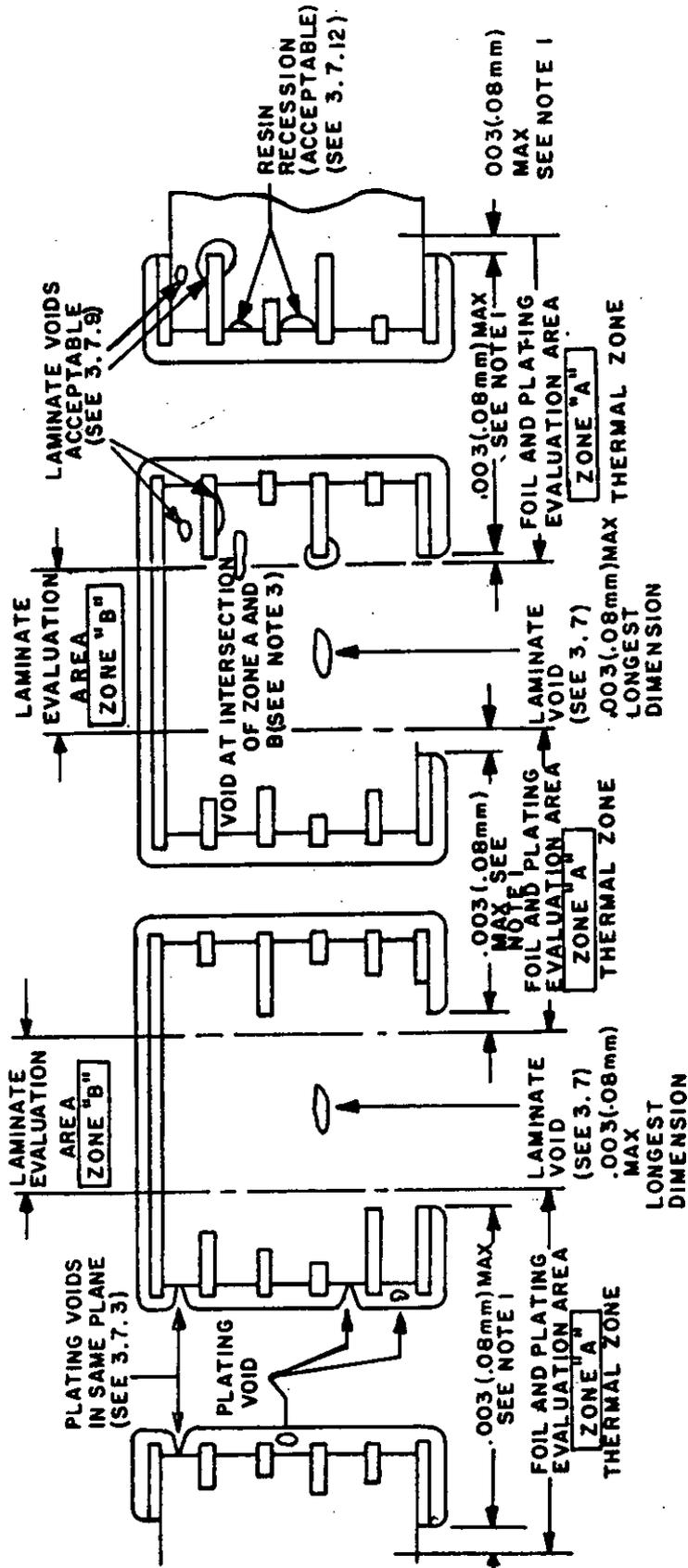
3.7.1.1 Heat-sinking planes. When examined in accordance with 3.7.1 the minimum dielectric between the plated thru hole and the metal-core shall be .0035 minimum. When tested in accordance with 4.8.6.3.3 the insulation material used for hole-fill dielectric shall provide an insulation resistance between the core and insulated plated thru holes greater than 100 Megohms.

3.7.2 Plated deposits or coating thickness. Unless otherwise specified on the master drawing plated deposits or coating thickness shall be in accordance with table VI and examined in accordance with 4.8.5.2. Plated deposits that are limited to areas other than in plated-through holes or are less than 0.000030 inch (0.00076 mm) shall not be measured by metallographic technics and shall be measured by electronic or chemical means.

TABLE VI. Plating or coating thickness.

Plating material	Surface and thru-hole plating thickness (inch)
Electroless copper	Sufficient for subsequent electrodeposition
Electrolytic copper <u>1/</u>	0.001 minimum (0.03 mm)
Gold	0.000050 minimum (0.0013 mm)
Nickel	0.0002 minimum (0.005 mm)
Tin/Lead, fused <u>2/</u>	0.0003 minimum (0.008 mm) at the surface
	0.0001 minimum (0.003 mm) inside the hole
Solder <u>2/ 3/</u>	0.0003 minimum (0.008 mm) at the surface
	0.0001 minimum (0.003 mm) inside the hole

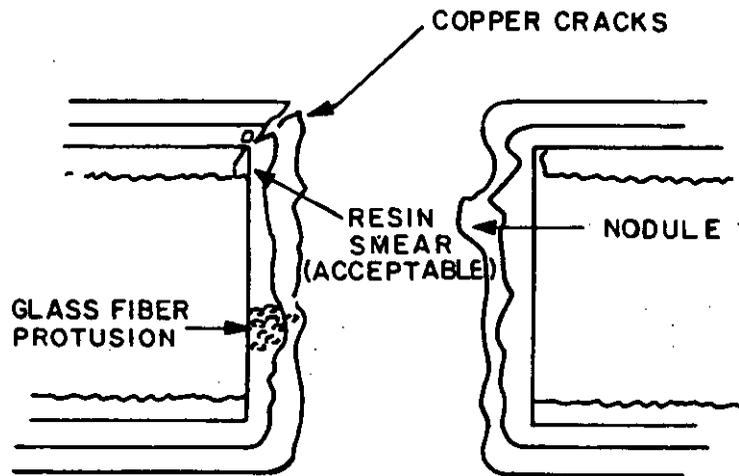
- 1/ Average value (in no case may the thickness be less than 0.0008 inch (0.020 mm) at any isolated area, excluding void areas acceptable under paragraph 3.7.3.
- 2/ Thickness shall be measured at the crest of the conductor or at the crest in the hole, as applicable. In the hole other than at the crest, minimum plating/coating thickness shall be copper coverage.
- 3/ Surface mounted component land patterns shall require additional coating. The minimum thickness of solder coating on these land patterns shall be 0.0008 inch (0.020 mm).



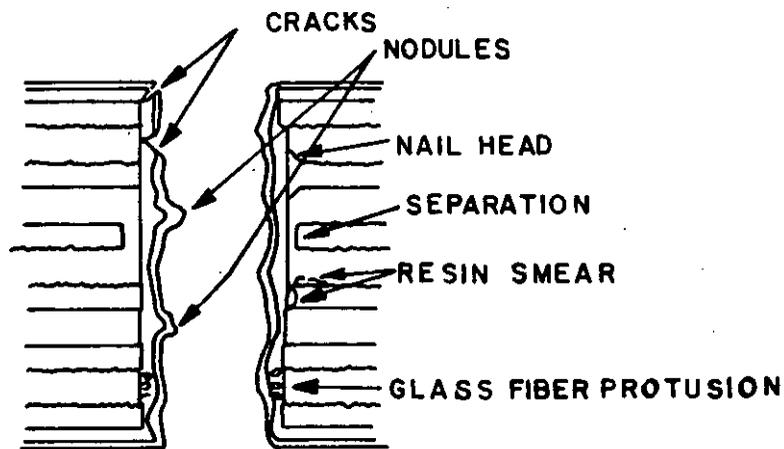
NOTES:

1. Typically beyond land edge most radially extended.
2. Laminate voids > .003 (0.08 mm) in length which extend into laminate evaluation area are rejectable.
3. Laminate voids are not evaluated in zone A, laminate voids greater than .003 (0.08 mm) that extend into zone B are rejectable.
4. Dimensions are in inches.
5. Metric equivalent is given for general information only.

FIGURE 4. Plated-through hole cross section (3 hole sample) (after thermal stress and rework simulation).



EXAMPLE (TYPE 2)



EXAMPLE (TYPE 3)

Type of Deficiency	Type(s) of Board to Which Deficiency Applies
Cracks	2, 3, 4
Nodules	2, 3, 4
Nail head	3, 4
Separation	3, 4
Resin smear	3, 4
Glass fiber protrusion	4

FIGURE 5. Workmanship (illustration of plated-through hole deficiencies).

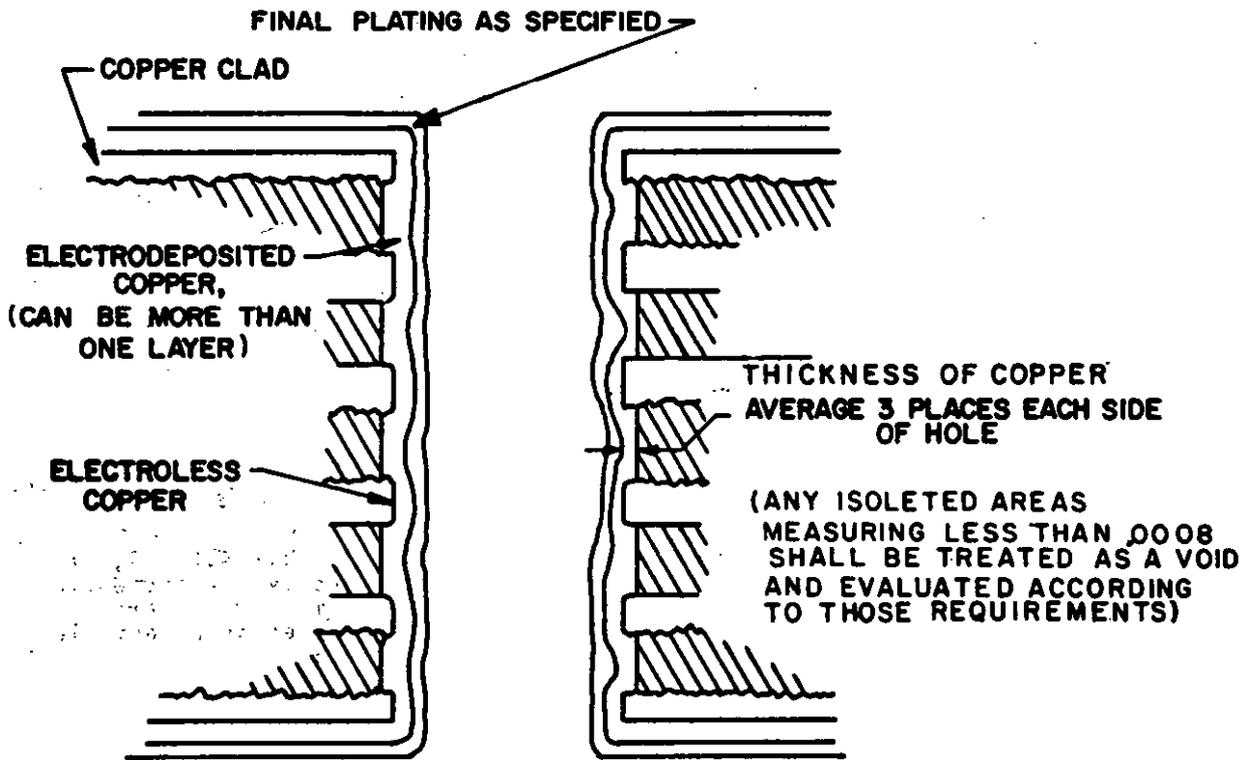


FIGURE 6. Plating thickness.

3.7.3 Plating voids. When examined in accordance with 4.8.1 and 4.8.1.2 the plated-through hole shall not exhibit more than three plating voids. The combined length of the voids shall not exceed five percent of the total wall length; the combined area of the voids shall not exceed ten percent of the surface area of the total barrel surface. No voids are allowed at the interface with a conductor or on both sides of a hole in the same plane (see figure 4).

3.7.4 Conductor thickness. The conductor thickness on flexible and rigid-flex printed-wiring shall be as specified on the master drawing and examined in accordance with 4.8.5.4.

3.7.5 Etchback or resin smear (types 3 and 4). Flexible and rigid-flex printed-wiring shall be free of smear.

3.7.5.1 Etchback. When etchback is specified on the master drawing and examined in accordance with 4.8.5.5, the etchback shall not exceed 0.003 inch (0.08 mm) or be less than 0.0001 inch (0.003 mm) with 0.0005 inch (0.013 mm) being a preferred value for etchback when measured at the interlayer connection. The etchback shall be effective on at least the top or bottom surface of each internal conductor.

3.7.5.2 Negative etchback. A negative etchback of 0.003 inches maximum shall be allowed providing that the specimen shall meet the requirements of 3.7.12 following the thermal stress test.

3.7.5.3 Hole cleaning. When etchback is not specified on the master drawing, the hole shall be cleaned to meet the requirements of 3.7.5.

3.7.6 Undercutting. When examined in accordance with 4.8.5.6, undercutting at each edge of the conductors shall not exceed the total thickness of clad and plated copper.

3.7.7 Annular ring (internal). When examined in accordance with 4.8.5.7, the minimum annular ring for internal lands for type 3 flexible and type 4 rigid-flex shall be 0.002 inch (0.05 mm). A 20 percent reduction of the minimum internal annular ring specified in 3.7.7, due to dents, nicks, and pinholes is acceptable.

3.7.8 Dielectric layer thickness. Unless otherwise specified on the master drawing, the minimum dielectric thickness shall be as defined in 3.7.8.1 and 3.7.8.2 when measured between metallic peaks in accordance with 4.8.5.8.

3.7.8.1 Rigid dielectric material (see 3.3.1). When rigid laminates are specified on the master drawing, there shall be a minimum thickness of 0.0035 inch (0.089 mm) of dielectric material between the consecutive conductor layers, when cured. The dielectric material shall be comprised of laminate, prepreg and laminate, or multiple layers of prepreg. There shall be no less than two sheets of prepreg used between each pair of adjacent conductor layers.

3.7.8.2 Flexible dielectric material (see 3.3.3 to 3.3.7). When flexible dielectric materials are specified on the master drawing, finished type 2, 3, 4, or 5 printed-wiring shall have a minimum thickness of 0.0015 inch (0.038 mm) of dielectric material between the consecutive conductor layers, when cured. The flexible dielectric shall be comprised of insulation material, adhesive, coverlayer, or any combination thereof.

3.7.9 Laminate voids. When examined in accordance with 4.8.5.9, finished flexible and rigid-flex printed-wiring shall have no delaminations (in excess of that allowed in 3.4.3). Laminate voids with the longest dimension of 0.003 inch (0.08 mm) or less shall be permitted (see figure 8). Resin recession at the outer surface of the plated-through hole barrel shall be permitted provided the maximum depth as measured from the barrel wall does not exceed 0.003 inch (0.08 mm) and the resin recession on any side of the plated-through hole does not exceed 40 percent of the cumulative base material thickness (sum of the dielectric layer thickness being evaluated) on the side of the plated-through hole being evaluated (see figure 8).

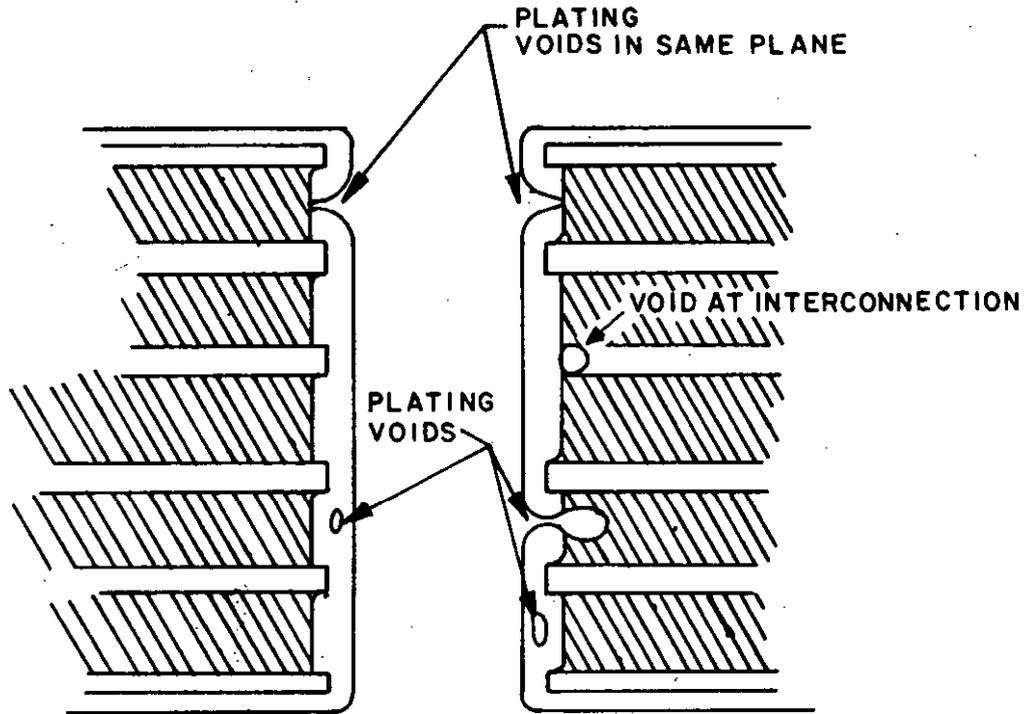


FIGURE 7. Typical plating voids.

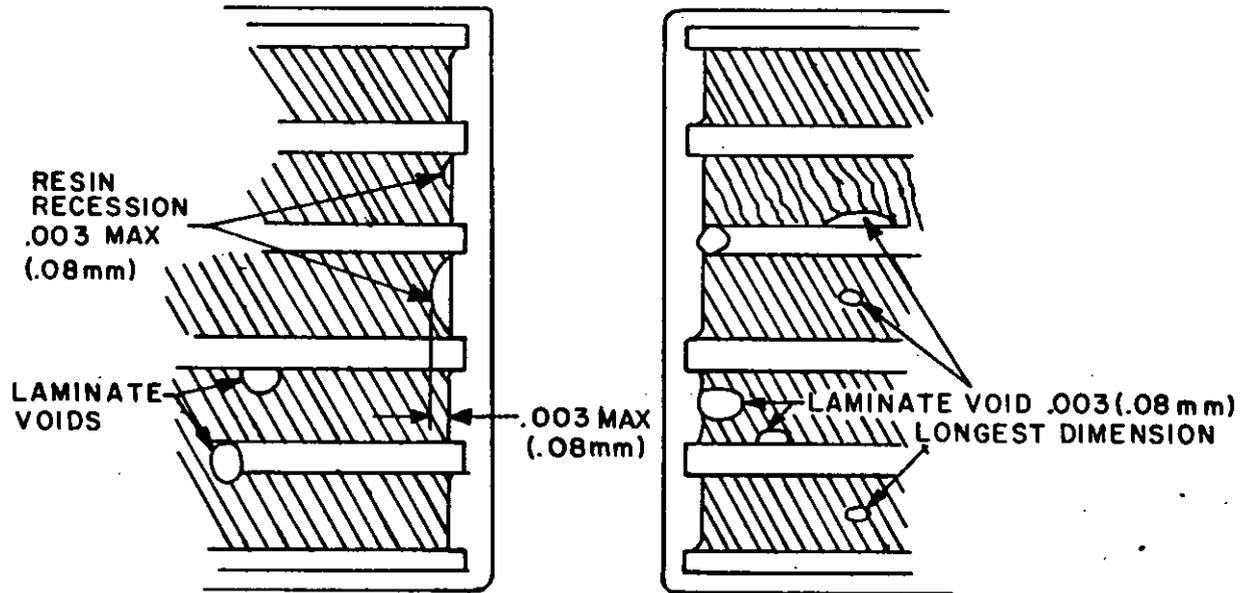


FIGURE 8. Voids (laminate).

3.7.10 Lifted lands (prior to thermal stress, rework simulation, or bond strength). When flexible and rigid-flex printed-wiring is examined as specified in 4.8.5.10, there shall be no lifted lands on the (as received) microsection specimens. As received meaning subsequent fusing but prior to thermal stress, rework simulation, or bond strength.

3.7.11 Rework simulation, plated-thru holes. Types 2, 3, or 4 flexible and rigid-flex printed-wiring shall be tested and examined in accordance with 4.8.5.11, after the fifth cycle of soldering and unsoldering of the test wire, the plated-through hole shall exhibit no plating or conductor cracks, (blistering or delamination in excess of that allowed in 3.4.3). Measling shall not exceed the class 3 allowances of IPC-R-600. Laminate voids in zone B of figure 4 less than .003 inches (.08 mm) are permitted provided all minimum dielectric requirements are met. Laminate voids are not evaluated in zone A. Laminate voids greater than .003 inches (.08 mm) inches that extend into both zones, shall be cause for rejection.

3.7.12 Thermal Stress.

3.7.12.1 Thermal stress (type 1). When tested as specified in 4.8.2.7 and examined in accordance with 4.8.1, type 1 printed-wiring specimens shall exhibit no cracking, separation of plating and conductors, lifted lands in excess of that allowed in 3.7.13, blistering or delamination in excess of that allowed in 3.4.2.

3.7.12.2 Thermal stress (type 2, 3, 4, and 5). When a type 2, 3, 4, or 5 specimen is tested in accordance with 4.8.2.7 and visually examined in accordance with 4.8.1, the specimen shall exhibit no cracking, separation of plating and conductors, blistering or delamination in excess of that allowed in 3.4.2 Measling shall not exceed the requirements of IPC-A-600, class 3. When examined in microsection as specified in 4.8.2.7 there shall be no cracks in the plating or in the internal foils. Laminate voids in Zone B (see figure 2) with the longest dimension of 0.003 inch (0.08 mm) or less shall be permitted provided the conductor spacing is not reduced below the minimum dielectric spacing, laterally or vertically, as shown on the master drawing. Resin recession at the outer surface of the plated-through hole barrel shall be permitted and is not cause for rejection.

3.7.13 Lifted lands (after thermal stress rework simulation, or bond strength). When flexible and rigid-flex printed-wiring specimens (which have been subjected to thermal stress, rework simulation or bond strength) are examined in accordance with 4.8.5.13, the maximum allowance of lifted land from the base material to the outer lower edge of the land shall be 0.001 inch (0.03 mm) on both sides of the hole. There shall be a minimum 50 percent of the land bonded for each side of the hole. (See figure 9).

3.7.14 Hole solderability. When flexible and rigid-flex printed-wiring specimens are tested in accordance with 4.8.2.7 and examined in accordance with 4.8.5.14, the specimens shall exhibit proper wetting of the wall of the plated-through hole and the associated land. Solder shall fill the plated-through hole, wetting the entire walls, and shall extend outward completely around the hole, wetting the land.

3.8 Electrical and environmental requirements.

3.8.1 Moisture and insulation resistance. When tested in accordance with 4.8.6.1, the specimen shall not exhibit (blistering, measling, or delamination in excess of that allowed in 3.4.3), (bow in excess of that allowed in 3.5.3), and shall have a minimum of 500 megohms of resistance between conductors.

3.8.2 Dielectric withstanding voltage. When tested in accordance with 4.8.6.2.1 or 4.8.6.2.2, there shall be no flashover, sparkover, or breakdown.

3.8.3 Circuitry.

3.8.3.1 Circuit continuity (certification). For certification testing, the circuit continuity test shall be in accordance with 4.8.6.3.1 and there shall be no open circuits in the specimen.

3.8.3.2 Circuit continuity (production). For production testing, the circuit continuity test shall be in accordance with 4.8.6.3.2 and there shall be no open circuits in the flexible and rigid-flex printed-wiring.

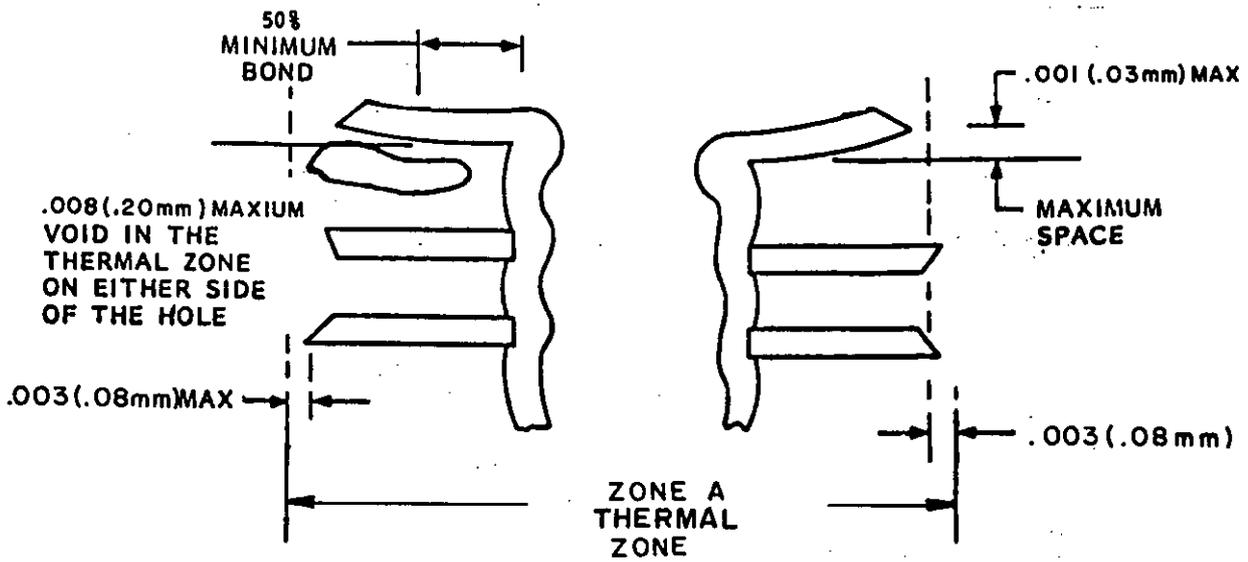


FIGURE 9. Lifted lands.

3.8.3.3 Insulation resistance (circuit shorts). When tested in accordance with 4.8.6.3.3, the insulation resistance between mutually insulated conductors shall be greater than 100 megohms.

3.8.4 Thermal shock. When tested in accordance with 4.8.6.4, the specimen shall meet the circuitry requirements of 3.8.3 and shall exhibit no evidence of rejectable delamination. The rigid areas of type 4 boards shall exhibit no blistering, measling, crazing, or delamination in excess of that allowed in 3.4.3.

3.8.5 Cleanliness. When tested in accordance with 4.8.6.5, flexible and rigid-flex printed-wiring shall be free of ionic and other contaminants. In the case of type 4 and 5 rigid-flex printed-wiring requiring permanent solder mask coating, the uncoated boards shall be free of ionic contaminants and other contaminants prior to the application of solder mask coating.

3.8.5.1 Resistivity of solvent extract (see 6.3). When noncoated (type 4 and 5 rigid area) rigid-flex printed-wiring is tested in accordance with 4.8.6.5, the resistivity shall not be less than 2×10^9 ohm-cm (or equivalent). The equivalent test method and factors specified in 6.3.1 may be used in lieu of the method specified in 4.8.6.5. Other equivalent test methods not specified in 6.3.1 may be used in lieu of 4.8.6.5 only when specifically approved by the government procuring activity. Such approval will be determined on the basis that the alternate method is demonstrated to have equal or better sensitivity and employs solvents with the ability to dissolve flux residue as does the alcohol-water solution specified in 4.8.6.5.

3.9 Repairs. Flexible and rigid-flex printed-wiring shall not be repaired. The base, conductor pattern, or coverlayer shall not be repaired.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662. Certified suppliers shall implement and maintain an inspection system which meets the requirements of MIL-I-45208 - Inspection System Requirements. The certified manufacturer is responsible for the quality of product or service provided.

4.2 Classification of inspections. The inspections specified herein are classified as follows:

- a. Materials inspection (see 4.3).
- b. Certification inspection (see 4.5).
- c. In-process inspection (see 4.6).
- d. Quality conformance inspection (see 4.7).

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table VII, used in fabricating the boards; are in accordance with the referenced requirements or reference specifications including quality assurance provisions as applicable prior to such fabrication.

4.4 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "General Requirements" of MIL-STD-202.

4.5 Supplier's certification inspection. Supplier's certification inspection shall be performed at a laboratory acceptable to the Government (see 6.5) on test specimens produced with material, equipment, and procedures that will be used in subsequent production.

4.5.1 Sample test specimens. Sample test specimens shall conform to the following for the type shown. Solder mask shall not be applied to the test specimen; stiffeners are not required. Test specimens shall meet the requirements specified in master drawing IPC-B-29/50884, as shown in the appendix.

TABLE VII. Materials inspection.

Material	Requirement paragraph	Applicable specification
Metal-clad laminate	3.3.1	MIL-P-13949
Preimpregnated bonding material (preg)	3.3.2	MIL-P-13949
Flexible clad dielectric	3.3.3	IPC-FC-241
Insulation material	3.3.4	IPC-FC-231
Coverlayer	3.3.5	IPC-FC-232
Shielding material	3.3.6	Master drawing
Adhesives (flexible)	3.3.7	IPC-FC-233
Stiffeners	3.3.8	Master drawing
Copper Foil	3.3.9	MIL-STD-2118
Plated deposits	3.3.10	IPC-CF-150
Solder	3.3.11	Master drawing
Solder flux	3.3.12	MIL-STD-2118
Solder mask	3.3.13	QQ-S-571
Marking ink	3.3.14	MIL-F-14256
		IPC-SM-840
		N/A

4.5.1.1 Sample size. The supplier shall produce six test specimens, four test specimens shall be tested at a laboratory acceptable to the Government. Two unused test specimens shall be filed and retained as reference samples by the supplier for a period of twelve months. The test report shall be submitted to the cognizant certification organization (see 6.5.1) for verification and approval.

4.5.2 Certification inspection. Certification inspection shall consist of the tests and inspections specified in table VIII.

4.5.3 Extent of certification. Certification of a particular type will be extended to cover all conductor patterns of that type produced. Certification of type 4 products shall be extended to cover all other types. Certification of type 3 products shall be extended to cover types 2 and 1. Certification of type 2 shall be extended to cover type 1. Certification to type 1 shall apply only to that type. Certification of any type shall be extended to cover the approved type with a stiffener or solder mask.

NOTE: When certifying for type 2, 3, 4, or 5, a type 1 shall also be submitted at the same time. Certification of etchback boards shall be extended to cover nonetchback boards. Nonetchback board certification shall not be extended to etchback boards.

4.5.4 Failures. One or more failures shall be cause for refusal to grant certification approval. Failure criteria for specimens shall be as specified in the applicable requirement paragraph.

TABLE VIII. Supplier certification inspection.

Inspection	Requirement paragraph	Method paragraph	Certification test specimen number (see 4.5.1.1)	Test coupon by Board type 1/ 4/					Whole specimen
				1	2	3	4	5	
Material	3.3 thru 3.3.14	4.3		Supplier certification					---
Visual: Edges (Flexible)	3.4.1.1	4.8.2.1	1, 2, 3, 4	-	-	-	-	-	X
Edges (rigid)	3.4.1.2	4.8.2.1	1, 2, 3, 4	-	-	-	-	-	X
Surface Imperfections	3.4.2	4.8.2.2	1, 2, 3, 4	-	-	-	-	-	X
Subsurface Imperfections	3.4.3	4.8.2.3	1, 2, 3, 4	-	-	-	-	-	X
Marking (missing and legibility)	3.4.4	4.8.2.4	1, 2, 3, 4	-	-	-	-	-	X
Workmanship	3.4.5	4.8.2.5	1, 2, 3, 4	-	-	-	-	-	X
Surface solderability	3.4.6	4.8.2.6	1	C-4	-	-	-	-	---
Thermal stress (type 1)	3.4.7	4.8.2.7		B-3	-	-	-	-	---
Dimensional: Hole pattern Accuracy	3.5.2	4.8.3.1	1, 2, 3, 4	-	-	-	-	-	X
Bow and twist	3.5.3	4.8.3.2	1, 2, 3, 4	-	-	-	2/ 2/	-	X
Conductor spacing	3.5.4	4.8.3.3	1, 2, 3, 4	E-5 E-3 E-1	E-5 E-3 E-1	E-5 E-3 E-1	E-5 E-3 E-1	E-5 E-3 E-1	---

TABLE VIII. Supplier certification inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Certification test specimen number (see 4.5.1.1)	Test coupon by Board type 1/ 4/					Whole specimen
				1	2	3	4	5	
Conductor pattern	3.5.5	4.8.3.4	1, 4	-	-	-	-	-	X
Layer to layer	3.5.6	4.8.3.5	1	-	B-3	B-3	B-3	B-3	---
Registration									
Annular ring (external):									
Unsupported hole	3.5.7.1	4.8.3.6	1, 4	A-3	-	-	-	-	---
Plated-through hole	3.5.7.2	4.8.3.6	1, 4	-	A-1	A-1	A-1	-	---
Adhesive on land	3.5.8	4.8.3.7							
Coverlayer separation	3.5.9.1	4.8.3.8	1, 2, 3, 4	-	-	-	-	-	X
Coverlayer wrinkles	3.5.9.2	4.8.3.9							
Coverlayer access holes	3.5.9.3	4.8.3.10							
Physical:									
Plating adhesion (tape test)	3.6.2	4.8.4.2	1, 2, 3, 4	C	C	C	C	C	---
Conductor edge overhang	3.6.3	4.8.4.3							
Bond strength (type 1)	3.6.4	4.8.4.4		A-2	-	-	-	-	---
Folding flexibility	3.6.5.1	4.8.4.5	4	-	-	H-2	H-2	H-2	---
Flexibility endurance	3.6.6.1	4.8.4.6	1	H-1	<u>3/</u>	<u>3/</u>	<u>3/</u>	<u>3/</u>	---
Construction integrity (microsection examination):									
Plated-through hole	3.7.1	4.8.5.1	1	-	B-3	B-3	B-3	-	---

TABLE VIII. Supplier certification inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Certification test specimen number (see 4.5.1.1)	Test coupon by Board type 1/ 4/					Whole specimen
				1	2	3	4	5	
Plating or coating thickness	3.7.2	4.8.5.2	1, 4	A-1 or A-5	A-1 or A-5	A-1 or A-5	A-1 or A-5	A-1 or A-5	---
Plating voids	3.7.3	4.8.5.3	1, 4	A-1 or A-5	A-1 or A-5	A-1 or A-5	A-1 or A-5	-	---
Conductor thickness	3.7.4	4.8.5.4	1, 4	A-1	A-1	A-1	A-1	A-1	---
Etchback (when required)	3.7.5	4.8.5.5	1, 4	-	-	A-1	A-1	-	---
Undercutting	3.7.6	4.8.5.6							
Annular ring (internal)	3.7.7	4.8.5.7	1, 4	-	-	A-1	A-1	A-1	---
Dielectric layer thickness:									
Rigid material	3.7.8.1	4.8.5.8	1, 4	-	-	-	A-1	A-1	---
Flexible material	3.7.8.2	4.8.5.8							
Laminate voids	3.7.9	4.8.5.9							
Lifted lands (as received)	3.7.10	4.8.5.10							
Rework simulation (plated-through hole)	3.7.11	4.8.5.11	1, 4	-	A-2	A-2	A-2	-	---
Thermal stress (types 2, 3, and 4)	3.7.12	4.8.5.12	1	-	B-3	B-3	B-3	-	---
Lifted lands	3.7.13	4.8.5.13							
Hole solderability	3.7.14	4.8.5.14	1	-	B-3	B-3	B-3	-	---
Electrical and environmental									

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TABLE VIII. Supplier certification inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Certification test specimen number (see 4.5.1.1)	Test coupon by Board type 1/ 4/					Whole specimen
				1	2	3	4	5	
Moisture and insulation resistance	3.8.1	4.8.6.1	1	E-5	E-5	E-5	E-5	E-5	---
Dielectric withstanding voltage	3.8.2	4.8.6.2.1	1	E-5	E-5	E-5	E-5	E-5	---
Circuitry:									
Continuity	3.8.3.1	4.8.6.3.1		-	D-3	D-3	D-3	D-3	---
Insulation resistance (circuit shorts)	3.8.3.3	4.8.6.3.3							
Thermal shock	3.8.4	4.8.6.4	1	-	D-3	D-3	D-3	D-3	---
Cleanliness	3.8.5 and 3.8.5.1	4.8.6.5	1, 2, 3, 4	-	-	-	-	-	X
Adhesive on land			1, 2, 3, 4	-	-	-	-	-	X
Coverlayer wrinkles			1, 2, 3, 4	-	-	-	-	-	X
Coverlayer access			1, 2, 3, 4	-	-	-	-	-	X
Solder mask (type IV only)				-	-	-	-	-	X
Flexible material			1, 4	-	-	-	A-1	A-1	---
Laminate voids			1, 4	-	-	-	A-1	A-1	---
Lifted lands	3.7.10	4.8.5.10	1, 4	-	-	-	A-1	A-1	---
Lifted lands	3.7.13	4.8.5.13	1	-	B-3	B-3	B-3	B-3	---

1/ See 1.2.1.

2/ Measurement of each rigid section.

3/ One type 1 specimen shall also be submitted.

4/ See figures 17, 19, and 22.

4.5.5 Retention of certification. To retain certification, the supplier shall forward a report at 12-month intervals to the cognizant certification organization. The cognizant certification organization shall establish the initial reporting date. The report shall consist of:

a. A summary of the results of the tests performed for inspection of product for delivery (group A) indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.

b. A summary of the results of tests performed for group B quality conformance inspection tests performed and completed during the 12-month period. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the procuring activity has not been taken, action shall be taken to remove certification.

c. A summary of the results of tests performed for group C quality conformance inspection tests performed and completed during a 6-month period. Within the 12-month interval, two group C summaries shall be submitted. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the procuring activity has not been taken, action shall be taken to remove certification. Failure to submit the report within 30 days after the end of each 12-month interval shall result in loss of certification. In addition to the periodic submission of inspection data, the supplier shall immediately notify the cognizant certifying activity when the inspection data indicates failure of the product to meet the requirements of this specification with corrective action acceptable to the procuring activity taken (see 4.7.1.4.3). In the event that no production occurred during the reporting period, the supplier shall be required to recertify (see 4.5).

d. If the flex endurance has not been run for a one year period, the supplier shall submit a Class B board to retain certification and endure 100,000 cycles.

4.6 In-process inspection. In-process inspection shall consist of the tests specified in table IX when permanent solder-mask coating is required.

TABLE IX. In-process inspection.

Inspection	Requirement paragraph	Method paragraph
Conductor pattern (type 3 and 4, prior to lamination)	3.5.5	4.8.3.4
Plating adhesion	3.6.2	4.8.4.2
Cleanliness and resistivity of solvent extract	3.8.5 and 3.8.5.1	4.8.6.5

4.6.1 Sampling plan. When permanent solder-mask coating is required, five rigid-flex printed-wiring boards shall be selected from each lot and subjected to the test of table IX immediately prior to permanent solder-mask coating. An inspection lot shall correspond to each production lot or each change of shift of work force, whichever occurs first. Production lots may be grouped based on same materials, same type or types of interfacial connections and terminations, and same processing requirements.

4.6.2 Rejected lots. When a lot is rejected as a result of a failure to pass a test specified in table IX the contractor shall withdraw the lot, take corrective action in connection with the cleaning materials and procedures, reclean the lot prior to application of permanent solder-mask coating, and resubmit the lot to the tests of table IX. Rigid-flex printed wiring boards are not acceptable if the permanent solder-mask coating has been applied to a contaminated surface.

4.7 Quality conformance inspection. Quality conformance inspection shall consist of inspections or tests on the production boards and the quality conformance test coupon area in tables XI, XII and XIII for groups A, B, and C (when required) inspections. Selection of test coupons for testing shall be in accordance with tables XI, XII and XIII. Each production board or panel of boards shall incorporate the quality conformance test coupon(s) as specified on the master drawing. The location of test coupons shall be no closer to the edge of the panel than the edge of the printed-wiring board to the edge of the panel. Unless otherwise specified, test patterns used in performing group A inspection and all unused quality conformance test coupons shall be retained for one year. Unless otherwise specified, quality conformance test coupons used in performing group B inspection shall be retained by the supplier.

4.7.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections. Except as specified in 4.7.1.4.3, delivery of products which have passed group A inspection shall not be delayed pending the results of the group B inspection. When group C inspection is required, the contract (purchase order) shall stipulate delivery restrictions.

4.7.1.1 Inspection lot. An inspection lot shall consist of all boards fabricated from the same materials, using the same processing procedures, produced under the same conditions within a maximum period of one month and offered for inspection at one time.

4.7.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table XI. One hundred percent inspection shall be performed for thermal stress, including plated-through hole and circuitry tests (see table XI).

4.7.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II except for small lot sampling. The small lot sample size shall be in accordance with table X for lots of 250 boards or less. For small lots, one or more failures shall be cause for rejection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

TABLE X. Small lot inspection plan.

Lot size	Sample size
2 to 15	2
16 to 40	3
41 to 65	5
66 to 110	7
111 to 180	10
181 to 250	20

TABLE XI. Group A inspection.

Inspection	Requirement paragraph	Method paragraph	Production board	Test coupon by board type					AQL (percent defective)	
				1/	11/	1	2	3	4	5
Material	3.3 thru 3.3.14	4.3	---	Supplier certification					---	---
Visual: Edges (flexible)	3.4.1.1	4.8.2.1	X	-	-	-	-	-	1.0	4.0
Edges (rigid)	3.4.1.2	4.8.2.1	X	-	-	-	-	-	1.0	4.0
Surface imperfections	3.4.2	4.8.2.2	X	-	-	-	-	-	1.0	4.0
Surface imperfection	3.4.3	4.8.2.3	X	-	-	-	-	-	1.0	4.0
Marking (missing and legibility)	3.4.4	4.8.2.4	X	-	-	-	-	-	1.0	4.0

TABLE XI. Group A inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Production board	Test coupon by board type					AQL (percent defective)		
				1/	11/	1	2	3	4	5	major
Workmanship	3.4.5	4.8.2.5	X	-	-	-	-	-	-	1.0	4.0
Surface solderability	3.4.6	4.8.2.6	---	2/	B	B	B	B	B	1.0	4.0
Thermal stress (type 1) 3/	3.4.7	4.8.2.7	---	4/	-	-	-	-	-	1.0	4.0
Dimensional:											
Hole pattern accuracy	3.5.2	4.8.3.1	X	-	-	-	-	-	-	1.0	4.0
Bow and twist	3.5.3	4.8.3.2	X	-	-	-	-	-	-	1.0	4.0
Conductor spacing	3.5.4	4.8.3.3	X	-	-	-	-	-	-	1.0	4.0
Conductor pattern	3.5.5	4.8.3.4	X	-	-	-	-	-	-	1.0	4.0
Layer to layer registration	3.5.6	4.8.3.5		-	B	B	B	B	B	1.0	4.0
Annular ring (external):											
Unsupported hole	3.5.7.1	4.8.3.6	---	A	-	-	-	-	-	1.0	4.0
Plated-through hole	3.5.7.2	4.8.3.6		-	A	A	A	-	-	1.0	4.0
Adhesive on land	3.5.8	4.8.3.7		-	A	A	A	-	-	1.0	4.0
Coverlayer separation	3.5.9.1	4.8.3.8	X	-	-	-	-	-	-	1.0	4.0
Coverlayer wrinkles	3.5.9.2	4.8.3.9	X	-	-	-	-	-	-	---	---
Coverlayer access holes	3.5.9.3	4.8.3.10	X	-	-	-	-	-	-	---	---
Physical:											
Solder mask (cure and adhesion)	3.6.1	4.8.4.1		-	-	-	G	-	-	1.0	4.0
Plating adhesion (tape test) 3/	3.6.2	4.8.4.2		2/	C	C	C	C	C	1.0	4.0
Conductor edge overhang	3.6.3	4.8.4.3	X	-	-	-	-	-	-	1.0	4.0

TABLE XI. Group A inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Production board	Test coupon by board type					AQL (percent defective)		
				1/	11/	1	2	3	4	5	major
Construction integrity 8/ (microsection examination)											
Plated-through hole	3.7.1	4.8.5.1	---	-	B	B	B	-		<u>8/</u>	
Plating or coating thickness	3.7.2	4.8.5.2	---	B	B	B	B	B		<u>8/</u>	
Plating voids	3.7.3	4.8.5.3	---	B	B	B	B			<u>8/</u>	
Conductor thickness	3.7.4	4.8.5.4	---	4/	B	B	B	B		<u>8/</u>	
Etchback (when required)	3.7.5	4.8.5.5	---	-	-	B	B	-		<u>8/</u>	
Undercutting	3.7.6	4.8.5.6	---	-	-	-	-	-		---	---
Annular ring (internal)	3.7.7	4.8.5.7	---	-	-	B	B	B		<u>8/</u>	
Dielectric layer thickness:											
Rigid material	3.7.8.1	4.8.5.8	---	-	-	-	B	B		<u>8/</u>	
Flexible material	3.7.8.2	4.8.5.8	---	4/	B	B	B	B		<u>8/</u>	
Laminate voids	3.7.9	4.8.5.9	---	-	-	-	-	-		---	---
Lifted lands (as received)	3.7.10	4.8.5.10	---							---	---
Thermal stress (types 2, 3, 4) 3/	3.7.12	4.8.5.12	---	-	B	B	B	-		<u>8/</u>	
Lifted lands	3.7.13	4.8.5.13	---	-	-	-	-	-		---	---
Hole solderability	3.7.14	4.8.5.14	---	-	B	B	B	-		<u>8/</u>	
Electrical and environmental:											

TABLE XI. Group A inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Production board	Test coupon by board type					AQL (percent defective)		
				1/	11/	1	2	3	4	5	major
Circuitry: <u>6/</u>											
Continuity	3.8.3.2	4.8.6.3.2	<u>7/</u> , <u>9/</u>	-	-	-	-	-		100% inspection	
Insulation resistance (circuit shorts)	3.8.3.3	4.8.6.3.3	<u>10/</u>	-	-	-	-	-		100% inspection	

1/ See 1.2.1.

2/ Coupon C or Production Board for type 1.

3/ Based on a per panel basis.

4/ Coupon B or Production Board for type 1.

5/ 1.0% major; 4.0% minor for type 1 or 2; 100% for type 3, 4, or 5.

6/ Based on each board produced.

7/ If required on the contract.

8/ 1 coupon per panel shall be microsectioned for Type 3 and 4 boards. The number of coupons to be microsectioned for Type 3 and 4 boards. The number of coupons to be microsectioned for Type 2 boards shall be based on a statistical sample per MIL-STD-105, general inspection level II of the number of panels produced and shall meet an AQL of 2.5 percent defective.

9/ For types 1 and 2.

10/ For types 3, 4, and 5.

11/ See figures 17, 19, and 22.

4.7.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier may screen out the defective units and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.7.1.3 Group B inspection. Group B inspection shall consist of the examinations or tests specified in table XII at a laboratory which has obtained laboratory suitability status from the cognizant certifying activity (DESC-EQ). Group B inspection shall be made on sample units selected randomly from inspection lots which have passed group A inspection.

TABLE XII. Group B inspection.

Inspection	Requirement paragraph	Method paragraph	Test coupon by board type					Production board
			1/	3/	1	2	3	
Stiffener adhesion	3.3.8	4.8.4.7	F	F	F	F	F	---
Marking ink	3.3.14	4.8.4.8	-	-	-	-	-	X
Bond strength (type 1)	3.6.4	4.8.4.4	B	-	-	-	-	---
Folding	3.6.5.2	4.8.4.5	F	F	-	-	-	---
Flexibility endurance <u>2/</u>	3.6.6.2	4.8.4.6	F	F	-	-	-	---
Rework simulation	3.7.11	4.8.5.11	-	B	B	B	-	---
Moisture and insulation resistance	3.8.1	4.8.6.1	E	E	E	E	E	---

TABLE XII. Group B inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Test coupon by board type 1/ 3/					Production board
			1	2	3	4	5	
Dielectric withstanding voltage	3.8.2	4.8.6.2.2	E	E	E	E	E	---
Cleanliness	3.8.5 and 3.8.5.1	4.8.6.5	-	-	-	-	-	X

1/ See 1.2.1.

2/ For Class B boards only (see 1.2.2).

3/ See figures 17, 19, and 22.

4.7.1.3.1 Sampling plan. Two production boards of the most complex pattern of each type and their associated quality conformance test coupons shall be selected from lots which have passed group A inspection. The sampling shall be on a monthly basis. "Complex" shall refer to the materials used; dielectric layer thickness; composite board thickness; number of layers; conductor widths and spacings; intricacy of patterns; size, quantity, quality and positioning of holes; tolerancing of any or all of the above; and all combinations of the above with respect to their manufacturing difficulty, and their effects upon the consistent ability of the boards to meet the requirements of group B. Unless otherwise specified by the procuring activity, "complexity" shall be determined by the manufacturer, using the definition of complexity given above, subject to approval by the cognizant inspection activity.

4.7.1.3.2 Failures. If one or more sample units fail to pass group B inspection, the sample shall be considered to have failed.

4.7.1.3.3 Disposition of sample units. Boards which have been subjected to and which have passed group B inspection may be delivered on the contract or purchase order.

4.7.1.3.4 Noncompliance. Unless otherwise indicated in the contract or purchase order, if a sample fails to pass group B inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same materials, processes, and so forth, and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Group A inspection may be reinstated; however, final acceptance shall be withheld until the group B reinspections have shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the certifying activity.

4.7.1.4 Group C inspection. When specified by the contract or purchase order, group C inspection shall consist of the inspection or test specified in table XIII. Group C inspection shall be on sample units selected from inspection lots which have passed groups A and B inspection.

TABLE XIII. Group C inspection.

Inspection	Requirement paragraph	Method paragraph	Test coupon by board type 1/ 3/					Production board
			1	2	3	4	5	
Folding flexibility 2/	3.6.5.2	4.8.4.5	-	-	F	F	F	2/
Flexibility endurance	3.6.6.2	4.8.4.6	-	-	F	F	F	2/

1/ See 1.2.1.

2/ Coupon F or Production board.

3/ See figures 17, 19, and 21.

4.7.1.4.1 Sampling plan. As defined in the contract or purchase order, every 6-month period, one production board or the quality conformance test coupon specified in table XIII shall be selected from lots which have passed both groups A and B inspection and shall be subjected to the inspection or test specified in table XIII.

4.7.1.4.2 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the purchase order.

4.7.1.4.3 Noncompliance. Unless otherwise indicated in the contract or purchase order, if a sample fails to pass group C inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same materials, processes, and so forth, and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Groups A and B inspection may be reinstated; however, final acceptance shall be withheld until the group C reinspections have shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the certifying activity. The noncompliance shall be specified on the master drawing.

4.8 Methods of inspection.

4.8.1 Visual and dimensional inspection. Flexible and rigid-flex printed-wiring shall be inspected to verify that the design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.4, 3.5 and 3.6) and the master drawing (see 3.1). Features of the board shall be inspected using an optical apparatus or aid which provides a minimum magnification of 3 diopters (approximately 3/4X). Referee inspection of board features shall be accomplished at a magnification of 10X.

4.8.1.2 Microsection examination. Microsection examinations (such as plated-through hole, plating thickness, foil thickness, and so forth) shall be accomplished by using methods in accordance with IPC-TM-650, method 2.1.1.

4.8.1.2.1 Microsectioning and examining. Specimens to be microsectioned shall be microsectioned in accordance with IPC-TM-650, Method 2.1.1. Plated-through holes shall be microsectioned in the vertical plane at the center of the hole and examined for foil and plating integrity at a magnification of 100X \pm 5%. Referee examinations shall be accomplished at a magnification of 200X \pm 5 percent. Each side of the hole shall be viewed independently. A minimum of one microsection containing at least three holes shall be made for each sample tested. Examination for laminate thickness, foil thickness, plating thickness, solder coatings, lay-up orientation, laminating and plating voids, and so forth shall be accomplished at magnifications specified above. Plating thickness below 0.00030 inch (0.00076 mm) shall not be measured using metallographic techniques.

4.8.2 Visual inspections.

4.8.2.1 Edges (rigid and flexible) (see 3.4.1.1 and 3.4.1.2). The edges of flexible and rigid sections shall be inspected in accordance with 4.8.1.

4.8.2.2 Surface imperfections (see 3.4.2). Surface imperfections shall be inspected in accordance with 4.8.1.

4.8.2.3 Subsurface imperfections (see 3.4.3). Subsurface imperfections shall be inspected in accordance 4.8.1.

4.8.2.4 Marking (see 3.4.4). The marking shall be inspected in accordance with 4.8.1.

4.8.2.5 Workmanship (see 3.4.5). Inspection of flexible and rigid-flex printed-wiring for workmanship shall be inspected in accordance with 4.8.1.

4.8.2.6 Surface solderability (see 3.4.6). Specimens shall be tested for surface solderability in accordance with IPC-S-801.

4.8.2.7 Thermal stress (solder float) (see 3.4.7 and 3.7.12). The specimens shall be conditioned at 250 to 300°F (121 to 149°C) for minimum of six hours to remove moisture. Note: More complex specimens may require longer conditioning times. After conditioning, place specimens in a dessicator on a ceramic plate to cool. The specimens shall then be fluxed (type RMA per MIL-F-14256) and floated in a solder bath of composition Sn 60, 62, or 63 percent maintained at 550°F ± 10°F (287°C ± 6°C) for a period of 10 seconds. Solder temperature shall be measured at a probe depth not to exceed 1.00 inch (25.4 mm) from the molten surface of the solder. After thermal stressing, place specimens on a piece of insulator to cool. Type 1 shall be examined in accordance with 4.8.1 and meet the requirements of 3.4.7. Types 2, 3 and 4 shall be examined in accordance with 4.8.5.12 and meet the requirements of 3.7.12.

4.8.3 Dimensional inspections.

4.8.3.1 Hole pattern accuracy (see 3.5.2). Hole pattern accuracy shall be examined in accordance with 4.8.1.

4.8.3.2 Bow and twist (see 3.5.3). Bow, twist, or any combination thereof, shall be determined by physical measurement and percentage calculation. The calculation shall be based on the formula:

$$\% = \frac{D}{L} \times 100, \text{ where:}$$

D = the measured deviation, worst case, of the board mounting surface from a true plane best approximating the mounting surface. Use the cumulative plus and minus planer deviations.

L = the measured breadth dimension of the board along the direction of the board's greatest degree of curvature.

4.8.3.2.1 Practical measurement of "D". Stand the assembly on two extremities of the board, at a zero planar reference. Rock the board so the two other points of greatest deviation from zero are equally displaced from zero ("twist" predominant), or rock the board so the other diagonal extremes closest to zero are equally displaced from zero ("bow" predominant). Measure the displacement from zero at the point on the mounting surface farthest from zero.

4.8.3.2.2 Practical measurement of "L".

- a. Twist predominant; measure the diagonal of the board along the direction of greatest apparent curvature.
- b. Bow predominant; measure the width or length of the board along the side most greatly curved.

4.8.3.3 Conductor spacing (see 3.5.4). Conductor patterns shall be examined in accordance with 4.8.1 and 4.8.5.1.

4.8.3.4 Conductor pattern (see 3.5.5). Conductor patterns shall be examined in accordance with 4.8.1.

4.8.3.5 Layer to layer registration (see 3.5.6). Layer to layer registration shall be determined by visual evaluation of a minimum of two registration coupons, positioned at diagonally opposing corners of the production panel. The design of the coupon is optional but shall be positioned by the manufacturer within the accuracy described for the production master (see MIL-STD-2118). When microsectioning is used to evaluate layer to layer registration (see figure 10), the layer to layer registration shall be measured at a magnification of 100X ± 5 percent after vertical microsectioning of two plated-through hole samples as detailed in 4.8.1.2.1. One sample shall be vertically cross-sectioned parallel to the board length, and one vertically cross-sectioned perpendicular to the board length. These microsections shall be evaluated by computing the difference of centerlines of all lands of all conductor layers shifted to extreme positions (see figure 10).

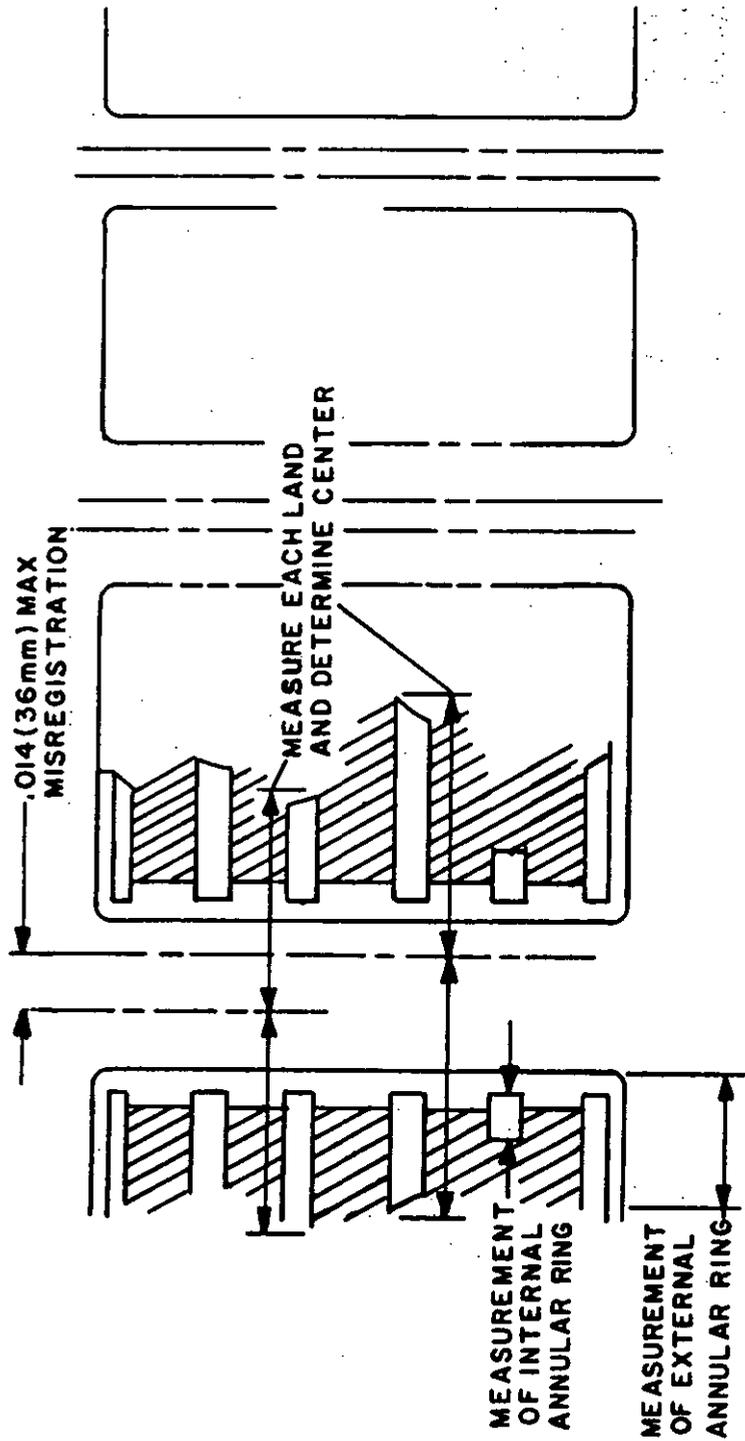


FIGURE 10. Layer to layer registration and annular ring measurement (3 hole sample).

4.8.3.6 Annular ring (external) (unsupported and plated-through hole) (see 3.5.7). When examined in accordance with 4.8.1, the measurement of the annular ring on external layers is from the inside surface (within the hole) of the plated hole or unsupported hole to the outer edge of the annular ring on the surface of the board (see figure 10).

4.8.3.7 Adhesive on land (see 3.5.8). Examination for extruded adhesive on lands shall be in accordance with 4.8.1.

4.8.3.8 Coverlayer separation (see 3.5.9.1). Examination for coverlayer separation shall be in accordance with 4.8.1.

4.8.3.9 Coverlayer wrinkles (see 3.5.9.2). Examination for coverlayer wrinkles shall be in accordance with 4.8.1.

4.8.3.10 Coverlayer access holes (see 3.5.9.3). Examination of coverlayer access holes shall be in accordance with 4.8.1.

4.8.4 Physical inspections.

4.8.4.1 Solder mask cure and adhesion (see 3.6.1). The permanency and adhesion of cured solder mask to rigid-flex printed-wiring shall be determined in accordance with IPC-SM-840. Testing shall be done prior to and subsequent to soldering using a RMA flux (or equivalent) in accordance with MIL-F-14256 and defluxing using Trichlorethane 1, 1, 1 (or equivalent).

4.8.4.2 Plating adhesion (see 3.6.2). A strip of pressure sensitive cellulose tape conforming to type 2, class A of L-T-90, 1/2 inch wide and 2 inches long shall be placed across the surface of the conductor pattern and pressed firmly to the conductors eliminating air bubbles. A tab shall be left for pulling. The tape shall be pulled with a snap pull at an angle of approximately 90° to the board. Tape shall be applied to, and removed from three different locations on each board tested. When edge board contacts are part of the pattern, at least one pull must be on the contacts. Fresh tape shall be used for each pull. If overhang metal breaks off (slivers) and adheres to the tape, it is evidence of overhang (see 3.6.3), but not a plating adhesion failure (see 3.6.2).

4.8.4.3 Conductor edge overhang (see 3.6.3). The extent of overhang, on conductors plated with gold, shall be determined by measuring the conductor width before and after mechanically removing the overhang metal. If a referee test is required, cross-sectioning of the conductor shall be performed. The procedure for removing gold overhang metal, for this test, shall be as follows:

- a. Wet the board in tap water at approximately room temperature.
- b. While wet, brush the board with a brass wire brush to remove the overhang metal. Brush in the direction of the functional line, using moderate pressure.

4.8.4.4 Bond strength (unsupported holes) (see 3.6.4). Three holes per coupon shall be tested. The inserted wire lead shall have a diameter whose difference between the hole diameter is no greater than 0.020 inch (0.51 mm) or less than 0.010 inch (0.25 mm). Insert wires in holes and solder by machine or by hand, as applicable. The wires shall not be clinched. Subject wires to five cycles of unsoldering and soldering by hand after the initial machine or hand soldering.

During the five cycles the wires shall be completely removed during each unsoldering operation and replaced during each soldering operation. A 60-watt conventional soldering iron operating at a reduced voltage sufficient to produce a tip temperature of 450 F to 500 F (232 C to 260 C), shall be used for the unsoldering and soldering operation. The iron shall be applied to the leads, not the foil, and shall be applied only as long as is necessary to perform the unsoldering and soldering operation. Following the fifth cycle, the flexible printed-wiring shall then be clamped in the jaws of the bond tester. A pull at the rate of two inches per minute shall be applied to the wire on the land side (opposite component side) of an unsupported hole. The pull shall be applied until the specified load (see 3.6.4) is reached. The tensile pull of 500 pounds per square inch for a land shall be in accordance with the following formula:

$$\frac{4L}{\pi (d_2^2 - d_1^2)} > 500 \text{ PSI}$$

where: d_1 = hole diameter
 d_2 = land diameter
 L = load

The load shall be applied perpendicular to the major surface of the land until the required poundage is reached or a failure occurs. Breaking of a wire, or wire pullout shall not be considered as a failure, but the wire shall be resoldered and pulled again. It shall be considered a failure when a land around an unsupported hole is loosened.

4.8.4.5 Folding flexibility (see 3.6.5). The folding test shall be in a manner shown in figure 11. The folding test requirements shall be as specified on the master drawing. The minimum parameters shall be specified:

- a. direction of bend
- b. degree of bend
- c. number of fold cycles
- d. diameter of mandrel (for certification diameter of mandrel twelve times overall material thickness for type 1 and 2 and twenty-four times overall material thickness for types 3 and 4)
- e. points of application

A fold cycle shall be defined as taking one end of the specimen and folding it around a mandrel and then unfold back to the original starting position, traveling 180° in one direction and 180° in the opposite direction. A fold cycle may also be defined as folding (using opposite ends) the ends toward each other (fold the same direction) and then unfold back to the original starting position, with each end traveling 90° in one direction and 90° in the opposite direction. The specified number of fold cycles shall be performed with the mandrel placed in contact with the specimen on one side and then again with the mandrel placed in contact with the specimen on the opposite side. After completion of the folding test, both directions, the flexible or rigid-flex printed-wiring shall be tested for electrical defects in accordance with 3.8.3.

4.8.4.6 Flexibility endurance (see 3.6.6). The flexibility endurance test shall be in accordance with IPC-TM-650, Method 2.4.3.1. The following exceptions shall apply:

- a. Universal Mfg., Fatigue Ductility Flex Tester, Model 2 FDF shall be used instead of Model FDF-1.
- b. Specimens to be tested shall be in accordance with Table VIII or XII, as applicable.

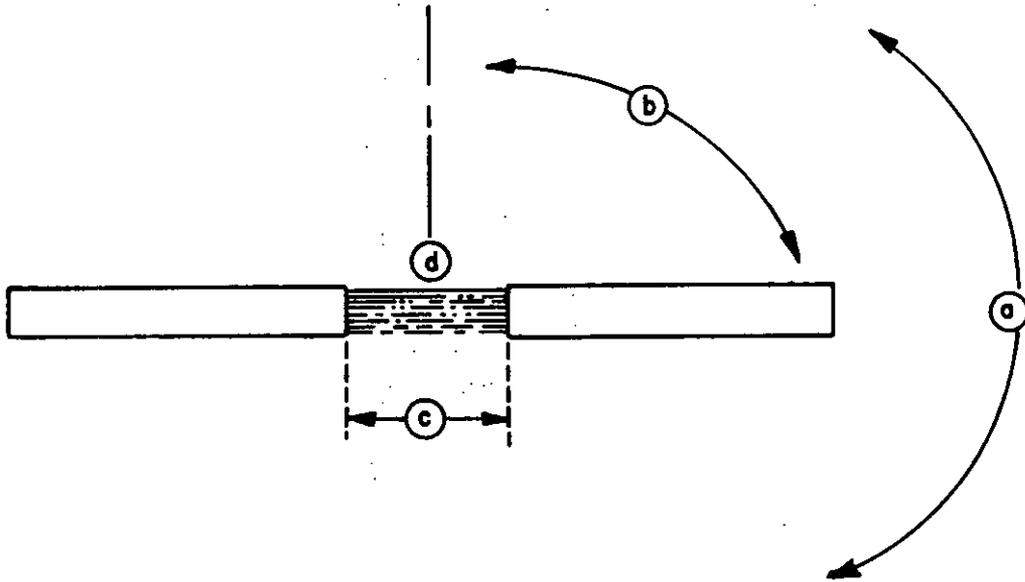


FIGURE 11. Folding test.

The flexibility endurance test requirements for certification shall be as specified in 3.6.6.1 and shall be as specified on the master drawing for group B tests. The minimum parameters specified on the master drawing shall be:

- a. Number of flex cycles.
- b. Diameter of mandrel.
- c. Flexing rate.
- d. Points of application.
- e. Travel of loop (one inch minimum).

After completion of the endurance test, the flexible printed-wiring shall be tested for electrical defects in accordance with 3.8.3. The flexibility endurance test may be performed using an alternate method specified in 6.4.

4.8.4.7 Stiffener adhesion (see 3.3.8). Using a sharp instrument such as a scalpel or razor blade, cut a pattern approximately one-half inch wide by three inches long through the flexible printed-wiring to the stiffener so that approximately half-way through the peeling operation the sample will be perpendicular to the pull. Pull at a rate of $2 \pm 1/4$ -inch per minute. Take readings at the beginning of the pull, middle and end of the pull and average these readings to determine acceptability. The peel strength between the flexible printed-wiring and the stiffener shall be a minimum 3 pounds per inch of width.

4.8.4.8 Marking ink (see 3.3.14). Marking ink used on flexible and rigid-flex printed-wiring shall be tested in accordance with MIL-STD-202, Method 215A. There shall be no evidence of physical damage and the marking shall remain legible.

4.8.5 Construction integrity inspections (microsection examination).

4.8.5.1 Plated-through hole (see 3.7.1). Plated-through holes shall be examined and microsectioned in accordance with 4.8.1.2 and 4.8.1.2.1 and meet the requirements of 3.7.1.

4.8.5.2 Plating thickness (see 3.7.2). Plating or coating thickness on the surface and in the plated-through hole shall be examined in accordance with 4.8.5.1. Plating or coating measurements in the plated-through hole shall be reported as the average of three determinations per each side of the hole. Isolated thick or thin sections shall not be used for averaging. Platings that are limited to areas other than in plated-through holes or are less than 0.00030 inch (0.00076 mm) shall be measured by electronic or chemical means.

4.8.5.3 Plating voids (see 3.7.3). Plating voids shall be examined in accordance with 4.8.5.1.

4.8.5.4 Conductor thickness (see 3.7.4). Conductor thickness shall be examined in accordance with 4.8.5.1.

4.8.5.5 Etchback or smear removal (see 3.7.5). Etchback or smear removal shall be examined in accordance with 4.8.5.1.

4.8.5.6 Undercutting (see 3.7.6). Undercutting shall be examined in accordance with 4.8.5.1.

4.8.5.7 Annular ring (internal) (see 3.7.7). The internal annular ring shall be examined in accordance with 4.8.5.1 and measured as shown on figure 10. This measurement shall apply to all internal lands, both sides of the hole, for all three holes.

4.8.5.8 Dielectric layer thickness (see 3.7.8). Dielectric layer thickness shall be examined in accordance with 4.8.5.1. The measurements shall be made at the closest point between consecutive conductor layers.

4.8.5.9 Laminate voids (see 3.7.9). Laminate voids shall be examined in accordance with 4.8.5.1.

4.8.5.10 Lifted lands (see 3.7.10). Lifted lands on the (as received) microsection specimen shall be examined in accordance with 4.8.5.1.

4.8.5.11 Rework simulation, plated-through hole (see 3.7.11). Rework simulation of plated-through holes shall be in accordance with IPC-TM-650, Method 2.4.36. Following the fifth cycle of soldering and unsoldering of the test wire, the plated-through holes shall be microsectioned and examined in accordance with 4.8.5.1 and meet the requirements of 3.7.11. The rework simulation shall be performed after stabilizing of the coupons at temperatures of 59°F to 95°F (15°C to 35°C) and relative humidity of 40 to 85 percent for a period of 24 hours.

4.8.5.12 Thermal stress (types 2, 3, and 4) (see 3.7.12). Thermal stress test shall be in accordance with 4.8.2.7. After thermal stressing and cooling of the specimens, they shall be microsectioned and examined in accordance with 4.8.5.1 and meet the requirements of 3.7.12.

4.8.5.13 Lifted lands (see 3.7.13). Types 2, 3, and 4 specimens, which have been subjected to tests specified in 4.8.2.7 or 4.8.5.11, shall be examined for lifted lands in accordance with 4.8.5.1. Type 1 specimens, which have been subjected to tests specified in 4.8.2.7 or 4.8.4.3, shall be examined for lifted lands in accordance with 4.8.1. Referee inspection for lifted lands may be accomplished by microsectioning of the unsupported holes in accordance with 4.8.1.2.1.

4.8.5.14 Hole solderability (see 3.7.14). The specimen shall be examined for hole solderability in accordance with 4.8.5.1.

4.8.6 Electrical and environmental inspections.

4.8.6.1 Moisture and insulation resistance (see 3.8.1). The moisture and insulation resistance for flexible and rigid-flex printed-wiring shall be performed in accordance with IPC-TM-650, Method 2.6.3. Conformal coating in accordance with MIL-I-46058 shall be applied to the external conductors prior to chamber exposure. All layers shall have a 100 ±10 volts dc polarizing voltage applied during chamber exposure. Final measurements shall be made at room temperature within two hours after removal from the test chamber. If mealing of the conformal coating occurs and the test specimen fails to pass the requirements, the test shall be rerun.

4.8.6.2 Dielectric withstanding voltage (see 3.8.2).

4.8.6.2.1 Dielectric withstanding voltage (certification). The dielectric withstanding voltage test shall be performed in accordance with MIL-STD-202, Method 301. The following details and exceptions apply:

- a. Magnitude of test voltage: 500 volts ac
- b. Duration of application of test voltage: 60 seconds

4.8.6.2.2 Dielectric withstanding voltage (production). The dielectric withstanding voltage test shall be performed in accordance with MIL-STD-202, Method 301. The following details and exceptions apply:

- a. Magnitude of test voltage: 1000 volts dc
- b. Duration of application of test voltage: 30 seconds
- c. Points of application: The dielectric withstanding voltage shall be applied between all common portions of each conductor pattern and all adjacent common portions of each conductor pattern. The voltage shall be applied between conductor patterns of each layer and the electrically isolated pattern of each adjacent layer.

4.8.6.3 Circuitry (see 3.8.3).

4.8.6.3.1 Continuity testing (certification) (see 3.8.3.1). A current of one ampere shall be passed through each conductor or group of interconnected conductors of the coupon for 30 seconds by applying electrodes on the terminals at each end of the conductor or group of conductors.

4.8.6.3.2 Continuity testing (production) (see 3.8.3.2). A current shall be passed through each conductor or group of interconnected conductors by applying electrodes on the terminals at each end of the conductor or group of conductors. The current passed through the conductors shall not exceed those specified in MIL-STD-2118 for the smallest conductor in the circuit.

4.8.6.3.3 Insulation resistance (circuit shorts) (see 3.8.3.3). The resistance test shall be performed in accordance with MIL-STD-202, Method 302. The following details and exceptions apply:

- a. Test condition A.
- b. Electrification time:
 - (1) Certification - 1 minute.
 - (2) Production - 30 seconds, unless automatic testing is used in which case the machine parameters will be allowed.

4.8.6.4 Thermal shock (see 3.8.4). The specimens shall be tested for thermal shock in accordance with method 107, test condition B-3, of MIL-STD-202. Note: The specimens shall be subjected to each specified temperature extreme for a minimum of 15 minutes, maximum of 17 minutes. This test is applicable for base material types GF, and GI. Transfer time between chambers shall be such that the ambient temperature shall reach the specified temperature within two minutes after the specimen has been transferred to the appropriate chamber. After completion of 100 thermal cycles, a circuitry test shall be performed in accordance with 4.8.6.3.

4.8.6.5 Cleanliness and resistivity of solvent extract (see 3.8.5 and 3.8.5.1). A convenient-sized funnel shall be positioned over an electrolytic beaker. The printed-wiring board shall be suspended within the funnel. A wash solution of 75 percent by volume of ACS reagent grade isopropyl alcohol and 25 percent by volume of distilled water shall be prepared. The wash solution must have resistivity equal to or greater than 6×10^6 ohm - centimeters (see 6.3). The wash solution shall be directed in a fine stream from a wash bottle onto both sides of the printed-wiring board until 100 milliliters of the wash solution is collected for each 10 square inches of board surface (including both sides of the board). The time required for the wash activity shall be a minimum of one minute. It is imperative that the initial washings be included in the sample to be measured for resistivity. The resistivity of the collected wash solution shall be measured with a conductivity bridge or other instrument of equivalent range and accuracy. The alternate test methods given in 6.3.1 may be used to perform the cleanliness test.

4.8.6.5.1 Cleanliness (Organic contaminants). The printed-wiring board shall be tested in accordance with IPC-TM-650, Method 2.3.38 and Method 2.3.39.

4.8.7 Classification of defects. Unless otherwise specified on the master drawing, the classification of defects for visual, dimensional, physical, construction integrity, and electrical and environmental inspections shall be as specified herein. A suggested coding system is indicated to allow the use of an automated data processing system so that a particular coded number will be applicable only to a specific kind of defect. The letter "A" is for major defects and the letter "B" for minor defects.

MAJOR DEFECTSDefect
Code
Number

A101	Improper configuration of flexible printed-wiring (see master drawing).
A102	Improper location of mounting holes (usually nonplated-through holes, see master drawing).
A103	Improper location of land holes (plated-through holes or non-plated-through holes, see 3.1).
A104	Missing or improper laminate material (see 3.3.1 and 3.3.3).
A105	Missing or improper solder coating or tin/lead plating (see 3.3.10 and 3.3.11).
A106	Missing or improper objective evidence on material, if appropriate (see 3.3.11 and 3.3.12).
A107	Improper conductor pattern (see 3.5.5).
A108	Conductor edge roughness greater than 0.005 inch from peak to valley over any 0.500 inch in length (see 3.5.5).
A109	Spacing between conductors less than the minimum spacing shown on the master drawing (see 3.5.4).
A110	Evidence of repair to the flexible and rigid-flex printed wiring (see 3.9).
A111	Presence of slivers or whiskers of conductor pattern (see 3.6.2).
A112	Evidence of looseness of bond or any conductor length or any indication of peeling among the elements of the flexible/rigid-flex printed-wiring.
A113	Any crack, chip, tear, cut or separation from the base material or conductor pattern at any edge or opening (see 3.5.9.1).
A114	Delamination between the coverlayer and base, except as allowable in 3.5.9.1.
A115	Land holes: The hole shall be cleancut with no visible chipping or cracking in the wall of the holes and there shall be no bulging around the holes or reduction of the hole diameters with base materials such as adhesives.
A116	Minimum annular ring between land hole and its surrounding conductor pad, less than specified in 3.5.7.
A117	Voids in any plated-through hole in excess of those allowed in 3.7.3.
A118	Misregistration of coverlayer access holes greater than allowed in 3.5.9.3.
A119	Presence of adhesive area greater than allowed in 3.5.8.
A120	Bow and twist (type 4 only) in excess of that allowed in 3.5.3.

MINOR DEFECTS

B201	Improper diameter of mounting holes usually nonplated-through holes (see master drawing).
B202	Improper diameter of land holes (plated-through holes or non-plated-through holes, see 3.1).
B203	Marking missing, improper, illegible or misleading (see 3.4.4).
B204	Evidence of poor workmanship (see 3.4.5).

5. PACKAGING

5.1 Preservation. Preservation shall be level A or C, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Cleaning. Flexible and rigid-flex printed wiring shall be cleaned in accordance with MIL-P-116, process C-1.

5.1.1.2 Drying. Flexible and rigid-flex printed wiring shall be dried in accordance with MIL-P-116.

5.1.1.3 Preservative application. Contact preservatives shall not be used.

5.1.1.4 Unit packs. Flexible and rigid-flex printed wiring shall be individually unit packed in accordance with submethod IA-8 of MIL-P-116 insuring compliance with the applicable requirements of that specification. Each unit pack shall be enclosed in a supplementary container conforming to PPP-B-566, PPP-B-676 or PPP-B-636.

5.1.1.5 Intermediate packs. Intermediate packs are not required.

5.1.2 Level C. The level C preservation for flexible and rigid-flex printed wiring shall conform to the MIL-STD-794 requirements for this level.

5.2 Packing. Packing shall be level A, B or C, as specified (see 6.2).

5.2.1 Level A. The packaged flexible and rigid-flex printed wiring shall be packed in wood boxes conforming to PPP-B-601, overseas type; PPP-B-621, class 2 or PPP-B-585, class 3. Closure and strapping shall be in accordance with the applicable container specification.

5.2.2 Level B. The packaged flexible and rigid-flex printed wiring shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, special requirements. The requirements for box closure, waterproofing and reinforcing shall be in accordance with method V of the PPP-B-636 appendix.

5.2.3 Level C. The level C packing for flexible and rigid-flex printed wiring shall conform to the MIL-STD-794 requirements for this level.

5.2.4 Unitized loads. Unitized loads, commensurate with the level of packing specified in the contract or order, shall be used whenever total quantities for shipment to one destination equal 40 cubic feet or more. Quantities less than 40 cubic feet need not be unitized. Unitized loads shall be uniform in size and quantities to the greatest extent practicable.

5.2.4.1 Level A. Flexible and rigid-flex printed wiring, packed as specified in 5.2.1, shall be unitized on pallets in conformance with MIL-STD-147, load type I, with a wood cap (storage aid 5) positioned over each load.

5.2.4.2 Level B. Flexible and rigid-flex printed wiring, packed as specified in 5.2.2, shall be unitized as specified in 5.2.4.1 except that weather resistant fiberboard caps (storage aid 4) shall be used in lieu of wood caps.

5.2.4.3 Level C. Flexible and rigid-flex printed wiring, packed as specified in 5.2.3, shall be unitized as specified in MIL-STD-794 except that conformance to MIL-STD-147 is not required.

5.3 Marking. In addition to any special or other identification marking required by the contract (see 6.2), each unit, supplementary and exterior container and unitized load shall be marked in accordance with MIL-STD-129. The complete military or contractor's type or part number (including the FSCM), as applicable, shall be marked on all unit and intermediate packs in accordance with the identification marking provisions of MIL-STD-129.

5.4 General.

5.4.1 Exterior containers. Exterior containers (see 5.2.1, 5.2.2 and 5.2.3) shall be of a minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent practicable.

5.4.2 Packaging inspection. The inspection of these packaging requirements shall be in accordance with 4.7.2.

5.4.3 Army acquisitions.

5.4.3.1 Level A supplementary containers. All supplementary containers shall be either weather (or water) resistant or overwrapped with waterproof barrier materials (see 5.1.1.4).

5.4.3.2 Level A packing. In addition to that specified in 5.2.1, metal strapping shall conform to QQ-S-781, type I, finish A. When the gross weight exceeds 200 pounds or the container length and width is 48 x 24 inches or more and the weight exceeds 100 pounds, 3 x 4 inch skids (laid flat) shall be applied in accordance with the requirements of the container specification. If not described in the container specification, the skids shall be applied in a manner which will adequately support the item and facilitate the use of material handling equipment.

5.4.3.3 Level A and B unitization. Unitization (see 5.2.4) shall be necessary when skids are not required (see 5.4.3.2), when quantities per destination exceed either a total of 250 pounds (excluding the pallet), or when the volume equals 20 cubic feet or more and the container size permits the use of one of the pallet patterns of MIL-STD-147. A quantity of containers, packed as specified in 5.4.3.2, except that the container strapping may be omitted, shall be placed on a pallet, load type I, conforming to MIL-STD-147. The pallet shall conform to MN-P-71, type IV, using group I or II woods. The loads shall be bonded to the pallet by strapping conforming to QQ-S-781, type I, finish A, or shrink film conforming to L-P-378, type IV. Stretch wrap in accordance with MIL-STD-147 is authorized for shipments within the continental U. S. and for all containerized shipments.

6. Notes.

6.1 Ordering data.

6.1.1 All acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Title, number and date of applicable master drawing (see 3.1).
- c. Appropriate type (see 1.2.1 and class (see 1.2.2) designation.
- d. Type of laminate material (see 3.3.1 and 3.3.3).
- e. Minimum conductor width (see 3.1).
- f. Minimum conductor spacing (see 3.5.4).
- g. Part identification (if applicable), and marking instructions including size, location and method (see 3.4.4).
- h. Levels of preservation-packaging and packing required (see 5.1 and 5.2).
- i. If special or other identification marking is required (see 5.3).
- j. Flexibility requirements (see 3.6.5 and 3.6.6).
- k. Termination technique (6.2).

6.1.2 Acquisition documents must also specify the following data, if applicable:

- a. Plating, if other than solder coating or tin/lead (see 3.3.10).
- b. Conductor edge overhang, if applicable (see 3.6.3).
- c. Edge requirement, if other than those specified in 3.5.9.
- d. Insulation resistance requirements (see 3.8.3.3).
- e. Peel strength, if applicable (see 3.6.2).
- f. Extruded adhesive requirements, of other than those specified in 3.5.8.
- g. Nondelivery of sample units which have not been subjected to the continuity test and have passed all other tests to groups A and B inspection (see 4.7.1.4.3).

6.2 Solderability. The requirements for solderability specified in this document are intended to ensure compatibility with the soldering operations to be used in maintenance of repairable assemblies which may employ flexible and rigid-flex printed-wiring. This is not intended to preclude the use of other types of terminations which may be used (e.g., welding in nonrepairable assemblies). However, other tests, inspections or materials requirements might be required in the master drawing (e.g., nickel plating to facilitate welding).

6.3 Resistivity of solvent extract (see 4.8.6.5). This test procedure, including solution preparation and a laboratory ware cleaning procedure, is documented in Materials Research Report No. 3-72. "Printed-wiring assemblies; detection of ionic contaminants on." Application for copies of this report should be addressed to the Commander, Naval Avionics Facility, Indianapolis, IN 46218.

6.3.1 Alternate methods. The following methods of determining the cleanliness of flexible printed-wiring have been shown to be equivalent to the resistivity of the solvent extract method:

- a. The Kenco Alloy and Chemical Company, Incorporated, "Omega Metertm, Model 200."
- b. Alpha Metals Incorporated, "Ionographtm."
- c. EI Dupont Company, Incorporated, "ION Chaserttm."

Test procedures and calibration techniques for these methods are documented in Materials Research Report 3-78, "Review of Data Generated with Instruments Used to Detect and Measure Ionic Contaminants on Printed-Wiring Assemblies." Application for copies of this report should be addressed to the Commander, Naval Avionics Center, Indianapolis, IN 46218. Table XIV lists the equivalence factors for these methods in terms of microgram equivalents of sodium chloride per unit area.

TABLE XIV Equivalence factors.

Method	MgNaCl/in ²	Equivalence factor	Instrument "Acceptance limit"	
			μgNaCl/cm ⁻²	μgNaCl/in ²
Resistivity of solvent extract	7.545	$\frac{7.545}{7.545} = 1$	1.56	10.0
Omega meter	10.51	$\frac{10.51}{7.545} = 1.39$	2.2	14
Ionograph	15.20	$\frac{15.20}{7.545} = 2.01$	3.1	20
Ion Chaser	24.50	$\frac{24.50}{7.545} = 3.25$	5.1	32

6.4 Alternate test method (flexibility endurance) (see 4.8.4.6). The flexibility endurance test may be performed using an alternate test method specified in IPC-TM-650, Method 2.4.3.

6.5 Supplier certification inspection. Contracts and awards under this specification will be made only for flexible and rigid-flex printed wiring boards fabricated by a supplier who has passed the certification inspection test (see Table VIII), (prior to the time set for opening of bids or subcontracting letting) and have been certified by the cognizant certification organization. In order to be eligible for award of contract, the attention of the supplier is called to this certification requirement (see 4.5). Supplier certification inspection shall be performed in accordance with the procedures described in this specification and the appendix.

6.5.1 Cognizant certification organization is Defense Electronics Supply Center, ATTN: DESC-EQ, Dayton, OH 45444. Information pertaining to certification may be obtained from the above address.

6.6 Terms and definitions. The definitions of all terms used herein shall be as specified in ANSI/IPC-T-50.

6.6.1 Splay. Splay is the tendency of a rotating drill bit to drill off center, out of round, nonperpendicular holes.

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - ER
Navy - EC
Air Force - 17

Preparing activity:

Navy - EC

(Project 5999-0114)

Review activities:

Army - AR, MI
Navy - OS, SH
Air Force - 11, 16, 85, 99
DLA - ES
NSA/S2

User activities:

Navy - AS, CG, MC
Air Force - 19

Agent:

DLA - ES

APPENDIX

SUPPLIER CERTIFICATION PROCEDURES

10. PURPOSE

10.1 Purpose. The purpose of this appendix is to provide the manufacturer with proper procedures for obtaining supplier certification.

10.2 Purpose of supplier certification. The purpose of supplier certification is to allow the supplier to provide, and the purchaser to obtain, satisfactory pre-contractual evidence that the supplier is competent to manufacture the certified product.

10.3 Intent of supplier certification. The intent of supplier certification is to:

- a. Standardize the requirements for evidence of supplier capability in advance of procurement action.
- b. Reduce procurement lead time.
- c. Reduce test costs by:
 1. Eliminating the need for repetitive first article or preproduction testing.
 2. Minimizing redundant, long/expensive test requirements; tests whose only function is to demonstrate supplier capability, need not be repeated during quality conformance inspection.
- d. Allow avoidance of situations where competition is unequal because one or more suppliers have established competence via prior procurements.
- e. Provide an additional tool for optimizing the relationship between engineering risk and quality assurance cost.

20. APPLICABLE DOCUMENTS

20.1 Government specifications and standards. Unless otherwise specified, the following specifications and standards, of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this specification to the extent specified herein.

HANDBOOK

MILITARY

MIL-HDBK-52 - Evaluation of Contractor's Calibration System.

(Copies of specifications, standards, drawings, and publications required for suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

30. GENERAL PROVISIONS

30.1 Extent of certification. Supplier certification is granted for a product made at a specific plant. It is not granted for a company; therefore, items subjected to supplier certification tests must be the product of that plant only.

30.2 Location of testing. Supplier certification testing may be done at the plant of the manufacturer or at a company owned or commercial test laboratory or combinations thereof; however, these facilities must have "suitability status" as described in section 40.

30.3 Cost of testing. The government will assume no cost for any aspect of supplier certification testing except the cost of the DESC representative(s) conducting a facilities audit and the Defense Contract Administration Service (DCAS) monitoring the testing.

40. SUITABILITY OF INPLANT OR COMMERCIAL TEST LABORATORY

40.1 Test equipment and calibration system. The test equipments to be used for supplier certification testing at a nongovernment laboratory must be determined to be suitable by DESC-EQ before an authorization to test can be granted. Calibration facilities and procedures must be found suitable and in accordance with MIL-STD-45662.

40.1.1 Test equipment list. Separate lists of supplier certification test equipment for each test location, either inplant or commercial laboratory, must be submitted. Do not intermingle different test location pages in the same list. Each test laboratory location must be approved separately. A suggested format (see figure 12) has been devised to reduce the time and effort required for the preparation of test equipment lists by manufacturers and the evaluation and approval of the lists by DESC-EQ. This format will facilitate the maintenance of the equipment lists and eliminate the need to recompile the complete list after several test equipment changes.

40.1.2 Calibration standards. A list of calibration standards must also be submitted in a format containing the equivalent information as shown on fig. A-1.

40.1.3 Calibration laboratories. Names and addresses of all calibration laboratories utilized must be submitted. The manufacturer/test laboratory shall be responsible for assuring that the calibration laboratories utilized are, in fact, capable of performing the required service (see paragraph 3.2.5.1 of MIL-STD-45662).

40.1.4 Calibration system description. The manufacturer shall provide and maintain a written description of his calibration system. The description may be in the form of instructions, procedures, or standard practices normally used by the manufacturer for his quality program or inspection system. The description shall be directive in nature and specific as to the functions to be performed in accomplishing these requirements and shall apply to all affected departments within the manufacturers organization. The system description shall include, but not be limited to, the following elements:

- a. Adequacy (accuracy, stability, range).
- b. Environmental controls.
- c. Intervals of calibration.
- d. Calibration procedures.
- e. Calibration source.
- f. Application and records.
- g. Calibration labeling.

The calibration system description documentation shall be cross-indexed to MIL-STD-45662 requirements by using a format similar to that shown on figure 12. This is to assist the manufacturer in speedily locating the pertinent documentation during audits of his facility by DESC-EQ personnel. Detailed interpretation of the requirements in MIL-STD-45662 are found in MIL-HDBK-52.

40.1.5 Moisture chamber. Since this specification requires the use of a moisture chamber, a completed humidity chart (wet and dry bulb readings or differential reading), demonstrating compliance with test method 106 of MIL-STD-202 will be submitted. The chart must also include the name of the manufacturer of the chamber, the model and serial number, and the date of recording. During the trial run which is necessary in order to obtain a recording on the chart, the chamber must be loaded with a mass of metal approximately equal to the mass of the maximum number of samples to be tested at one time. This procedure and the data recorded are to approximate actual testing conditions.

40.1.6 Test equipment list updating. Because approval of supplier certification test equipment by DESC-EQ is required prior to use of this test equipment for supplier certification testing, it is important that the equipment lists be kept up to date. Failure to do so will result in delay in acceptance of a test report or rejection of the test report. If the equipment used for a specific test (test method or specification paragraph) is listed on a single page, updating can be done on a page by page basis. Any time an item listed on a qualification test facilities page is discarded, or replaced by another item, that page can be revised at the time the change is made and sent to DESC-EQ for approval and replacement of that page in the DESC-EQ records. If a new test method is to be added to the list, a page can be completed for this method and sent to DESC for acceptance. It can then be filed in the correct numerical order without the necessity of retyping previous listings. After the DESC audit of the company test facilities, all additional test equipment listed on new or revised pages sent to DESC-EQ shall be verified by the Government QAR.

40.2 Audit of the test laboratory. Audit of the test laboratory consists of the following:

- a. DESC-EQ personnel will review the lists and associated information submitted by the laboratory. The laboratory will be notified if additional information, corrections, etc., are needed. As soon as the required information is complete, a date for an audit of the supplier certification test facilities will be established.
- b. At the time of audit, all test equipment and standards on the lists shall be available for inspection. Test personnel shall be available to operate the equipment. All operating instructions and calibration records shall be up to date and available for review.
- c. Testing procedures, test reports, and supplier certification procedures also will be discussed during the audit. At the conclusion of the audit, any deficiencies will be discussed with appropriate company personnel. Deficiencies requiring correction will be listed in a letter to the company. As soon as deficiencies are corrected, a report of the corrective action shall be sent to DESC-EQ. If the corrective action is acceptable, a laboratory suitability letter will be sent to the company. The suitability letter applies only to the test equipment listed on the test facilities forms.

40.3 Suitability status. Granting of "suitability status" to a test laboratory does not mean that the Government will automatically approve a test report prepared by the laboratory. Some of the most common reasons for rejection of test laboratory reports are the following:

- a. Testing prior to receipt of an authorization to test.
- b. Failure to make suitable arrangements for a Government Quality Assurance Representative (QAR) to monitor testing.
- c. Use of improperly calibrated test equipment.
- d. Use of test equipment not previously found acceptable by DESC-EQ.
- e. Incorrect test procedures.
- f. Failure to record actual test conditions or results.

50. SUPPLIER CERTIFICATION TESTING AT NONGOVERNMENT TEST LABORATORY

50.1 Application for supplier certification.

50.1.1 Application format. One copy of the application (see figure 13) is to be submitted to DESC-EQ. The product(s) to be tested shall be properly identified and listed on the application.

50.1.2 Submittal of application. Normally, applications should be submitted approximately one month before test samples will be ready for testing. If any test equipment must be audited for suitability status, then the application is to be submitted as soon as possible to permit DESC-EQ to schedule the trip. (See 40.2).

50.1.3 Location of testing. If testing is to be done at more than one location, either approved company implant laboratories or approved commercial test laboratories, the applicant must show clearly which tests each test laboratory will perform.

50.1.4 Laboratory suitability. Item 2, Section II and Item 3, Section III of the application are reminders that all test facilities must be acceptable to DESC-EQ before being used in testing. Failure to have laboratory suitability prior to testing is the most common cause of rejection of a test report or delay in acceptance of a test report by DESC-EQ.

50.1.5 Conditions of certification. The application must be signed by a company official who has the authority to commit the manufacturer of the product to the conditions on page four of the application. The application shown on figure 13 is only a suggested format; however, the conditions listed on page 4 must be included if the supplier chooses to use a format other than that shown. The application is not to be signed by any official of the commercial test laboratory.

50.2 Authorization to conduct supplier certification testing. The manufacturer will be issued a letter of authorization to proceed with testing in accordance with the application, unless modified by DESC-EQ. The letter will also assign a test report number(s) to be used to identify the test report(s). The following conditions apply to the authorization:

- a. DESC must be notified of the starting and estimated completion dates for the tests. Manufacturers are responsible for coordinating the starting date with DCAS QAR.
- b. The authorization will be canceled if tests have neither been started in six months nor completed in 12 months. If an extension of time is necessary, notify DESC-EQ by letter.
- c. Only test equipment which has been determined to be suitable for testing by DESC shall be used for tests.
- d. Products subjected to tests must have been manufactured at the plant location indicated on the application.
- e. If any failures or serious test equipment problems are encountered during testing, discontinue testing and ask DESC-EQ for instructions. DESC is to be notified within ten working days of the problem.
- f. Testing shall not be started prior to receipt of the DESC authorization to test. Testing at all nongovernment laboratories must be monitored by a Government QAR. He may select the tests that he wishes to witness. The company must schedule those tests at a time agreeable to him. The Government QAR signature verifies the test report, but it does not constitute government approval of the test report.
- g. Tests must be performed at the laboratories listed for those tests on the DESC authorization to test. If it is necessary to change the laboratory doing any test, the manufacturer shall inform DESC prior to testing. DESC-EQ will then revise or amend the authorization to test.
- h. Samples must be subjected to all tests required and in the sequence required by this specification. Test procedures must be in accordance with the applicable specification test paragraph or MIL-STD Test Method as interpreted by DESC-EQ. If there are any questions on a test procedure, consult DESC-EQ before performing that test.
- i. The original and one copy of the test report prepared in accordance with 50.3 and 50.4 must be submitted to DESC-EQ.
- j. When testing is performed in more than one test location, the manufacturer of the product will be responsible for combining the results of testing into one composite report for each product being tested.
- k. Each test report must include a list of actual material used and a certification that this material meets the requirements of this specification, where applicable.
- l. The 10 humidity cycle charts identified with the assigned test report number(s) must be included in the original test data (may include 3-day charts to cover weekends).
- m. All tested samples shall be furnished with the test report(s) at no cost to the Government.

50.3 Recording of data - test data sheets. Data should be presented in sufficient detail to substantiate, to interested parties not witnessing the test, the test procedures used and the results obtained in the testing. Failure to submit data in sufficient detail will subject reports to the risk of being rejected and create the possibility of extensive retesting being required. If pre-printed test data sheets or word processing equipment is used in preparing the test report, adequate safe guards must be taken to prevent the inadvertant mixing of test results between reports. A system to assure the traceability of the results of tests contained in the report to the data obtained at the time of the test of the product, is to be maintained by the test laboratory.

50.3.1 Data sheet format. Test results shall be recorded on company data sheets; however, it is recommended they be reviewed by DESC-EQ prior to use in testing. The DESC-EQ review is to assure that the company data sheet will contain all required information.

50.3.2 Date and time of test. Date and time each test was started and completed shall be recorded on the data sheet so that the sequence of testing can be established.

50.3.3 Test conditions. All actual environmental, mechanical, and electrical test conditions existing shall be recorded at the time of test by the test equipment operator. It is important that this data be recorded by the operator at the time of test and not copied from this specification before testing or when the test report is being assembled.

50.3.4 Actual readings. All data in a test report, such as test conditions and test results, must be the actual reading on each item in test. Variables data is required for every measurement taken.

50.3.5 Environmental tests. Test data for environmental tests must include all environmental test conditions. For example, moisture resistance test data must include resistance between conductors, polarizing voltage, duration, and any electrical value applied and recorded during test. For tests involving time as a test condition (e.g., thermal shock test) the data should show the clock time that the test started and ended, as well as the clock time and temperature for each step of each cycle. This data can be recorded on an operating log sheet and is acceptable as test conditions data in a test report.

50.3.6 Electrical tests. For electrical tests, the data must include all applicable test conditions, i.e., voltage, current, frequency, etc., as well as the specified test characteristic. If the characteristic value is calculated, the data must include all readings, the characteristics measured, the formula used for calculation, and a sample calculation, as well as the calculated values. For example, when voltage and current readings are taken for wattage calculation, the values of the voltage and current measured must be recorded on the data sheets as well as the calculated wattage. A copy of any chart, table, or nomograph used instead of calculations must be included with the data.

50.3.7 Corrections. Corrections on data sheets will be made by "lining out" the incorrect entries with a single line and inserting the correct entry immediately adjacent to the "lined out" entry. Erasures and mark overs are not permitted in original test data sheets.

50.4 Assembly of the supplier certification test report.

50.4.1 Preparation of test report. The test laboratory will prepare a separate test report for each test report number assigned in accordance with the DESC-EQ authorization letter (see 50.2). All copies shall be properly collated and bound. The test report shall consist of the following items:

- a. A completed forwarding form (see figure 15). Do not omit any of the required information. Page 3 should show all tests in the order of the supplier certification test table. The laboratory performing the test can be shown in the remarks column. A separate page 4 should be used for each laboratory and should list only the equipment used for testing. Figure 12 is not an acceptable substitute for this page. The date of calibration listed on this page should be the last date of calibration prior to this test.
- b. Certification of materials.
- c. Data sheets in the same order as the listing of tests in the supplier certification test table of this specification.
- d. Other data or information (e.g., VSWR charts, formulae, moisture resistance charts, etc.), if required by this specification or requested by DESC.

50.4.2 Original test data. One copy of the test report shall be identified on the front cover as the DESC-EQ original test data copy. This copy differs from the other copies as follows:

- a. The DESC-EQ original data copy contains the original handwritten sheets in addition to the typed or recopied sheets.
- b. The EQ original test data copy also contains:
 - (1) Original moisture charts. The moisture resistance charts will be marked with different colors of ink denoting wet and dry bulb recording. In addition to colored ink, the various pen traces will be properly identified. The chart will also include the following information:
 - (a) Test laboratory name and location.
 - (b) Date the chart was recorded.
 - (c) Military designation of the product(s) under test.
 - (d) Test report number. (If several tests are performed simultaneously, all test report numbers will be included.)
 - (2) Image reproductions of the moisture resistance charts will be accepted by DESC-EQ if it is impractical to submit the original charts. (For example, tests may be performed for several reports simultaneously and it would be impossible to submit the original charts with each test report.) The reproduction will be of the same scale as the original charts. (When the laboratory uses this option, the reason will be stated in the remarks section of the forwarding form and the produced charts annotated to show the report number under which original charts were submitted).

50.4.3 Disruption of testing. When testing is initiated and then discontinued for any reason, DESC-EQ is to be notified within 10 working days. If testing is not resumed, a test report covering all testing performed prior to discontinuance must be submitted. Failure to notify DESC-EQ or to submit this test report by the date agreed is cause to reject future applications for testing and may result in loss of laboratory suitability status. If a report covering product failure is submitted and the manufacturer wants to retest, he must submit a new application and his proposed corrective action. DESC-EQ will evaluate the proposed corrective action and, if acceptable, will issue a new authorization and test report number.

60 NOTES

60.1 Supplier certification. Supplier certification and supplier certification procedures are an experiment not covered by the Defense Standardization Manual (DSM4120.3). Establishment and use of these procedures were authorized by Defense Materiel Specifications and Standards Office (DMSSO) and the Army Department Standardization Office (DepSO) at a meeting at Defense Electronics Supply Center (DESC), 21 February 1978.

INSTRUCTIONS FOR COMPLETING THIS LIST

1. Complete top of page on all pages. Show street location not office address. Date block is for this page. Revision dates are for revision of this page.
2. Use a separate page for each test name. List all equipment used to perform this test. Include test fixtures, ovens, all separate instrumentation, etc. If test equipment is homemade either at the facility or built to the facilities design, include wiring diagram showing all connections between instrumentation and product under test. List all instrumentation on this page, completing all columns. Do not forget instrumentation other than electrical i.e. thermometers, accelerometers and associated amplifiers and scopes.
3. Information required in each column.
 - a. Test Name - Do not list test name for each piece of equipment, once is enough.
 - b. Equipment - Use proper name, i.e. Voltmeter, Megohm Bridge, Thermometer, Frequency meter, Signal Generator, etc.
 - c. Manufacturer - Do not abbreviate name or use initials unless it is normal trademark of company.
 - d. Type or Model - As shown on equipment name plate.
 - e. Serial or Inventory Number - This should be the number that is used for this equipment in your calibration records.
 - f. Description - If a drawing is included, list drawing number. List other tests that use the same test setup. List different devices, families, etc. that are tested on this test setup. Describe any features that will help us to understand test setup.
 - g. Equipment Limits - List both maximum and minimum values of applied conditions as well as test result characteristic.
 - h. Accuracy - List for each test equipment. If test set is composed of several items do not add accuracies together; list each one.
 - i. Frequency of Calibration - Do not put a date here.
 - j. If the above information is insufficient for evaluation, DESC-EQ will ask for additional information, manuals, photos, schematics, etc.
4. If a piece of test equipment is used in several tests, do not duplicate complete description. Put complete description on page for the first test in alphabetical order. On other page, complete the first five columns and in the remarks put "Described under test (method or paragraph)."
5. If a test setup performs more than one test, do not duplicate all details for each test. It is necessary only to give us a complete description once. However, to keep pages and test methods in proper sequence, it is necessary to have a page for each test method. The page for the lowest test method contains all details. Pages on other test methods using the same test setup should contain only the test name with this statement. "This test uses the identical test facilities described under test (name)."
6. Assemble pages in a loose leaf binder in ascending alphabetical order of test (name) number.
7. If changes occur in equipment, only the page with the details of that equipment need be revised. The entire list, using a loose leaf binder format should never have to be rewritten.

FIGURE 12. Suggested format for test equipment list.

CROSS INDEX OF CALIBRATION SYSTEM REQUIREMENTS (MIL-STD-45662 VS. COMPANY DOCUMENTATION)	
COMPANY NAME: _____ ADDRESS: _____ PREPARED BY: _____ TITLE: _____ DATE: _____	
Please indicate where each program element is covered in the company documentation. If documentation does not exist because a specific program element does not apply, so state and explain. If additional space is required, use a separate sheet. (may be handcribed.)	
PROGRAM ELEMENT AND MIL-STD-45662 PARAGRAPH	PLEASE LIST COMPANY DOCUMENT TITLE, NUMBER, REVISION, SECTION, PARAGRAPH, PAGE, ETC. (As Applicable)
CALIBRATION	
a. Description of Calibration System	
(1) Controls for segregation of obsolete, damaged, or otherwise inaccurate equipment	
(2) Controls for verification of production tooling (jigs, fixtures, etc.) when used	
(3) List of Measurement Standards (reference and transfer)	
(4) Availability of system description, procedures, and calibration reports	
b. Adequacy of Standards. Measurement standards established for calibration of test and measuring equipment have the capabilities for the intended use. (3.2.1)	
(1) Accuracy	
(2) Stability	
(3) Range	
c. Environmental Controls (3.2.2)	
(1) Environmental conditions controlled to the extent necessary to assure continued measurements of the required accuracy. Consideration given to:	
Temperature	
Humidity	
Vibration	
Cleanliness	
Other controllable factors affecting precise measurement	
(2) Controls for the application of compensating corrections to calibration results obtained in environments other than standard	
d. Calibration Intervals (3.2.3) Procedures provide control for:	
(1) The calibration of measuring and test equipment and measurement standards at periodic intervals	
(2) The establishment of an interval period based upon stability, purpose, and degree of usage	
(3) The adjustment of interval periods when evidenced by the results of previous calibrations	
e. Calibration Procedures (3.2.4)	

FIGURE 13. Suggested format for calibration system cross index.

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PROGRAM ELEMENT MIL-STD-45662 PARAGRAPH	PLEASE LIST COMPANY DOCUMENT TITLE, NUMBER, REVISION, SECTION, PARAGRAPH, PAGE, ETC (As Applicable).
(1) Preparation, provision, and utilization of written procedures for the calibration of measuring and test equipment and measurement standards	
(2) Requirement for calibration to be performed by comparison with higher accuracy level standards	
(3) Utilization of published standard practices or manufacturers instructions	
(4) Surveillance or checks that procedures are being followed	
(5) Availability of procedures to calibration personnel	
f. Calibration Sources. (3.2.5) Procedures provide control for:	
(1) The calibration of test and measuring equipment by a source whose standards are traceable to the National Bureau of Standards	
(2) The calibration of reference standards by a capable commercial facility, a Government laboratory or the National Bureau of Standards	
(3) A report, certificate, or data sheet attesting to the date, accuracy, and conditions under which the calibration results of reference standards were obtained	
(4) The provision of reports, record cards, etc., for subordinate standards, measuring and test equipment when such information is deemed essential	
(5) Assuring that calibration sources other than the National Bureau of Standards or a Government laboratory are in fact capable of performing the required service	
(6) Producing such reports for review by the Government representative	
g. Application and Records (3.2.6) Procedures provide control for:	
(1) Supporting records to show that established schedules and procedures are applied to maintain the accuracy of measuring and test equipment and measurement standards	
(2) An individual record of calibration for each item of measuring and test equipment and measurement standard providing calibration interval, date of certification and result of last calibration	
(3) Noting the report or certificate number on the individual record of those items whose accuracy is reported by calibration report or certificate	
(4) Producing such records for review by the Government representative	
h. Calibration labeling (3.2.7) Procedures provide control for:	
(1) The labeling of measuring and test equipment and measurement standards to indicate the date of last calibration, by whom, and the date when next calibration is due	
(2) An identifying code to reflect the status of serviceability for those items whose size or functional characteristics prohibit the application of a label	
(3) The monitoring of recall records to assure adherence to calibration schedules	
(4) Labels, codes, or recall records indicating the applicable condition of those items which are not required to be used to their full capabilities or which require a functional check only	

FIGURE 13. Suggested format for calibration system cross index - Continued.

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APPLICATION FOR SUPPLIER CERTIFICATION TESTING	
DEFENSE ELECTRONICS SUPPLY CENTER DIRECTORATE OF ENGINEERING STANDARDIZATION	
CHECK TESTING OPTION DESIRED	
<input type="checkbox"/> AT THE PLANT OF THE MANUFACTURER (IN-PLANT) <i>(Complete Sections I, II, and IV)</i>	
<input type="checkbox"/> AT A NON-GOVERNMENT TEST LABORATORY (OTHER THAN IN-PLANT) <i>(Complete Sections I, III, and IV)</i>	
<input type="checkbox"/> AT A COMBINATION CONSISTING OF THE ABOVE OPTIONS <i>(Complete All Sections)</i>	
SECTION I	
COMPANY NAME AND MAILING ADDRESS (NAME AND ADDRESS TO APPEAR ON CERTIFICATION)	DATE OF APPLICATION
PLANT NAME & ADDRESS WHERE PRODUCT(S) IS MANUFACTURED	
SPECIFICATION NUMBER, TITLE & DATE	AMENDMENT DATE
DETAIL SPECIFICATION(S) OR SHEET(S) & DATE(S)	AMENDMENT DATE
QUANTITY	IDENTIFICATION OF PRODUCT TO BE CERTIFIED

FIGURE 14. Suggested application format.

SECTION II TESTING AT THE LABORATORY OF THE MANUFACTURER (IN-PLANT)	
<p>Complete this section ONLY if testing (either complete or partial) is to be conducted at the laboratory of the manufacturer (in-plant). If partial testing is to be conducted in-plant, the information furnished in this section should cover only those tests to be run in-plant. Information covering those tests which will not be run in-plant must be furnished by completing Section III. Under this test option, several different products covered by the same specification may be included in one application; however, a new application must be submitted for products not previously covered by an application.</p>	
1. NAME & ADDRESS OF THE MANUFACTURER'S LABORATORY	
2. HAS THE MANUFACTURER'S LABORATORY BEEN INSPECTED BY DESC PERSONNEL? <input type="checkbox"/> YES <input type="checkbox"/> NO INSPECTION WAS CONDUCTED ON _____ (DATE) BY _____	
3. WERE ALL TEST FACILITIES REQUIRED FOR THIS CERTIFICATION INCLUDED IN THIS INSPECTION OR SUBSEQUENTLY APPROVED BY DESC? <input type="checkbox"/> YES <input type="checkbox"/> NO IF NOT, INCLUDE LIST OF ALL TESTING FACILITIES ADDED SINCE LAST INSPECTION OR APPROVAL.	
4. IF THE MANUFACTURER'S LABORATORY HAS NOT YET BEEN FOUND BY DESC TO BE SUITABLY EQUIPPED AND STAFFED FOR PERFORMING TESTING UNDER THE SPECIFICATION LISTED ON THE FIRST PAGE OF THIS APPLICATION, INDICATE BELOW THE DATE THE EQUIPMENT PROPOSED FOR USE WILL BE AVAILABLE FOR INSPECTION BY DESC PERSONNEL _____ (DATE)	
5. WILL ALL OF THE TESTS BE PERFORMED AT THE MANUFACTURER'S LABORATORY? <input type="checkbox"/> YES <input type="checkbox"/> NO IF THE ANSWER IS "NO" SECTION III MUST BE COMPLETED	
6. IF TESTING IS AUTHORIZED BY DESC, WHEN WILL THE TEST SPECIMENS BE READY AND TESTS STARTED?	
6A. WHEN WILL THE TESTS BE COMPLETED?	
7. DOES THE MANUFACTURER'S LABORATORY HAVE A GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE? <input type="checkbox"/> YES <input type="checkbox"/> NO QAR'S NAME _____ <input type="checkbox"/> RESIDENT <input type="checkbox"/> ROVING ADDRESS _____	
8. NAMES AND ADDRESSES OF CALIBRATION SOURCES	
<p>NOTE: The following must also be available at the time of the inspection:</p> <ul style="list-style-type: none"> a. Certified calibration records for the calibration standards and in-plant test equipment. b. Calibration standards. c. Test personnel concerned with testing at the laboratory. d. All test equipment in operating condition. e. MIL-STD-45662 Documentation. 	
9. IS MILITARY SECURITY CLEARANCE REQUIRED TO GAIN ACCESS TO ANY OF THE MANUFACTURER'S FACILITIES? <input type="checkbox"/> YES <input type="checkbox"/> NO DEGREE OF CLEARANCE REQUIRED <input type="checkbox"/> CONFIDENTIAL <input type="checkbox"/> SECRET	

FIGURE 14. Suggested application format - Continued.

SECTION IV CONDITIONS	
THE APPLICANT CERTIFIES THE FOLLOWING:	
<ul style="list-style-type: none">a. That he is the manufacturer of the product.b. That he has determined from actual tests (within the limits of test equipment commonly available, unless otherwise specified) that the product conforms to the applicable specification.c. That he will supply items for test which are representative of the manufacturer's production.d. That he will supply for use of the purchaser, products which meet the requirements of the specification in every respect.e. That he will not apply for retest of the product until satisfactory evidence is furnished that all of the defects which were disclosed by previous tests have been corrected.f. That he will not state or advertise that the product is the only product so certified or in any way imply that the Department of Defense endorses his product.g. That he will notify the Defense Electronics Supply Center (DESC-EQ), Dayton, OH 45444 of any change in his product after approval and will state at the same time whether in his belief the change will or will not prejudice the capability of the product to meet the qualification test requirements; whether he intends to submit new samples for testing or desires to have his product removed from certification; and whether the changes will affect the applicants brand designation for the product.h. That he will notify the certifying activity of the discontinuance of manufacture of a product.i. That he will notify the certifying activity of plans to move a plant where it is desired to manufacture certified products at the new location.j. That he will subject all products identified on page one of this application to the Quality Conformance Requirements as specified in 4.7 of MIL-P-50884.k. That he will accumulate data for retention reports as specified in 4.5.5 of MIL-P-50884.	
THE UNDERSIGNED CERTIFIES THAT THE INFORMATION SUBMITTED TO DESC IN THIS APPLICATION IS TRUE AND ACCURATE TO THE BEST OF HIS KNOWLEDGE AND FURTHER, AGREES TO THE CONDITIONS AS SHOWN IN SECTION IV ABOVE.	
TYPE NAME AND TITLE (RESPONSIBLE OFFICIAL OF THE APPLICANT)	DATE
SIGNATURE	

FIGURE 14. Suggested application format - Continued.

SUPPLIER CERTIFICATION TEST REPORT AT A NON-GOVERNMENT TEST LABORATORY THIS INFORMATION SHALL BE COMPLETED FOR EACH TEST LOCATION	
MILITARY SPECIFICATION, TITLE (Roman Name) DATE, AMENDMENT AND DATE	TEST REPORT NUMBER
	TEST REPORT DATE
SPECIFICATION SHEET/DETAIL SPECIFICATION AND DATE	AMENDMENT AND DATE
APPLICANT'S NAME AND MAILING ADDRESS	MANUFACTURER'S PLANT LOCATION(S)
TEST LABORATORY NAME AND ADDRESS	
DESCRIPTION OF PRODUCT(S) TESTED (Government Designation and Manufacturer's Designation)	
LETTER NUMBER AND DATE OF DESC LABORATORY SUITABILITY STATUS	
LETTER NUMBER AND DATE OF DESC AUTHORIZATION TO TEST	
<p>GOVERNMENT REPRESENTATIVE</p> <p><i>I certify that I did witness, at specified intervals, the tests indicated in this report by my stamp or signature, and that such tests were conducted as specified. This certification does not constitute approval or disapproval of the products.</i></p> <p>NAME _____ (TYPE OR PRINT) (Government Representative)</p> <p>TITLE _____</p> <p>SIGNATURE _____</p> <p>DATE _____</p> <p>TEST LABORATORY (Mfg. or Commercial)</p> <p><i>I certify that all tests described in this report were performed as specified, by competent personnel using test facilities which have been inspected and found acceptable by the Government.</i></p> <p>NAME _____ (Laboratory Representative)</p> <p>TITLE _____</p> <p>SIGNATURE _____</p> <p>DATE _____</p>	<p>MANUFACTURER (Check Applicable Block)</p> <p><input type="checkbox"/> I certify that the tests were conducted upon sample items randomly selected from a normal production lot, and that the items were manufactured at the location and by the manufacturer indicated above.</p> <p><input type="checkbox"/> I certify that the tests were conducted upon sample items which are representative of our production and that the items were manufactured at the location and by the manufacturer indicated above.</p> <p>NAME _____ (TYPE OR PRINT) (Manufacturer's Representative)</p> <p>TITLE _____</p> <p>SIGNATURE _____</p> <p>DATE _____</p> <p>PURPOSE OF TESTING</p> <p><input type="checkbox"/> INITIAL CERTIFICATION</p> <p><input type="checkbox"/> EXTENSION OF RANGE OF PREVIOUSLY CERTIFIED ITEMS</p> <p><input type="checkbox"/> RECERTIFICATION TO REVISED OR AMENDED SPECIFICATION</p> <p><input type="checkbox"/> DESIGN AND CONSTRUCTION CHANGE</p> <p><input type="checkbox"/> OTHER (Describe)</p>
<p>EXTENT OF TESTING PERFORMED</p> <p><input type="checkbox"/> COMPLETE</p> <p><input type="checkbox"/> PARTIAL (Describe)</p>	

FIGURE 15. Suggested format for forwarding test report.

TEST PERSONNEL (List all Personnel Actually Performing Tests and Personnel Supervising Tests.)
DEVICE FAILURES (List all Failure Modes Encountered and The Causes of These Failures During Turn-In and Life Tests)
REMARKS (Include any Abnormalities in Testing, Explanation of Failures, etc. If for Design & Construction Change, include Explanation of Change and Reason (Benefits) for Change.)

FIGURE 15. Suggested format for forwarding test report - Continued.

FLEXIBLE AND RIGID-FLEX PRINTED WIRING TEST COUPONS
CERTIFICATION TEST BOARD NOTES
TYPE I PER MIL-P-50884C

1. Materials: Reference FIGURE 16.
 - a. Flexible metal clad dielectrics per IPC-FC-241A one ounce copper one mil polyimide
 - b. Adhesive coated dielectric films per IPC-FC-232A one mil polyimide
 - c. Flexible adhesive bonding films per IPC-FC-233A
2. Plating:
 - a. All exposed copper to be tin lead plated and fused or solder coated per MIL-P-50884C, Paragraph 3.4.7.
3. Dimensional - Reference FIGURE 17
 - a. Minimum annular ring requirement is .015 inch
 - b. Tolerance on all hole locations is .005 RTP
 - c. Thru-hole diameter to be $.022 \pm .003$
 - d. Cover coat hole diameter to be $.062 \pm .005$
 - e. "C" coupon to be left uncovered
 - f. All lines and spacing are to be $\pm 20\%$ of artwork master
 - g. All trim dimensions $\pm .030$
 - h. Fine line patterns are not a requirement for certification
 - i. Artwork master No. IPC-B-28/50884, Layer 1
4. Shipping Information
 - a. The manufacturer will ship with the certification board a list of materials used and any deviations to the drawing.

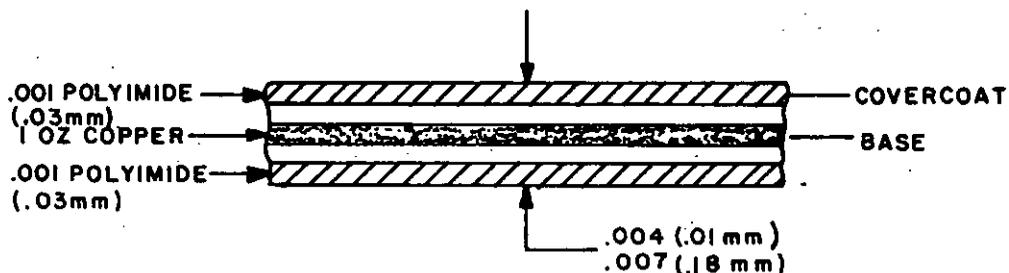
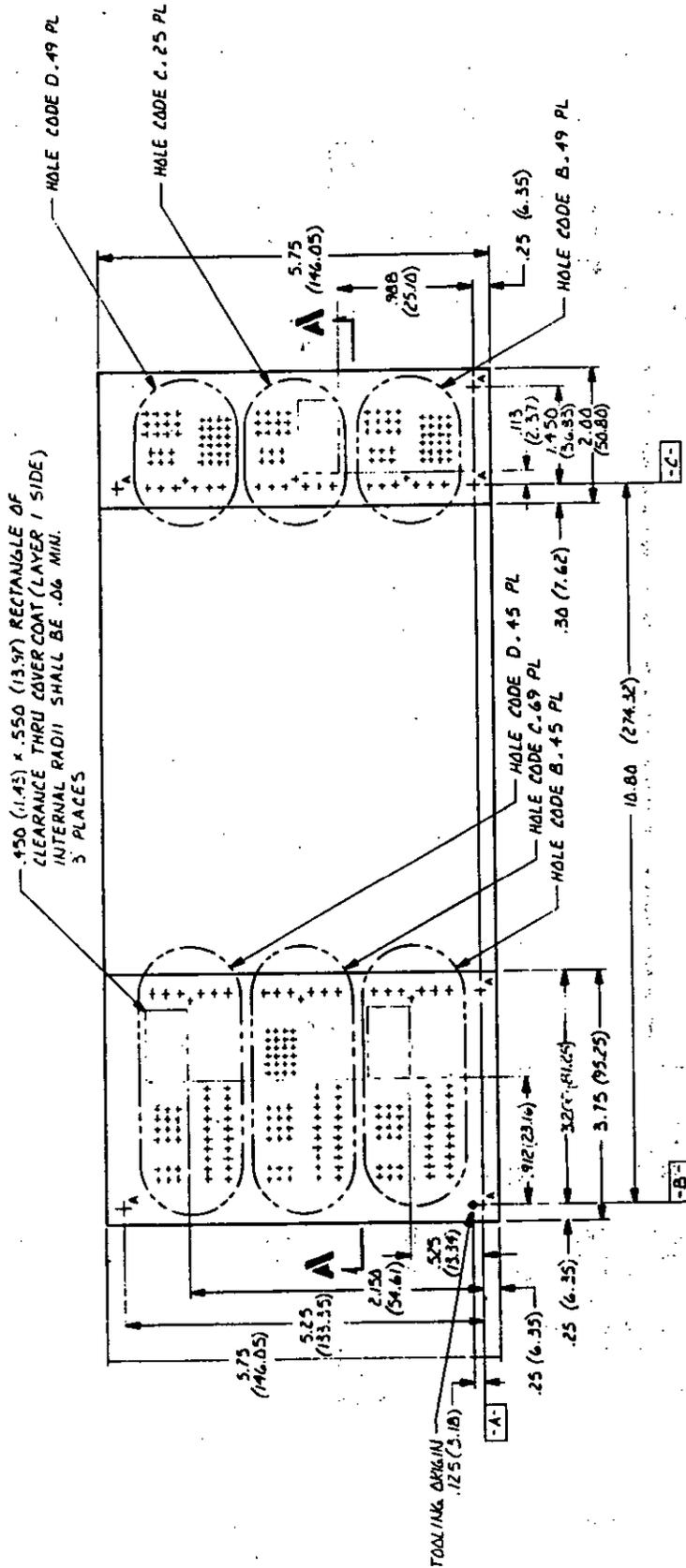


FIGURE 16. Type I materials.

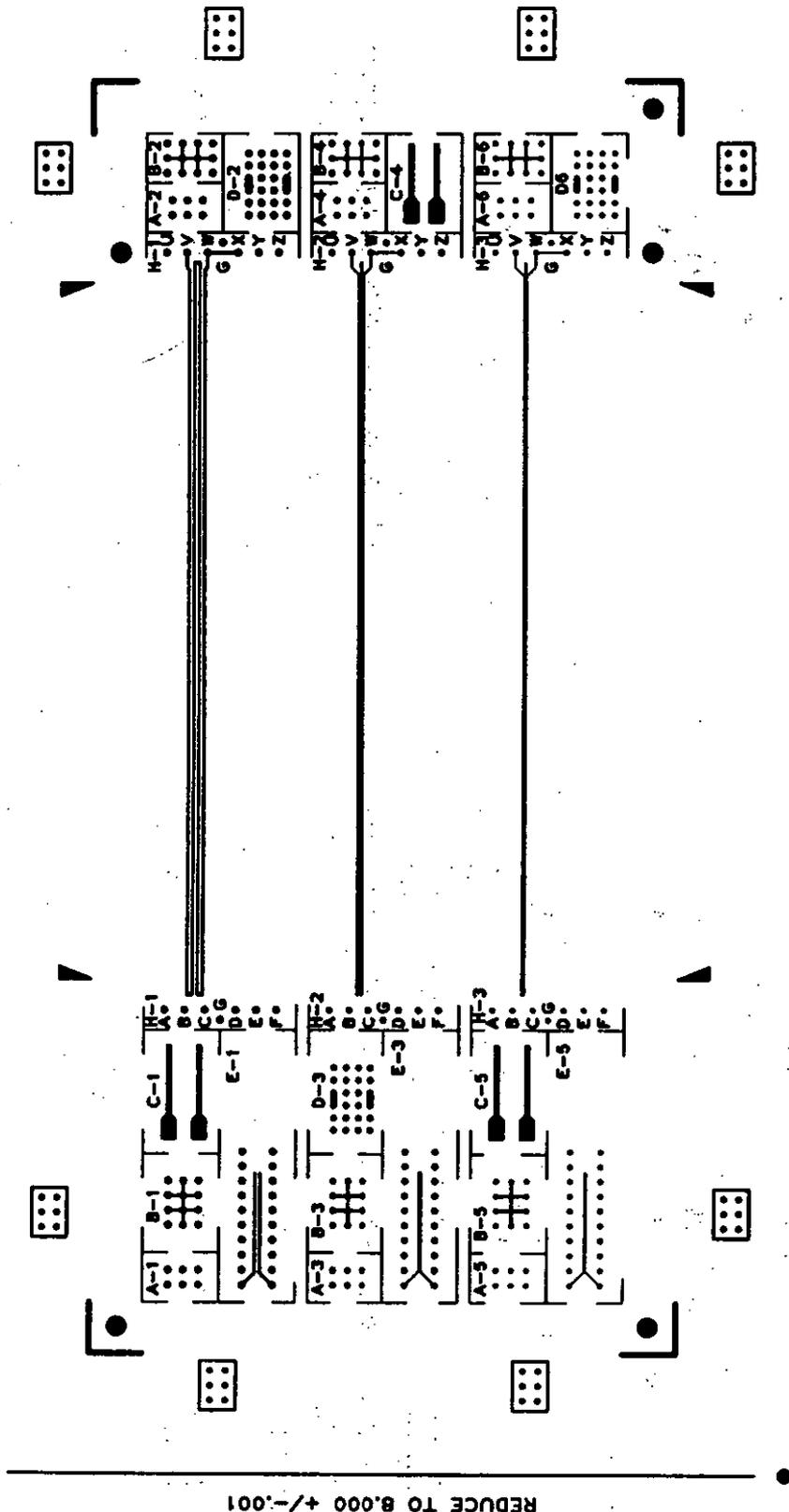
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HOLE TABULATION CHART		
CODE	DRILL NO	FINISHED DIA COVERCOAT DIA (LAYER 1)
A	1/16	.080 ± .005
B	---	.016 ± .003
C	---	.022 ± .003
D	---	.022 ± .003
		.062 ± .005

FIGURE 17. Single sided test specimen IPC-A-28/29.

REDUCE TO 1:1000 +/- .001



REDUCE TO 8:000 +/- .001

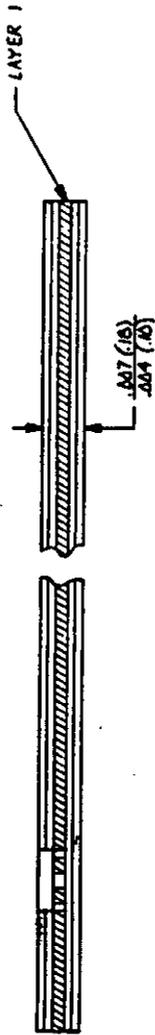
FIGURE 17. SINGLE SIDED TEST SPECIMEN
IPC-A-28/29 -Continued.

HOLE LOCATION CHART											
PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM	PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM	PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM
A	B	.000 (0.00)	.000 (0.00)	A	B	.725 (18.42)	2.400 (60.96)	A	B	.875 (22.23)	3.725 (94.62)
A	B	.000 (0.00)	5.250 (133.35)	A	B	.875 (22.23)	2.400 (60.96)	A	B	1.025 (26.04)	3.725 (94.62)
A	B	3.200 (81.28)	.000 (0.00)	A	B	1.025 (26.04)	2.400 (60.96)	A	B	1.175 (29.85)	3.725 (94.62)
A	B	.425 (10.80)	.475 (12.07)	A	B	1.175 (29.85)	2.400 (60.96)	A	B	1.325 (33.66)	3.725 (94.62)
A	B	.575 (14.61)	.475 (12.07)	A	B	1.325 (33.66)	2.400 (60.96)	A	B	1.475 (37.47)	3.725 (94.62)
A	B	.725 (18.42)	.475 (12.07)	A	B	1.475 (37.47)	2.400 (60.96)	A	B	1.625 (41.28)	3.725 (94.62)
A	B	.875 (22.23)	.475 (12.07)	A	B	1.625 (41.28)	2.400 (60.96)	A	B	1.775 (45.09)	3.725 (94.62)
A	B	1.025 (26.04)	.475 (12.07)	A	B	1.775 (45.09)	2.400 (60.96)	A	B	.425 (10.80)	4.025 (102.24)
A	B	1.175 (29.85)	.475 (12.07)	A	B	.425 (10.80)	2.825 (71.76)	A	B	.575 (14.61)	4.025 (102.24)
A	B	1.325 (33.66)	.475 (12.07)	A	B	.575 (14.61)	2.825 (71.76)	A	B	.725 (18.42)	4.025 (102.24)
A	B	1.475 (37.47)	.475 (12.07)	A	B	.725 (18.42)	2.975 (75.57)	A	B	.875 (22.23)	4.025 (102.24)
A	B	1.625 (41.28)	.475 (12.07)	A	B	.875 (22.23)	2.975 (75.57)	A	B	1.025 (26.04)	4.025 (102.24)
A	B	1.775 (45.09)	.475 (12.07)	A	B	1.025 (26.04)	3.125 (79.38)	A	B	1.175 (29.85)	4.025 (102.24)
A	B	.425 (10.80)	.775 (19.69)	A	B	1.175 (29.85)	3.125 (79.38)	A	B	1.325 (33.66)	4.025 (102.24)
A	B	.575 (14.61)	.775 (19.69)	A	B	1.325 (33.66)	3.125 (79.38)	A	B	1.475 (37.47)	4.025 (102.24)
A	B	.725 (18.42)	.775 (19.69)	A	B	1.475 (37.47)	2.825 (71.76)	A	B	1.625 (41.28)	4.025 (102.24)
A	B	.875 (22.23)	.775 (19.69)	A	B	1.625 (41.28)	2.825 (71.76)	A	B	1.775 (45.09)	4.025 (102.24)
A	B	1.025 (26.04)	.775 (19.69)	A	B	1.775 (45.09)	2.825 (71.76)	A	B	.425 (10.80)	4.450 (113.03)
A	B	1.175 (29.85)	.775 (19.69)	A	B	1.825 (46.18)	2.975 (75.57)	A	B	.575 (14.61)	4.450 (113.03)
A	B	1.325 (33.66)	.775 (19.69)	A	B	1.825 (46.18)	2.975 (75.57)	A	B	.725 (18.42)	4.450 (113.03)
A	B	1.475 (37.47)	.775 (19.69)	A	B	1.975 (50.00)	3.125 (79.38)	A	B	.875 (22.23)	4.450 (113.03)
A	B	1.625 (41.28)	.775 (19.69)	A	B	1.975 (50.00)	3.125 (79.38)	A	B	1.025 (26.04)	4.450 (113.03)
A	B	1.775 (45.09)	.775 (19.69)	A	B	2.125 (53.92)	3.125 (79.38)	A	B	1.175 (29.85)	4.450 (113.03)
A	B	.425 (10.80)	1.200 (30.48)	A	B	2.125 (53.92)	3.125 (79.38)	A	B	1.325 (33.66)	4.450 (113.03)
A	B	.575 (14.61)	1.350 (34.29)	A	B	2.275 (57.75)	3.275 (83.20)	A	B	1.475 (37.47)	4.450 (113.03)
A	B	.725 (18.42)	1.350 (34.29)	A	B	2.275 (57.75)	3.275 (83.20)	A	B	1.625 (41.28)	4.450 (113.03)
A	B	.875 (22.23)	1.350 (34.29)	A	B	2.425 (61.58)	3.425 (87.02)	A	B	1.775 (45.09)	4.450 (113.03)
A	B	1.025 (26.04)	1.350 (34.29)	A	B	2.425 (61.58)	3.425 (87.02)	A	B	.425 (10.80)	4.875 (124.45)
A	B	1.175 (29.85)	1.350 (34.29)	A	B	2.575 (65.41)	3.575 (90.84)	A	B	.575 (14.61)	4.875 (124.45)
A	B	1.325 (33.66)	1.350 (34.29)	A	B	2.575 (65.41)	3.575 (90.84)	A	B	.725 (18.42)	4.875 (124.45)
A	B	1.475 (37.47)	1.350 (34.29)	A	B	2.725 (69.24)	3.725 (94.62)	A	B	.875 (22.23)	4.875 (124.45)
A	B	1.625 (41.28)	1.350 (34.29)	A	B	2.725 (69.24)	3.725 (94.62)	A	B	1.025 (26.04)	4.875 (124.45)
A	B	1.775 (45.09)	1.350 (34.29)	A	B	2.875 (73.07)	3.875 (98.44)	A	B	1.175 (29.85)	4.875 (124.45)
A	B	.425 (10.80)	1.500 (38.10)	A	B	2.875 (73.07)	3.875 (98.44)	A	B	1.325 (33.66)	4.875 (124.45)
A	B	.575 (14.61)	1.500 (38.10)	A	B	3.025 (76.90)	4.025 (102.24)	A	B	1.475 (37.47)	4.875 (124.45)
A	B	.725 (18.42)	1.500 (38.10)	A	B	3.025 (76.90)	4.025 (102.24)	A	B	1.625 (41.28)	4.875 (124.45)
A	B	.875 (22.23)	1.500 (38.10)	A	B	3.175 (80.73)	4.175 (106.06)	A	B	1.775 (45.09)	4.875 (124.45)
A	B	1.025 (26.04)	1.500 (38.10)	A	B	3.175 (80.73)	4.175 (106.06)	A	B	.425 (10.80)	5.300 (135.06)
A	B	1.175 (29.85)	1.500 (38.10)	A	B	3.325 (84.56)	4.325 (109.88)	A	B	.575 (14.61)	5.300 (135.06)
A	B	1.325 (33.66)	1.500 (38.10)	A	B	3.325 (84.56)	4.325 (109.88)	A	B	.725 (18.42)	5.300 (135.06)
A	B	1.475 (37.47)	1.500 (38.10)	A	B	3.475 (88.39)	4.475 (113.70)	A	B	.875 (22.23)	5.300 (135.06)
A	B	1.625 (41.28)	1.500 (38.10)	A	B	3.475 (88.39)	4.475 (113.70)	A	B	1.025 (26.04)	5.300 (135.06)
A	B	1.775 (45.09)	1.500 (38.10)	A	B	3.625 (92.22)	4.625 (117.52)	A	B	1.175 (29.85)	5.300 (135.06)
A	B	.425 (10.80)	1.650 (41.91)	A	B	3.625 (92.22)	4.625 (117.52)	A	B	1.325 (33.66)	5.300 (135.06)
A	B	.575 (14.61)	1.650 (41.91)	A	B	3.775 (96.05)	4.775 (121.34)	A	B	1.475 (37.47)	5.300 (135.06)
A	B	.725 (18.42)	1.650 (41.91)	A	B	3.775 (96.05)	4.775 (121.34)	A	B	1.625 (41.28)	5.300 (135.06)
A	B	.875 (22.23)	1.650 (41.91)	A	B	3.925 (99.88)	4.925 (125.16)	A	B	1.775 (45.09)	5.300 (135.06)
A	B	1.025 (26.04)	1.650 (41.91)	A	B	3.925 (99.88)	4.925 (125.16)	A	B	.425 (10.80)	5.725 (145.67)
A	B	1.175 (29.85)	1.650 (41.91)	A	B	4.075 (103.71)	5.075 (128.99)	A	B	.575 (14.61)	5.725 (145.67)
A	B	1.325 (33.66)	1.650 (41.91)	A	B	4.075 (103.71)	5.075 (128.99)	A	B	.725 (18.42)	5.725 (145.67)
A	B	1.475 (37.47)	1.650 (41.91)	A	B	4.225 (107.54)	5.225 (132.81)	A	B	.875 (22.23)	5.725 (145.67)
A	B	1.625 (41.28)	1.650 (41.91)	A	B	4.225 (107.54)	5.225 (132.81)	A	B	1.025 (26.04)	5.725 (145.67)
A	B	1.775 (45.09)	1.650 (41.91)	A	B	4.375 (111.37)	5.375 (136.63)	A	B	1.175 (29.85)	5.725 (145.67)
A	B	.425 (10.80)	2.100 (53.34)	A	B	4.375 (111.37)	5.375 (136.63)	A	B	1.325 (33.66)	5.725 (145.67)
A	B	.575 (14.61)	2.100 (53.34)	A	B	4.525 (115.20)	5.525 (140.45)	A	B	1.475 (37.47)	5.725 (145.67)
A	B	.725 (18.42)	2.100 (53.34)	A	B	4.525 (115.20)	5.525 (140.45)	A	B	1.625 (41.28)	5.725 (145.67)
A	B	.875 (22.23)	2.100 (53.34)	A	B	4.675 (119.03)	5.675 (144.27)	A	B	1.775 (45.09)	5.725 (145.67)
A	B	1.025 (26.04)	2.100 (53.34)	A	B	4.675 (119.03)	5.675 (144.27)	A	B	.425 (10.80)	6.100 (155.48)
A	B	1.175 (29.85)	2.100 (53.34)	A	B	4.825 (122.86)	5.825 (148.30)	A	B	.575 (14.61)	6.100 (155.48)
A	B	1.325 (33.66)	2.100 (53.34)	A	B	4.825 (122.86)	5.825 (148.30)	A	B	.725 (18.42)	6.100 (155.48)
A	B	1.475 (37.47)	2.100 (53.34)	A	B	4.975 (126.69)	5.975 (152.12)	A	B	.875 (22.23)	6.100 (155.48)
A	B	1.625 (41.28)	2.100 (53.34)	A	B	4.975 (126.69)	5.975 (152.12)	A	B	1.025 (26.04)	6.100 (155.48)
A	B	1.775 (45.09)	2.100 (53.34)	A	B	5.125 (130.52)	6.125 (155.94)	A	B	1.175 (29.85)	6.100 (155.48)
A	B	.425 (10.80)	2.400 (60.96)	A	B	5.125 (130.52)	6.125 (155.94)	A	B	1.325 (33.66)	6.100 (155.48)
A	B	.575 (14.61)	2.400 (60.96)	A	B	5.275 (134.35)	6.275 (159.76)	A	B	1.475 (37.47)	6.100 (155.48)
A	B	.725 (18.42)	2.400 (60.96)	A	B	5.275 (134.35)	6.275 (159.76)	A	B	1.625 (41.28)	6.100 (155.48)
A	B	.875 (22.23)	2.400 (60.96)	A	B	5.425 (138.18)	6.425 (163.58)	A	B	1.775 (45.09)	6.100 (155.48)
A	B	1.025 (26.04)	2.400 (60.96)	A	B	5.425 (138.18)	6.425 (163.58)	A	B	.425 (10.80)	6.525 (166.17)
A	B	1.175 (29.85)	2.400 (60.96)	A	B	5.575 (142.01)	6.575 (169.99)	A	B	.575 (14.61)	6.525 (166.17)
A	B	1.325 (33.66)	2.400 (60.96)	A	B	5.575 (142.01)	6.575 (169.99)	A	B	.725 (18.42)	6.525 (166.17)
A	B	1.475 (37.47)	2.400 (60.96)	A	B	5.725 (145.84)	6.725 (173.81)	A	B	.875 (22.23)	6.525 (166.17)
A	B	1.625 (41.28)	2.400 (60.96)	A	B	5.725 (145.84)	6.725 (173.81)	A	B	1.025 (26.04)	6.525 (166.17)
A	B	1.775 (45.09)	2.400 (60.96)	A	B	5.875 (149.67)	6.875 (177.63)	A	B	1.175 (29.85)	6.525 (166.17)
A	B	.425 (10.80)	2.800 (71.12)	A	B	5.875 (149.67)	6.875 (177.63)	A	B	1.325 (33.66)	6.525 (166.17)
A	B	.575 (14.61)	2.800 (71.12)	A	B	6.025 (153.50)	7.025 (181.45)	A	B	1.475 (37.47)	6.525 (166.17)
A	B	.725 (18.42)	2.800 (71.12)	A	B	6.025 (153.50)	7.025 (181.45)	A	B	1.625 (41.28)	6.525 (166.17)
A	B	.875 (22.23)	2.800 (71.12)	A	B	6.175 (157.33)	7.175 (185.27)	A	B	1.775 (45.09)	6.525 (166.17)
A	B	1.025 (26.04)	2.800 (71.12)	A	B	6.175 (157.33)	7.175 (185.27)	A	B	.425 (10.80)	6.950 (176.68)
A	B	1.175 (29.85)	2.800 (71.12)	A	B	6.325 (161.16)	7.325 (189.10)	A	B	.575 (14.61)	6.950 (176.68)
A	B	1.325 (33.66)	2.800 (71.12)	A	B	6.325 (161.16)	7.325 (189.10)	A	B	.725 (18.42)	6.950 (176.68)
A	B	1.475 (37.47)	2.800 (71.12)	A	B	6.475 (164.99)	7.475 (192.92)	A	B	.875 (22.23)	6.950 (176.68)
A	B	1.625 (41.28)	2.800 (71.12)	A	B	6.475 (164.99)	7.475 (192.92)	A	B	1.025 (26.04)	6.950 (176.68)
A	B	1.775 (45.09)	2.800 (71.12)	A	B	6.625 (168.82)	7.625 (196.74)	A	B	1.175 (29.85)	6.950 (176.68)
A	B	.425 (10.80)	3.200 (81.28)	A	B	6.625 (168.82)	7.625 (196.74)	A	B	1.325 (33.66)	6.950 (176.68)
A	B	.575 (14.61)	3.200 (81.28)	A	B	6.775 (172.65)	7.775 (200.56)	A	B	1.475 (37.47)	6.950 (176.68)
A	B	.725 (18.42)	3.200 (81.28)	A	B	6.775 (172.65)	7.775 (200.56)	A	B	1.625 (41.28)	6.950 (176.68)
A	B	.875 (22.23)	3.200 (81.28)	A	B	6.925 (176.48)	7.925 (204.38)	A	B	1.775 (45.09)	6.950 (176.68)
A	B	1.025 (26.04)	3.200 (81.28)	A	B	6.925 (176.48)	7.925 (204.38)	A	B	.425 (10.80)	7.375 (186.89)
A	B	1.175 (29.85)	3.200 (81.28)	A	B	7.075 (180.31)	8.075 (208.21)	A	B	.575 (14.61)	7.375 (186.89)
A	B	1.325 (33.66)	3.200 (81.28)	A	B	7.075 (180.31)	8.075 (208.21)	A	B	.725 (18.42)	7.375 (186.89)
A	B	1.475 (37.47)	3.200 (81.28)	A	B	7.225 (184.14)	8.225 (212.03)	A	B	.875 (22.23)	7.375 (186.89)
A	B	1.625 (41.28)	3.200 (81.28)	A	B	7.225 (184.14)	8.225 (212.03)	A	B	1.025 (26.04)	7.375 (186.89)
A	B	1.775 (45.09)	3.200 (81.28)	A	B	7.375 (187.97)	8.375 (215.85)	A	B	1.175 (29.85)	7.3

MIL-P-50884C
APPENDIX

HOLE LOCATION CHART											
PRI DATUM	SEC DATUM	X' DIM	Y' DIM	PRI DATUM	SEC DATUM	X' DIM	Y' DIM	PRI DATUM	SEC DATUM	X' DIM	Y' DIM
A	C	.000 (0.00)	.000 (0.00)	A	C	.525 (13.34)	2.825 (71.76)	A	C	.800 (20.32)	4.650 (118.11)
A	C	.000 (0.00)	5.250 (133.35)	A	C	.375 (9.53)	2.975 (75.57)	A	C	.950 (24.13)	4.650 (118.11)
A	C	1.450 (36.83)	.000 (0.00)	A	C	.525 (13.34)	2.975 (75.57)	A	C	1.100 (27.94)	4.650 (118.11)
A	C	.000 (0.00)	.450 (11.43)	A	C	.375 (9.53)	3.125 (79.38)	A	C	.800 (20.32)	4.800 (121.92)
A	C	.000 (0.00)	.650 (16.51)	A	C	.525 (13.34)	3.125 (79.38)	A	C	.950 (24.13)	4.800 (121.92)
A	C	.000 (0.00)	.850 (21.59)	A	C	.800 (20.32)	2.725 (69.22)	A	C	1.100 (27.94)	4.800 (121.92)
A	C	.000 (0.00)	1.150 (29.21)	A	C	.950 (24.13)	2.725 (69.22)				
A	C	.000 (0.00)	1.350 (34.29)	A	C	1.100 (27.94)	2.725 (69.22)				
A	C	.000 (0.00)	1.550 (39.37)	A	C	.800 (20.32)	2.875 (73.03)				
A	C	.100 (2.54)	1.000 (25.40)	A	C	.950 (24.13)	2.875 (73.03)				
A	C	.375 (9.53)	.375 (9.53)	A	C	1.100 (27.94)	2.875 (73.03)				
A	C	.500 (12.70)	.375 (9.53)	A	C	.800 (20.32)	3.025 (76.84)				
A	C	.625 (15.88)	.375 (9.53)	A	C	.950 (24.13)	3.025 (76.84)				
A	C	.750 (19.05)	.375 (9.53)	A	C	1.100 (27.94)	3.025 (76.84)				
A	C	.875 (22.23)	.375 (9.53)	A	C	.800 (20.32)	3.175 (80.65)				
A	C	1.000 (25.40)	.375 (9.53)	A	C	.950 (24.13)	3.175 (80.65)				
A	C	.375 (9.53)	.500 (12.70)	A	C	1.100 (27.94)	3.175 (80.65)				
A	C	.500 (12.70)	.500 (12.70)	A	C	.000 (0.00)	3.700 (93.98)				
A	C	.625 (15.88)	.500 (12.70)	A	C	.000 (0.00)	3.900 (99.06)				
A	C	.750 (19.05)	.500 (12.70)	A	C	.000 (0.00)	4.100 (104.14)				
A	C	.875 (22.23)	.500 (12.70)	A	C	.000 (0.00)	4.400 (111.76)				
A	C	1.000 (25.40)	.500 (12.70)	A	C	.000 (0.00)	4.600 (116.84)				
A	C	.375 (9.53)	.625 (15.88)	A	C	1.000 (25.40)	4.800 (121.92)				
A	C	.500 (12.70)	.625 (15.88)	A	C	.100 (2.54)	4.250 (107.95)				
A	C	.625 (15.88)	.625 (15.88)	A	C	.375 (9.53)	3.625 (92.08)				
A	C	.750 (19.05)	.625 (15.88)	A	C	.500 (12.70)	3.625 (92.08)				
A	C	.875 (22.23)	.625 (15.88)	A	C	.625 (15.88)	3.625 (92.08)				
A	C	1.000 (25.40)	.625 (15.88)	A	C	.750 (19.05)	3.625 (92.08)				
A	C	.375 (9.53)	.750 (19.05)	A	C	.875 (22.23)	3.625 (92.08)				
A	C	.500 (12.70)	.750 (19.05)	A	C	1.000 (25.40)	3.625 (92.08)				
A	C	.625 (15.88)	.750 (19.05)	A	C	.375 (9.53)	3.750 (95.25)				
A	C	.750 (19.05)	.750 (19.05)	A	C	.500 (12.70)	3.750 (95.25)				
A	C	.875 (22.23)	.750 (19.05)	A	C	.625 (15.88)	3.750 (95.25)				
A	C	1.000 (25.40)	.750 (19.05)	A	C	.750 (19.05)	3.750 (95.25)				
A	C	.375 (9.53)	1.200 (30.48)	A	C	.875 (22.23)	3.750 (95.25)				
A	C	.525 (13.34)	1.200 (30.48)	A	C	1.000 (25.40)	3.750 (95.25)				
A	C	.375 (9.53)	1.350 (34.29)	A	C	.375 (9.53)	3.875 (98.43)				
A	C	.525 (13.34)	1.350 (34.29)	A	C	.500 (12.70)	3.875 (98.43)				
A	C	.375 (9.53)	1.500 (38.10)	A	C	.625 (15.88)	3.875 (98.43)				
A	C	.525 (13.34)	1.500 (38.10)	A	C	.750 (19.05)	3.875 (98.43)				
A	C	.800 (20.32)	1.100 (27.94)	A	C	.875 (22.23)	3.875 (98.43)				
A	C	.950 (24.13)	1.100 (27.94)	A	C	1.000 (25.40)	3.875 (98.43)				
A	C	1.100 (27.94)	1.100 (27.94)	A	C	.375 (9.53)	4.000 (101.60)				
A	C	.800 (20.32)	1.250 (31.75)	A	C	.500 (12.70)	4.000 (101.60)				
A	C	.950 (24.13)	1.250 (31.75)	A	C	.625 (15.88)	4.000 (101.60)				
A	C	1.100 (27.94)	1.250 (31.75)	A	C	.750 (19.05)	4.000 (101.60)				
A	C	.800 (20.32)	1.400 (35.56)	A	C	.875 (22.23)	4.000 (101.60)				
A	C	.950 (24.13)	1.400 (35.56)	A	C	1.000 (25.40)	4.000 (101.60)				
A	C	1.100 (27.94)	1.400 (35.56)	A	C	.375 (9.53)	4.450 (113.03)				
A	C	.800 (20.32)	1.550 (39.37)	A	C	.525 (13.34)	4.450 (113.03)				
A	C	.950 (24.13)	1.550 (39.37)	A	C	.375 (9.53)	4.600 (116.84)				
A	C	1.100 (27.94)	1.550 (39.37)	A	C	.525 (13.34)	4.600 (116.84)				
A	C	.000 (0.00)	2.075 (52.71)	A	C	.375 (9.53)	4.750 (120.65)				
A	C	.000 (0.00)	2.275 (57.79)	A	C	.525 (13.34)	4.750 (120.65)				
A	C	.000 (0.00)	2.475 (62.87)	A	C	.800 (20.32)	4.550 (110.49)				
A	C	.000 (0.00)	2.775 (70.49)	A	C	.950 (24.13)	4.350 (110.49)				
A	C	.000 (0.00)	2.975 (75.57)	A	C	1.100 (27.94)	4.350 (110.49)				
A	C	.000 (0.00)	3.175 (80.65)	A	C	.800 (20.32)	4.500 (114.30)				
A	C	.100 (2.54)	2.625 (66.68)	A	C	.950 (24.13)	4.500 (114.30)				
A	C	.375 (9.53)	2.825 (71.76)	A	C	1.100 (27.94)	4.500 (114.30)				

FIGURE 17. Single sided test specimen IPC-A-28/29 - Continued.



SECTION A-A

MATERIAL KEY

-  COPPER
-  ADHESIVE
-  KAPTON

FIGURE 17. Single sided test specimen IPC-A-28/29 - Continued.

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Dimensions are in inches.
2. Metric equivalents are in parentheses.
3. Metric equivalents are given for general information only.
4. Unless otherwise specified tolerances are ± 0.03 (0.8 mm) for two place decimals and ± 0.10 (0.25 mm) for three place decimals.
5. Interpret drawing per MIL-D-1000.
6. Fabricate per MIL-P-50884.
7. Flex clad material shall be IPC-FC-241A/0-X-XXIX-CFW7-1S/00, class 3.
8. Adhesive material shall be IPC-FC-233/0-X-XXXX-X, class 3. Thickness is at manufacturers discretion.
9. Dielectric material shall be IPC-FC-232A/0-X-XXIX-1/0, class 3.
10. The "A" coupons around the outer periphery of the board, are for manufacturing purposes only. They do not need to be shipped with the finished boards.
11. All holes are within \varnothing .005 (0.13 mm) and are located on a .025 (0.64 mm) grid pattern.
12. Use artwork master no. IPC-B-28/50884, layer 1.
13. All exposed copper shall be tin-lead plated and fused or solder coated per paragraph 3.3.11 and 3.7.2.

FIGURE 17. Single sided test specimen IPC-A-28/29 - Continued.

FLEXIBLE AND RIGID-FLEX PRINTED WIRING TEST COUPONS
CERTIFICATION TEST BOARD NOTES
TYPE II PER MIL-P-50884C

1. Materials: Reference FIGURE 18
 - a. Flexible metal clad dielectrics per IPC-FC-241A double clad one ounce copper one mil polyimide
 - b. Adhesive coated dielectric films per IPC-FC-232A one mil polyimide
 - c. Flexible adhesive bonding films per IPC-FC-233A
 - d. Stiffener plastic sheet per MIL-P-13949 unclad .032 thick
2. Plating
 - a. Copper plating in holes to be .001 minimum per MIL-C-14550
 - b. All exposed copper to be tin-lead plated and fused or solder coated per MIL-P-50884C, Paragraph 3.4.7
3. Dimensional - Reference: FIGURE 19
 - a. Minimum annular ring requirement is .005 inch
 - b. Tolerance on all hole locations is .005 RTP
 - c. Plated thru hole diameter to be $.026 \pm .003$ inch
 - d. Cover coat insulation hole diameter to be $.062 \pm .005$ inch
 - e. Stiffener hole diameter to be $.062 \pm .005$ inch
 - f. "C" coupon to be left uncovered on layer 1 only
 - g. All lines and spacing are to be $\pm 20\%$ of artwork master
 - h. All trim dimensions $\pm .030$
 - i. Stiffener to be bonded to layer 2 side
 - j. Artwork master No. IPC-B-29/50884, Layer 1 and 2
4. Shipping Information
 - a. The manufacturer will ship with the certification board a list of materials used and any deviations to the drawing.

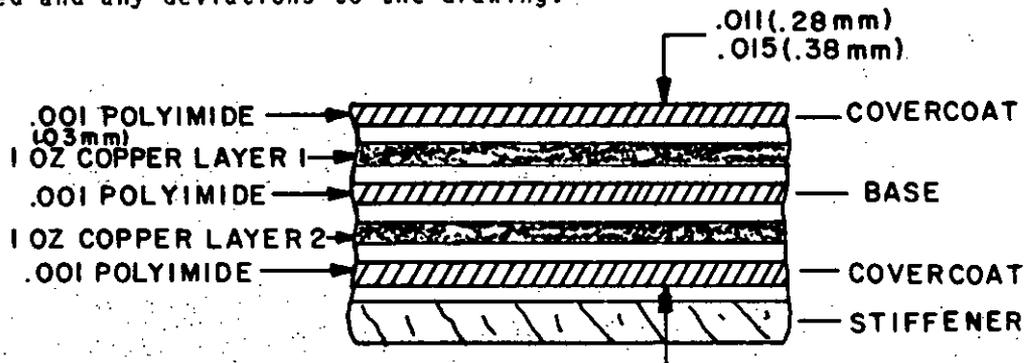
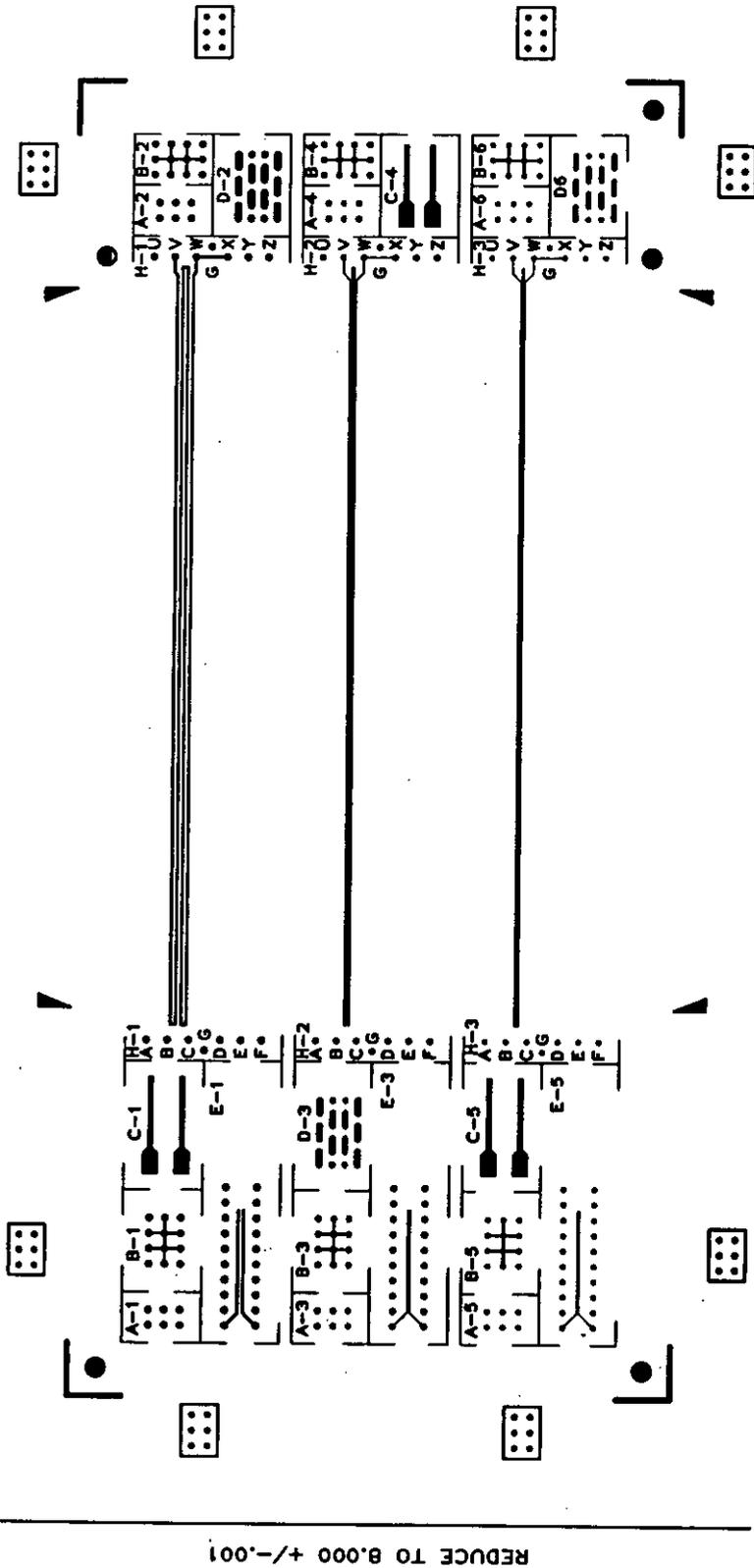


FIGURE 18. Type 2 materials.

REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 19. DOUBLE SIDED TEST SPECIMEN
IPC-A-28
LAYER 1 - Continued.

REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 19. DOUBLE SIDED TEST SPECIMEN
IPC-A-28
LAYER 2 - Continued

MIL-P-50884C
APPENDIX

HOLE LOCATION CHART											
PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM	PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM	PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM
A	B	000 (00.00)	000 (00.00)	A	B	.725 (18.42)	2.400 (60.96)	A	B	.875 (22.23)	3.725 (94.62)
A	B	000 (00.00)	5.250 (133.35)	A	B	.875 (22.23)	2.400 (60.96)	A	B	1.025 (26.04)	3.725 (94.62)
A	B	3.200 (81.28)	000 (00.00)	A	B	1.025 (26.04)	2.400 (60.96)	A	B	1.175 (29.85)	3.725 (94.62)
A	B	.425 (10.80)	.475 (12.07)	A	B	1.175 (29.85)	2.400 (60.96)	A	B	1.325 (33.66)	3.725 (94.62)
A	B	.575 (14.61)	.475 (12.07)	A	B	1.325 (33.66)	2.400 (60.96)	A	B	1.475 (37.47)	3.725 (94.62)
A	B	.725 (18.42)	.475 (12.07)	A	B	1.475 (37.47)	2.400 (60.96)	A	B	1.625 (41.28)	3.725 (94.62)
A	B	.875 (22.23)	.475 (12.07)	A	B	1.625 (41.28)	2.400 (60.96)	A	B	1.775 (45.09)	3.725 (94.62)
A	B	1.025 (26.04)	.475 (12.07)	A	B	1.775 (45.09)	2.400 (60.96)	A	B	.425 (10.80)	4.025 (102.24)
A	B	1.175 (29.85)	.475 (12.07)	A	B	.425 (10.80)	2.825 (71.76)	A	B	.575 (14.61)	4.025 (102.24)
A	B	1.325 (33.66)	.475 (12.07)	A	B	.575 (14.61)	2.825 (71.76)	A	B	.725 (18.42)	4.025 (102.24)
A	B	1.475 (37.47)	.475 (12.07)	A	B	.725 (18.42)	2.975 (75.57)	A	B	.875 (22.23)	4.025 (102.24)
A	B	1.625 (41.28)	.475 (12.07)	A	B	.875 (22.23)	2.975 (75.57)	A	B	1.025 (26.04)	4.025 (102.24)
A	B	1.775 (45.09)	.475 (12.07)	A	B	.925 (23.38)	3.125 (79.38)	A	B	1.175 (29.85)	4.025 (102.24)
A	B	.425 (10.80)	.775 (19.69)	A	B	1.025 (26.04)	2.825 (71.76)	A	B	1.325 (33.66)	4.025 (102.24)
A	B	.575 (14.61)	.775 (19.69)	A	B	1.175 (29.85)	2.825 (71.76)	A	B	1.475 (37.47)	4.025 (102.24)
A	B	.725 (18.42)	.775 (19.69)	A	B	1.325 (33.66)	2.825 (71.76)	A	B	.425 (10.80)	4.450 (113.03)
A	B	.875 (22.23)	.775 (19.69)	A	B	1.475 (37.47)	2.825 (71.76)	A	B	.575 (14.61)	4.450 (113.03)
A	B	1.025 (26.04)	.775 (19.69)	A	B	1.625 (41.28)	2.975 (75.57)	A	B	.725 (18.42)	4.450 (113.03)
A	B	1.175 (29.85)	.775 (19.69)	A	B	1.775 (45.09)	2.975 (75.57)	A	B	.875 (22.23)	4.450 (113.03)
A	B	1.325 (33.66)	.775 (19.69)	A	B	1.925 (49.40)	3.125 (79.38)	A	B	1.025 (26.04)	4.450 (113.03)
A	B	1.475 (37.47)	.775 (19.69)	A	B	2.075 (53.71)	3.125 (79.38)	A	B	1.175 (29.85)	4.450 (113.03)
A	B	1.625 (41.28)	.775 (19.69)	A	B	2.225 (57.15)	3.125 (79.38)	A	B	1.325 (33.66)	4.450 (113.03)
A	B	1.775 (45.09)	.775 (19.69)	A	B	2.375 (60.59)	3.125 (79.38)	A	B	1.475 (37.47)	4.450 (113.03)
A	B	.425 (10.80)	1.200 (30.48)	A	B	2.525 (64.03)	3.125 (79.38)	A	B	1.625 (41.28)	4.450 (113.03)
A	B	.575 (14.61)	1.200 (30.48)	A	B	2.675 (67.47)	3.125 (79.38)	A	B	1.775 (45.09)	4.450 (113.03)
A	B	.725 (18.42)	1.350 (34.29)	A	B	2.825 (71.91)	3.125 (79.38)	A	B	1.925 (49.40)	4.450 (113.03)
A	B	.875 (22.23)	1.350 (34.29)	A	B	2.975 (75.35)	3.125 (79.38)	A	B	2.075 (53.71)	3.750 (94.62)
A	B	1.025 (26.04)	1.350 (34.29)	A	B	3.125 (79.38)	3.125 (79.38)	A	B	2.225 (57.15)	3.750 (94.62)
A	B	1.175 (29.85)	1.350 (34.29)	A	B	3.275 (83.82)	3.125 (79.38)	A	B	2.375 (60.59)	3.750 (94.62)
A	B	1.325 (33.66)	1.350 (34.29)	A	B	3.425 (87.26)	3.125 (79.38)	A	B	2.525 (64.03)	3.750 (94.62)
A	B	1.475 (37.47)	1.350 (34.29)	A	B	3.575 (91.70)	3.125 (79.38)	A	B	2.675 (67.47)	3.750 (94.62)
A	B	1.625 (41.28)	1.350 (34.29)	A	B	3.725 (95.14)	3.125 (79.38)	A	B	2.825 (71.91)	3.750 (94.62)
A	B	1.775 (45.09)	1.350 (34.29)	A	B	3.875 (98.58)	3.125 (79.38)	A	B	2.975 (75.35)	3.750 (94.62)
A	B	1.925 (49.40)	1.350 (34.29)	A	B	4.025 (102.02)	3.125 (79.38)	A	B	3.125 (79.38)	3.750 (94.62)
A	B	2.075 (53.71)	1.500 (38.10)	A	B	4.175 (106.46)	3.125 (79.38)	A	B	3.275 (83.82)	3.750 (94.62)
A	B	2.225 (57.15)	1.500 (38.10)	A	B	4.325 (110.90)	3.125 (79.38)	A	B	3.425 (87.26)	3.750 (94.62)
A	B	2.375 (60.59)	1.500 (38.10)	A	B	4.475 (115.34)	3.125 (79.38)	A	B	3.575 (91.70)	3.750 (94.62)
A	B	2.525 (64.03)	1.500 (38.10)	A	B	4.625 (119.78)	3.125 (79.38)	A	B	3.725 (95.14)	3.750 (94.62)
A	B	2.675 (67.47)	1.500 (38.10)	A	B	4.775 (124.22)	3.125 (79.38)	A	B	3.875 (98.58)	3.750 (94.62)
A	B	2.825 (71.91)	1.500 (38.10)	A	B	4.925 (128.66)	3.125 (79.38)	A	B	4.025 (102.02)	3.750 (94.62)
A	B	2.975 (75.35)	1.500 (38.10)	A	B	5.075 (133.10)	3.125 (79.38)	A	B	4.175 (106.46)	3.750 (94.62)
A	B	3.125 (79.38)	1.500 (38.10)	A	B	5.225 (137.54)	3.125 (79.38)	A	B	4.325 (110.90)	3.750 (94.62)
A	B	3.275 (83.82)	1.500 (38.10)	A	B	5.375 (141.98)	3.125 (79.38)	A	B	4.475 (115.34)	3.750 (94.62)
A	B	3.425 (87.26)	1.500 (38.10)	A	B	5.525 (146.42)	3.125 (79.38)	A	B	4.625 (119.78)	3.750 (94.62)
A	B	3.575 (91.70)	1.500 (38.10)	A	B	5.675 (150.86)	3.125 (79.38)	A	B	4.775 (124.22)	3.750 (94.62)
A	B	3.725 (95.14)	1.500 (38.10)	A	B	5.825 (155.30)	3.125 (79.38)	A	B	4.925 (128.66)	3.750 (94.62)
A	B	3.875 (98.58)	1.500 (38.10)	A	B	5.975 (159.74)	3.125 (79.38)	A	B	5.075 (133.10)	3.750 (94.62)
A	B	4.025 (102.02)	1.500 (38.10)	A	B	6.125 (164.18)	3.125 (79.38)	A	B	5.225 (137.54)	3.750 (94.62)
A	B	4.175 (106.46)	1.500 (38.10)	A	B	6.275 (168.62)	3.125 (79.38)	A	B	5.375 (141.98)	3.750 (94.62)
A	B	4.325 (110.90)	1.500 (38.10)	A	B	6.425 (173.06)	3.125 (79.38)	A	B	5.525 (146.42)	3.750 (94.62)
A	B	4.475 (115.34)	1.500 (38.10)	A	B	6.575 (177.50)	3.125 (79.38)	A	B	5.675 (150.86)	3.750 (94.62)
A	B	4.625 (119.78)	1.500 (38.10)	A	B	6.725 (181.94)	3.125 (79.38)	A	B	5.825 (155.30)	3.750 (94.62)
A	B	4.775 (124.22)	1.500 (38.10)	A	B	6.875 (186.38)	3.125 (79.38)	A	B	5.975 (159.74)	3.750 (94.62)
A	B	4.925 (128.66)	1.500 (38.10)	A	B	7.025 (190.82)	3.125 (79.38)	A	B	6.125 (164.18)	3.750 (94.62)
A	B	5.075 (133.10)	1.500 (38.10)	A	B	7.175 (195.26)	3.125 (79.38)	A	B	6.275 (168.62)	3.750 (94.62)
A	B	5.225 (137.54)	1.500 (38.10)	A	B	7.325 (199.70)	3.125 (79.38)	A	B	6.425 (173.06)	3.750 (94.62)
A	B	5.375 (141.98)	1.500 (38.10)	A	B	7.475 (204.14)	3.125 (79.38)	A	B	6.575 (177.50)	3.750 (94.62)
A	B	5.525 (146.42)	1.500 (38.10)	A	B	7.625 (208.58)	3.125 (79.38)	A	B	6.725 (181.94)	3.750 (94.62)
A	B	5.675 (150.86)	1.500 (38.10)	A	B	7.775 (213.02)	3.125 (79.38)	A	B	6.875 (186.38)	3.750 (94.62)
A	B	5.825 (155.30)	1.500 (38.10)	A	B	7.925 (217.46)	3.125 (79.38)	A	B	7.025 (190.82)	3.750 (94.62)
A	B	5.975 (159.74)	1.500 (38.10)	A	B	8.075 (221.90)	3.125 (79.38)	A	B	7.175 (195.26)	3.750 (94.62)
A	B	6.125 (164.18)	1.500 (38.10)	A	B	8.225 (226.34)	3.125 (79.38)	A	B	7.325 (199.70)	3.750 (94.62)
A	B	6.275 (168.62)	1.500 (38.10)	A	B	8.375 (230.78)	3.125 (79.38)	A	B	7.475 (204.14)	3.750 (94.62)
A	B	6.425 (173.06)	1.500 (38.10)	A	B	8.525 (235.22)	3.125 (79.38)	A	B	7.625 (208.58)	3.750 (94.62)
A	B	6.575 (177.50)	1.500 (38.10)	A	B	8.675 (239.66)	3.125 (79.38)	A	B	7.775 (213.02)	3.750 (94.62)
A	B	6.725 (181.94)	1.500 (38.10)	A	B	8.825 (244.10)	3.125 (79.38)	A	B	7.925 (217.46)	3.750 (94.62)
A	B	6.875 (186.38)	1.500 (38.10)	A	B	8.975 (248.54)	3.125 (79.38)	A	B	8.075 (221.90)	3.750 (94.62)
A	B	7.025 (190.82)	1.500 (38.10)	A	B	9.125 (252.98)	3.125 (79.38)	A	B	8.225 (226.34)	3.750 (94.62)
A	B	7.175 (195.26)	1.500 (38.10)	A	B	9.275 (257.42)	3.125 (79.38)	A	B	8.375 (230.78)	3.750 (94.62)
A	B	7.325 (199.70)	1.500 (38.10)	A	B	9.425 (261.86)	3.125 (79.38)	A	B	8.525 (235.22)	3.750 (94.62)
A	B	7.475 (204.14)	1.500 (38.10)	A	B	9.575 (266.30)	3.125 (79.38)	A	B	8.675 (239.66)	3.750 (94.62)
A	B	7.625 (208.58)	1.500 (38.10)	A	B	9.725 (270.74)	3.125 (79.38)	A	B	8.825 (244.10)	3.750 (94.62)
A	B	7.775 (213.02)	1.500 (38.10)	A	B	9.875 (275.18)	3.125 (79.38)	A	B	8.975 (248.54)	3.750 (94.62)
A	B	7.925 (217.46)	1.500 (38.10)	A	B	10.025 (279.62)	3.125 (79.38)	A	B	9.125 (252.98)	3.750 (94.62)
A	B	8.075 (221.90)	1.500 (38.10)	A	B	10.175 (284.06)	3.125 (79.38)	A	B	9.275 (257.42)	3.750 (94.62)
A	B	8.225 (226.34)	1.500 (38.10)	A	B	10.325 (288.50)	3.125 (79.38)	A	B	9.425 (261.86)	3.750 (94.62)
A	B	8.375 (230.78)	1.500 (38.10)	A	B	10.475 (292.94)	3.125 (79.38)	A	B	9.575 (266.30)	3.750 (94.62)
A	B	8.525 (235.22)	1.500 (38.10)	A	B	10.625 (297.38)	3.125 (79.38)	A	B	9.725 (270.74)	3.750 (94.62)
A	B	8.675 (239.66)	1.500 (38.10)	A	B	10.775 (301.82)	3.125 (79.38)	A	B	9.875 (275.18)	3.750 (94.62)
A	B	8.825 (244.10)	1.500 (38.10)	A	B	10.925 (306.26)	3.125 (79.38)	A	B	10.025 (279.62)	3.750 (94.62)
A	B	8.975 (248.54)	1.500 (38.10)	A	B	11.075 (310.70)	3.125 (79.38)	A	B	10.175 (284.06)	3.750 (94.62)
A	B	9.125 (252.98)	1.500 (38.10)	A	B	11.225 (315.14)	3.125 (79.38)	A	B	10.325 (288.50)	3.750 (94.62)
A	B	9.275 (257.42)	1.500 (38.10)	A	B	11.375 (319.58)	3.125 (79.38)	A	B	10.475 (292.94)	3.750 (94.62)
A	B	9.425 (261.86)	1.500 (38.10)	A	B	11.525 (324.02)	3.125 (79.38)	A	B	10.625 (297.38)	3.750 (94.62)
A	B	9.575 (266.30)	1.500 (38.10)	A	B	11.675 (328.46)	3.125 (79.38)	A	B	10.775 (301.82)	3.750 (94.62)
A	B	9.725 (270.74)	1.500 (38.10)	A	B	11.825 (332.90)	3.125 (79.38)	A	B	10.925 (306.26)	3.750 (94.62)
A	B	9.875 (275.18)	1.500 (38.10)	A	B	11.975 (337.34)	3.125 (79.38)	A	B	11.075 (310.70)	3.750 (94.62)
A	B	10.025 (279.62)	1.500 (38.10)	A	B	12.125 (341.78)	3.125 (79.38)	A	B	11.225 (315.14)	3.750 (94.62)
A	B	10.175 (284.06)	1.500 (38.10)	A	B	12.275 (346.22)	3.125 (79.38)	A	B	11.375 (319.58)	3.750 (94.62)
A	B	10.325 (288.50)	1.500 (38.10)	A	B	12.425 (350.66)	3.125 (79.38)	A	B	11.525 (324.02)	3.750 (94.62)
A	B	10.475 (292.94)	1.500 (38.10)	A	B	12.575 (355.10)	3.125 (79.38)	A	B	11.675 (328.46)	3.750 (94.62)
A	B	10.625 (297.38)	1.500 (38.10)	A	B	12.725 (359.54)	3.125 (79.38)	A	B	11.825 (332.90)	3.75

MIL-P-50884C
APPENDIX

HOLE LOCATION CHART											
PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM	PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM	PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM
A	C	.000 (0.00)	.000 (0.00)	A	C	.525 (13.34)	2.825 (71.76)	A	C	.800 (20.32)	4.650 (118.11)
A	C	.000 (0.00)	5.250 (133.35)	A	C	.375 (9.53)	2.975 (75.57)	A	C	.950 (24.13)	4.650 (118.11)
A	C	1.450 (36.83)	.000 (0.00)	A	C	.525 (13.34)	2.975 (75.57)	A	C	1.100 (27.94)	4.650 (118.11)
A	C	.000 (0.00)	.450 (11.43)	A	C	.375 (9.53)	3.125 (79.38)	A	C	.800 (20.32)	4.800 (121.92)
A	C	.000 (0.00)	.650 (16.51)	A	C	.525 (13.34)	3.125 (79.38)	A	C	.950 (24.13)	4.800 (121.92)
A	C	.000 (0.00)	.850 (21.59)	A	C	.000 (0.00)	2.725 (69.22)	A	C	1.100 (27.94)	4.800 (121.92)
A	C	.000 (0.00)	1.150 (29.21)	A	C	.950 (24.13)	2.725 (69.22)				
A	C	.000 (0.00)	1.350 (34.29)	A	C	1.100 (27.94)	2.725 (69.22)				
A	C	.000 (0.00)	1.550 (39.37)	A	C	.800 (20.32)	2.875 (73.03)				
A	C	.100 (2.54)	1.000 (25.40)	A	C	.950 (24.13)	2.875 (73.03)				
A	C	.375 (9.53)	.375 (9.53)	A	C	1.100 (27.94)	2.875 (73.03)				
A	C	.500 (12.70)	.375 (9.53)	A	C	.800 (20.32)	3.025 (76.84)				
A	C	.625 (15.88)	.375 (9.53)	A	C	.950 (24.13)	3.025 (76.84)				
A	C	.750 (19.05)	.375 (9.53)	A	C	1.100 (27.94)	3.025 (76.84)				
A	C	.875 (22.23)	.375 (9.53)	A	C	.800 (20.32)	3.175 (80.65)				
A	C	1.000 (25.40)	.375 (9.53)	A	C	.950 (24.13)	3.175 (80.65)				
A	C	.375 (9.53)	.500 (12.70)	A	C	1.100 (27.94)	3.175 (80.65)				
A	C	.500 (12.70)	.500 (12.70)	A	C	.000 (0.00)	3.700 (93.98)				
A	C	.625 (15.88)	.500 (12.70)	A	C	.000 (0.00)	3.900 (99.06)				
A	C	.750 (19.05)	.500 (12.70)	A	C	.000 (0.00)	4.100 (104.14)				
A	C	.875 (22.23)	.500 (12.70)	A	C	.000 (0.00)	4.400 (111.76)				
A	C	1.000 (25.40)	.500 (12.70)	A	C	.000 (0.00)	4.600 (116.84)				
A	C	.375 (9.53)	.625 (15.88)	A	C	1.000 (25.40)	4.800 (121.92)				
A	C	.500 (12.70)	.625 (15.88)	A	C	.100 (2.54)	4.250 (107.95)				
A	C	.625 (15.88)	.625 (15.88)	A	C	.375 (9.53)	3.625 (92.08)				
A	C	.750 (19.05)	.625 (15.88)	A	C	.500 (12.70)	3.625 (92.08)				
A	C	.875 (22.23)	.625 (15.88)	A	C	.625 (15.88)	3.625 (92.08)				
A	C	1.000 (25.40)	.625 (15.88)	A	C	.750 (19.05)	3.625 (92.08)				
A	C	.375 (9.53)	.750 (19.05)	A	C	.875 (22.23)	3.625 (92.08)				
A	C	.500 (12.70)	.750 (19.05)	A	C	1.000 (25.40)	3.625 (92.08)				
A	C	.625 (15.88)	.750 (19.05)	A	C	.375 (9.53)	3.750 (95.25)				
A	C	.750 (19.05)	.750 (19.05)	A	C	.500 (12.70)	3.750 (95.25)				
A	C	.875 (22.23)	.750 (19.05)	A	C	.625 (15.88)	3.750 (95.25)				
A	C	1.000 (25.40)	.750 (19.05)	A	C	.750 (19.05)	3.750 (95.25)				
A	C	.375 (9.53)	1.000 (25.40)	A	C	.875 (22.23)	3.750 (95.25)				
A	C	.525 (13.34)	1.200 (30.48)	A	C	1.000 (25.40)	3.750 (95.25)				
A	C	.375 (9.53)	1.350 (34.29)	A	C	.375 (9.53)	3.875 (98.45)				
A	C	.525 (13.34)	1.350 (34.29)	A	C	.500 (12.70)	3.875 (98.45)				
A	C	.375 (9.53)	1.500 (38.10)	A	C	.625 (15.88)	3.875 (98.45)				
A	C	.525 (13.34)	1.500 (38.10)	A	C	.750 (19.05)	3.875 (98.45)				
A	C	.800 (20.32)	1.100 (27.94)	A	C	.875 (22.23)	3.875 (98.45)				
A	C	.950 (24.13)	1.100 (27.94)	A	C	1.000 (25.40)	3.875 (98.45)				
A	C	1.100 (27.94)	1.100 (27.94)	A	C	.375 (9.53)	4.000 (101.60)				
A	C	.800 (20.32)	1.250 (31.75)	A	C	.500 (12.70)	4.000 (101.60)				
A	C	.950 (24.13)	1.250 (31.75)	A	C	.625 (15.88)	4.000 (101.60)				
A	C	1.100 (27.94)	1.250 (31.75)	A	C	.750 (19.05)	4.000 (101.60)				
A	C	.800 (20.32)	1.400 (35.56)	A	C	.875 (22.23)	4.000 (101.60)				
A	C	.950 (24.13)	1.400 (35.56)	A	C	1.000 (25.40)	4.000 (101.60)				
A	C	1.100 (27.94)	1.400 (35.56)	A	C	.375 (9.53)	4.450 (113.03)				
A	C	.800 (20.32)	1.550 (39.37)	A	C	.525 (13.34)	4.450 (113.03)				
A	C	.950 (24.13)	1.550 (39.37)	A	C	.375 (9.53)	4.600 (116.84)				
A	C	1.100 (27.94)	1.550 (39.37)	A	C	.525 (13.34)	4.600 (116.84)				
A	C	.000 (0.00)	2.075 (52.71)	A	C	.375 (9.53)	4.750 (120.65)				
A	C	.000 (0.00)	2.275 (57.79)	A	C	.525 (13.34)	4.750 (120.65)				
A	C	.000 (0.00)	2.475 (62.87)	A	C	.800 (20.32)	4.350 (110.49)				
A	C	.000 (0.00)	2.775 (70.49)	A	C	.950 (24.13)	4.350 (110.49)				
A	C	.000 (0.00)	2.975 (75.57)	A	C	1.100 (27.94)	4.350 (110.49)				
A	C	.000 (0.00)	3.175 (80.65)	A	C	.800 (20.32)	4.500 (114.30)				
A	C	.100 (2.54)	2.625 (66.68)	A	C	.950 (24.13)	4.500 (114.30)				
A	C	.375 (9.53)	2.825 (71.76)	A	C	1.100 (27.94)	4.500 (114.30)				

FIGURE 19. Double sided test specimen IPC-A-28 - Continued.

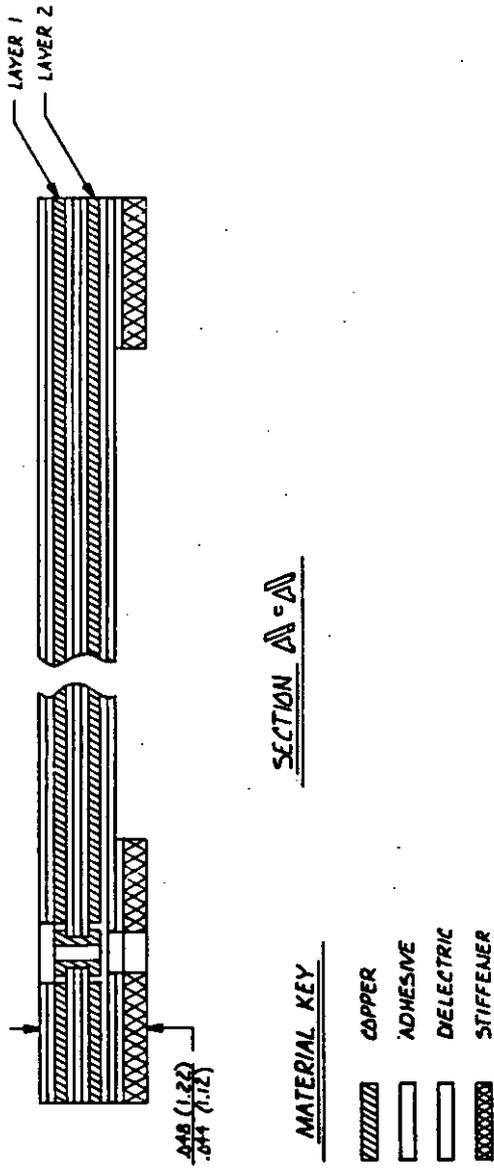


FIGURE 19. Double sided test specimen IPC-A-28 - Continued.

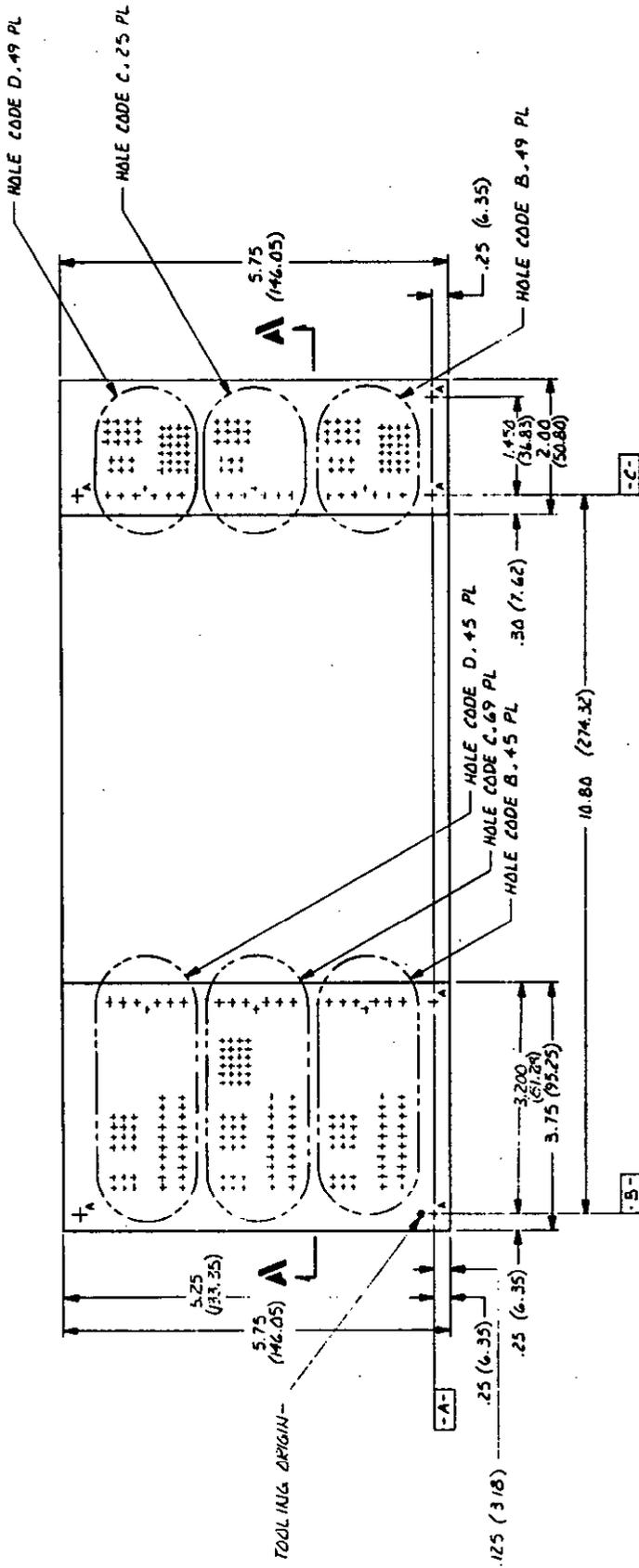
NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Dimensions are in inches.
2. Metric equivalents are in parentheses.
3. Metric equivalents are given for general information only.
4. Unless otherwise specified tolerances are ± 0.03 (0.8 mm) for two place decimals and ± 0.010 (0.25 mm) for three place decimals.
5. Interpret drawing per MIL-D-1000.
6. Fabricate per MIL-P-50884.
7. Flex clad material shall be IPC-FC-241A/O-X-XXIX-CFW7-1S/1S, class 3.
8. Adhesive material shall be IPC-FC-233/O-X-XXXX-X, class 3. Thickness is at manufacturer's discretion.
9. Dielectric material shall be IPC-FC-232A/O-X-XXIX-1/0, class 3.
10. The "A" coupons around the outer periphery of the board, are for manufacturing purposes only. They do not need to be shipped with the finished boards.
11. All holes are within ϕ .005 (0.13 mm) and are located on a .025 (0.64 mm) grid pattern.
12. Use artwork master no. IPC-B-28/50884, layer 1.
13. All exposed copper shall be tin-lead plated and fused or solder coated per paragraph 3.3.11 and 3.7.2.
14. Stiffener shall be plastic sheet per MIL-P-13949, .032 (0.81 mm) thick.
15. All plated thru holes shall be electrolytically copper plated to .001 (0.03 mm) minimum per paragraph 3.3.10 and 3.7.2.
16. Stiffner to be bonded to layer 2 side.

FIGURE 19. Double sided test specimen IPC-A-28 - Continued.

FLEXIBLE AND RIGID-FLEX PRINTED WIRING TEST COUPONS
CERTIFICATION TEST BOARD NOTES
TYPES III and IV PER MIL-P-50884C

1. Materials: Reference FIGURE 20 TYPE III, FIGURE 21 TYPE IV
 - a. Flexible metal clad dielectrics per IPC-FC-241A
Single and double clad one and two ounce copper with 1 mil polyimide
 - b. Adhesive coated dielectric films per IPC-FC-232A 1 mil polyimide
 - c. Flexible adhesive bonding films per IPC-FC-233A
 - d. Plastic sheet per MIL-P-13949, Type IV, single clad one ounce copper .010 thick or Type III stiffener unclad .032 thick
2. Plating
 - a. Copper plating in holes to be .001 inch minimum per MIL-C-14550
 - b. All exposed copper to be tin-lead plated and fused or solder coated per MIL-P-50884C, Paragraph 3.4.7
3. Dimensional - Reference FIGURE 22
 - a. Minimum external annular ring to be .005 to .004 inch
 - b. Minimum internal annular ring to be .002 inch
 - c. Plated thru hole diameter to be $.032 \pm .005$
 - d. Stiffener hole diameter to be $.086 \pm .005$, Type III
 - e. Tolerance on all hole locations is .005 RTP
 - f. Datum hole diameters to be $.062 \pm .005$
 - g. All lines and spacing are to be $\pm 20\%$ of artwork masters.
 - h. All trim dimensions $\pm .030$
 - i. Stiffener to be bonded to layer 10 side, Type III only
 - j. Fine line patterns are not a requirement for certification
 - k. Artwork master No. IPC-8-29/50884, Layer 1 thru Layer 10
 - l. Manufacturer will be required to check dimensionally all hole locations prior to shipment.
 - m. Manufacturer will ship the certification board, precut into three sections along "H" coupons lengthwise designators.
4. Shipping Information
 - a. The manufacturer will ship with the certification board a list of materials used and any deviations to the drawing.

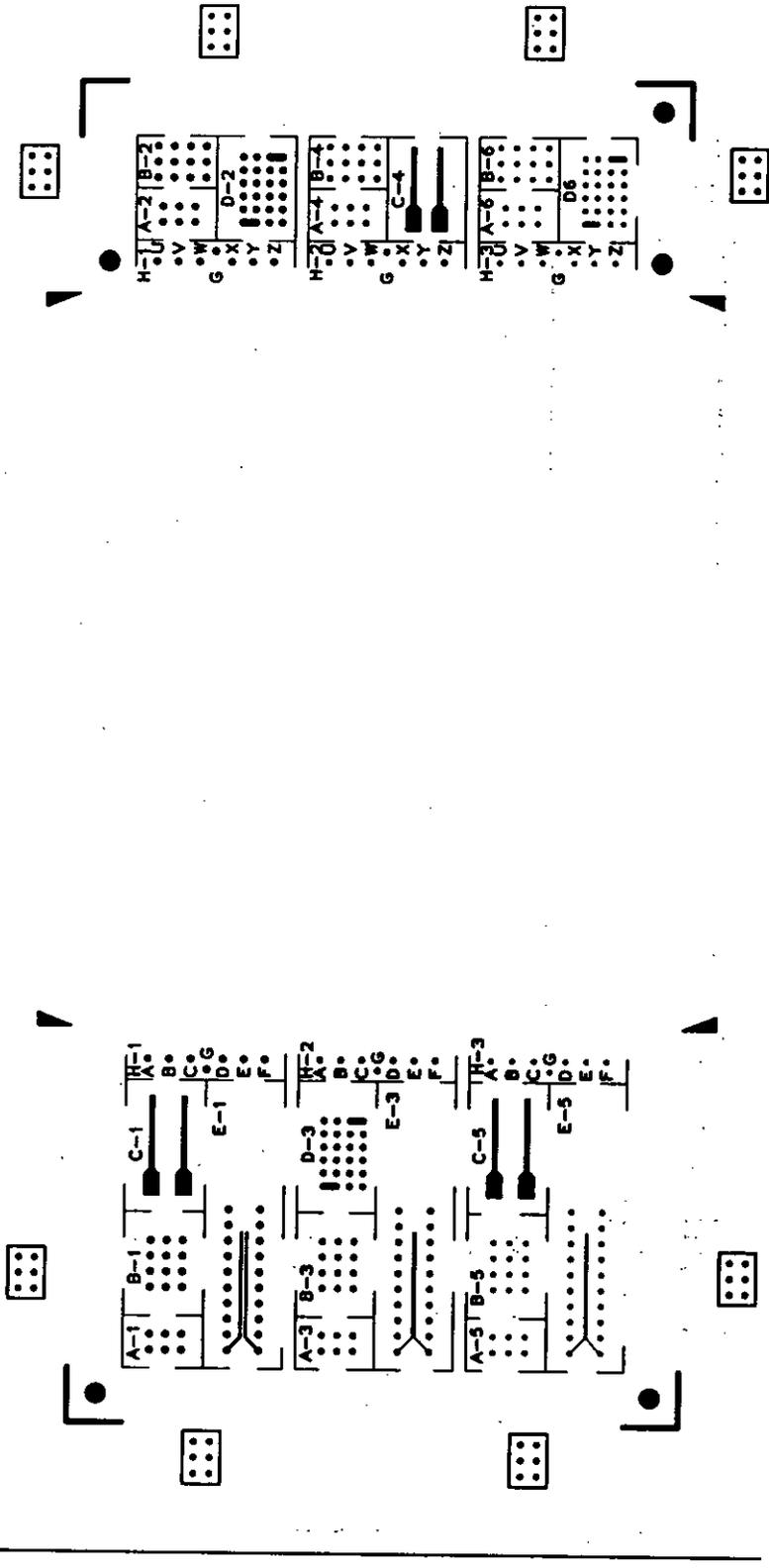


HOLE TABULATION CHART

CODE	DRILL NO	FINISHED DIA	STIFFNECK DIA	PLATED
A	1/16	—	.116 ± .005	NO
B	—	.076 ± .005	.066 ± .005	YES
C	—	.052 ± .005	.076 ± .005	YES
D	—	.032 ± .005	.066 ± .005	YES

FIGURE 22. Multilayer test specimen IPC-A-29.

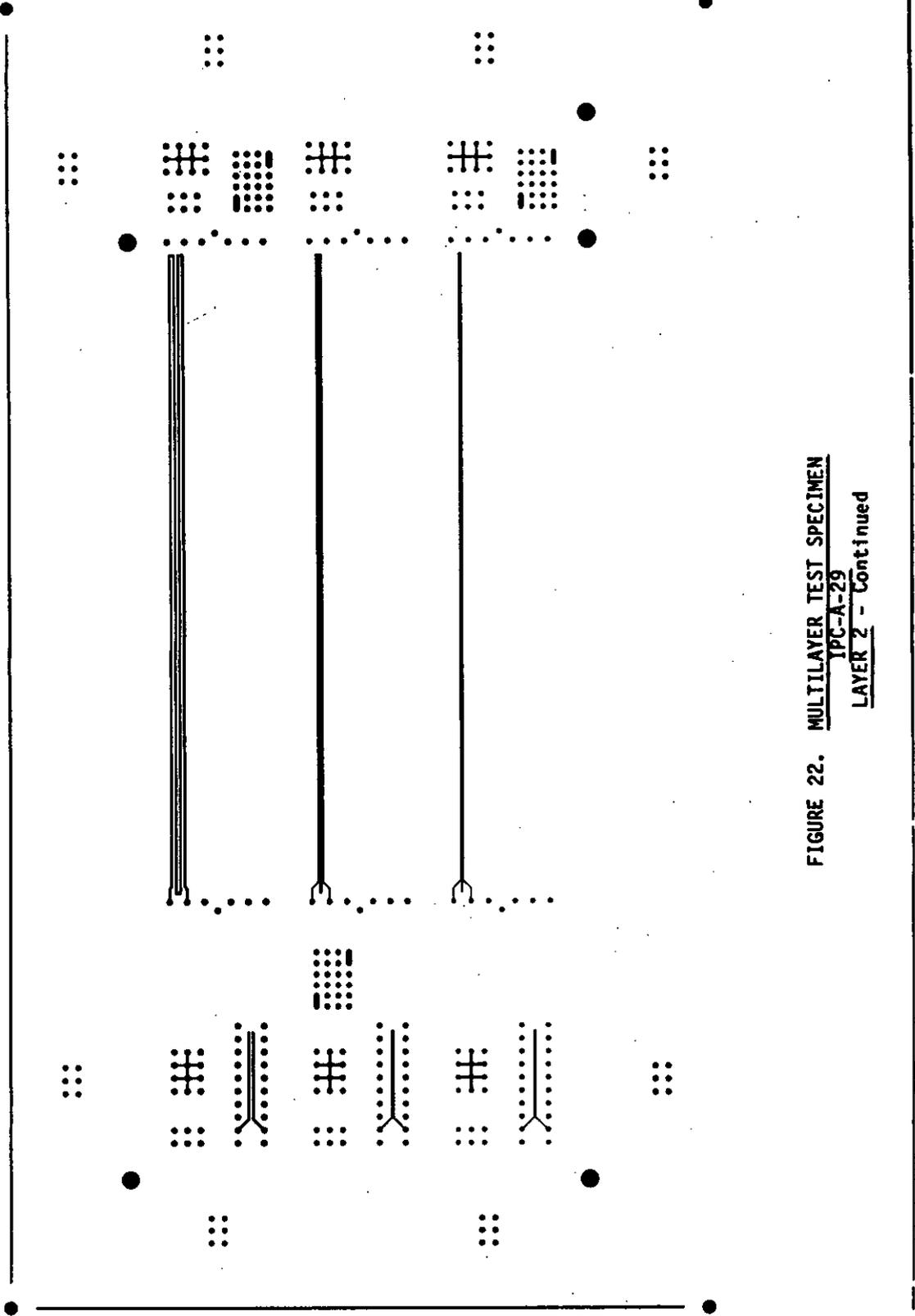
REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER T -Continued.

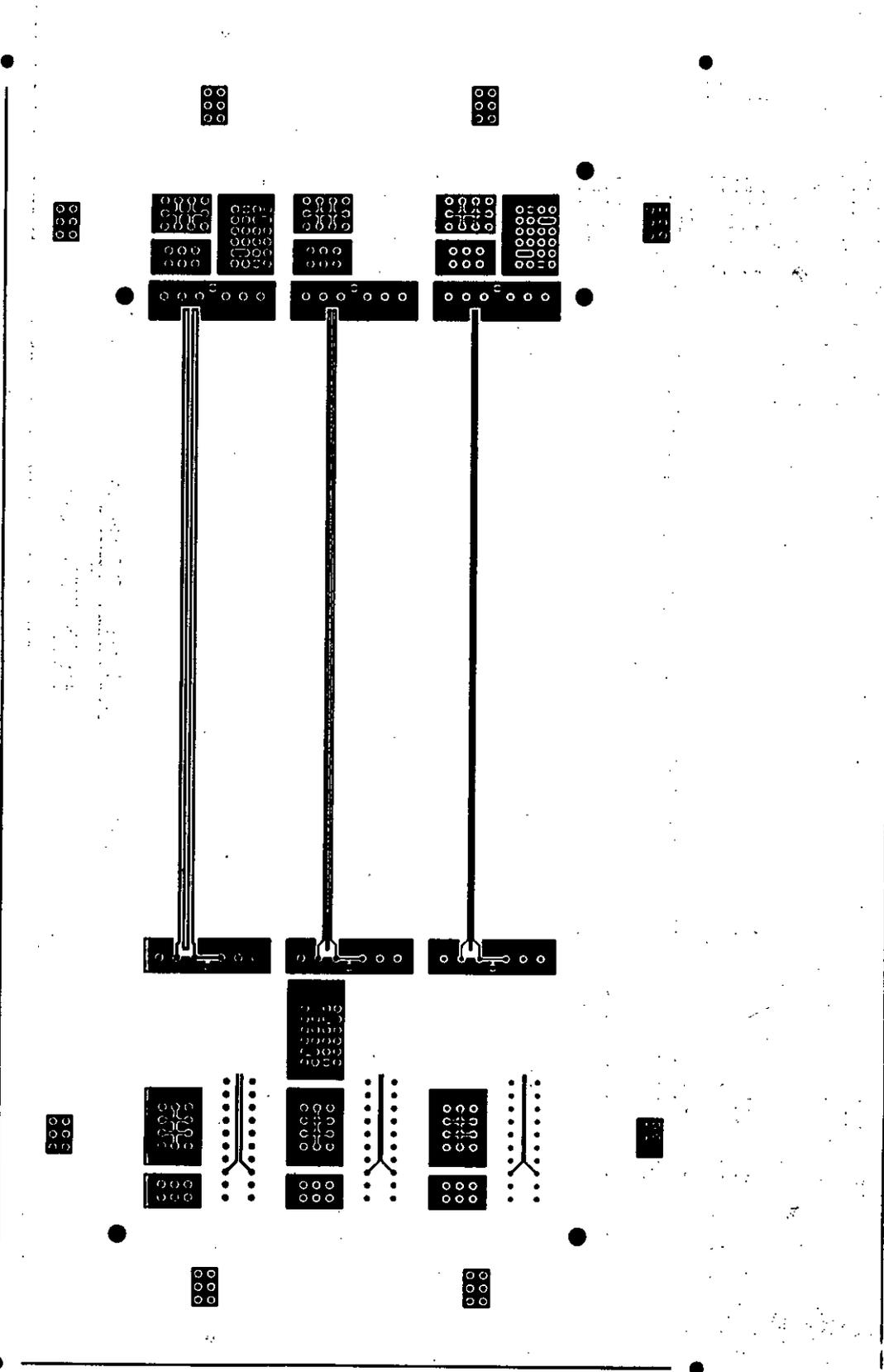
REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 2 - Continued

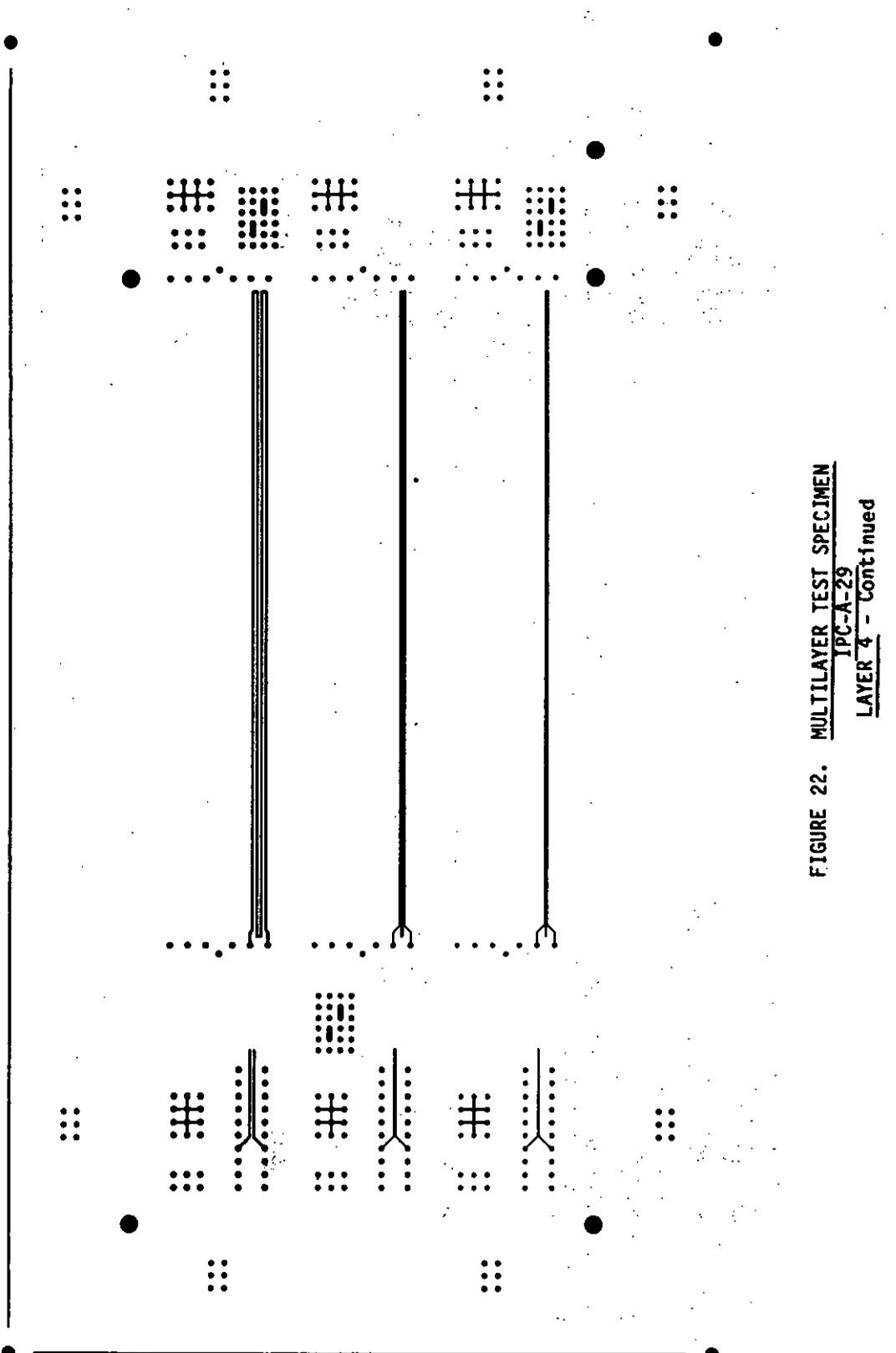
REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 3 - Continued

REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 4 - Continued

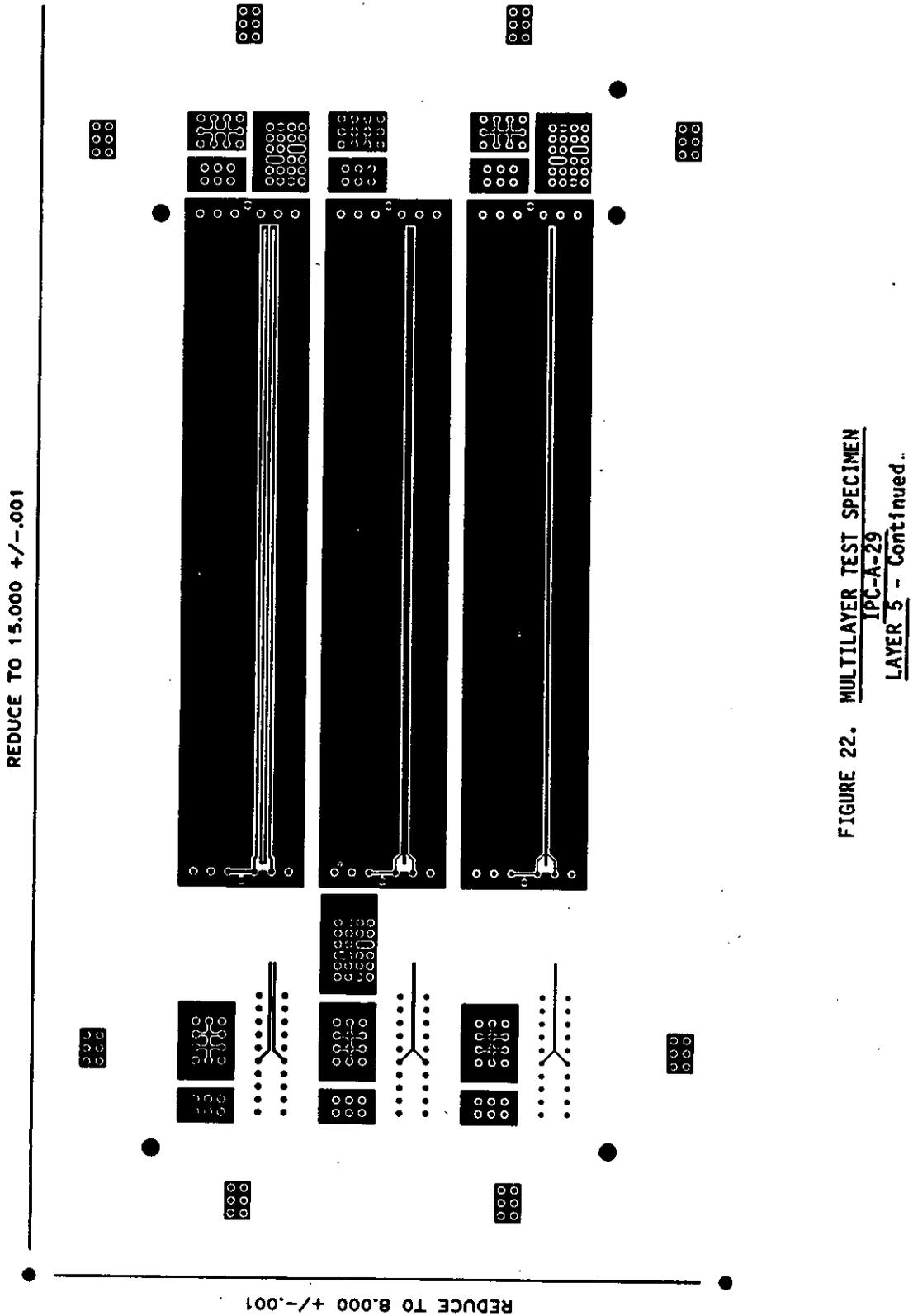
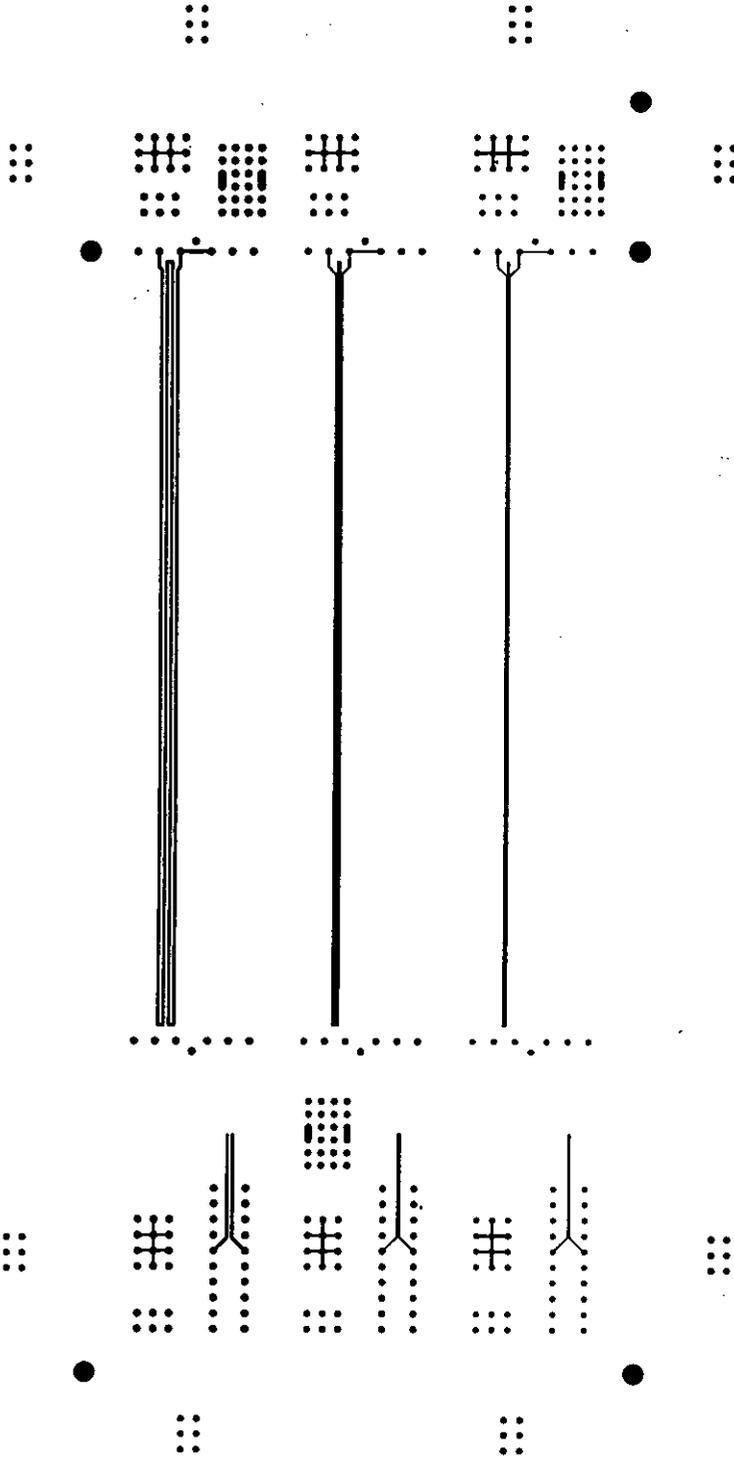


FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 5 - Continued.

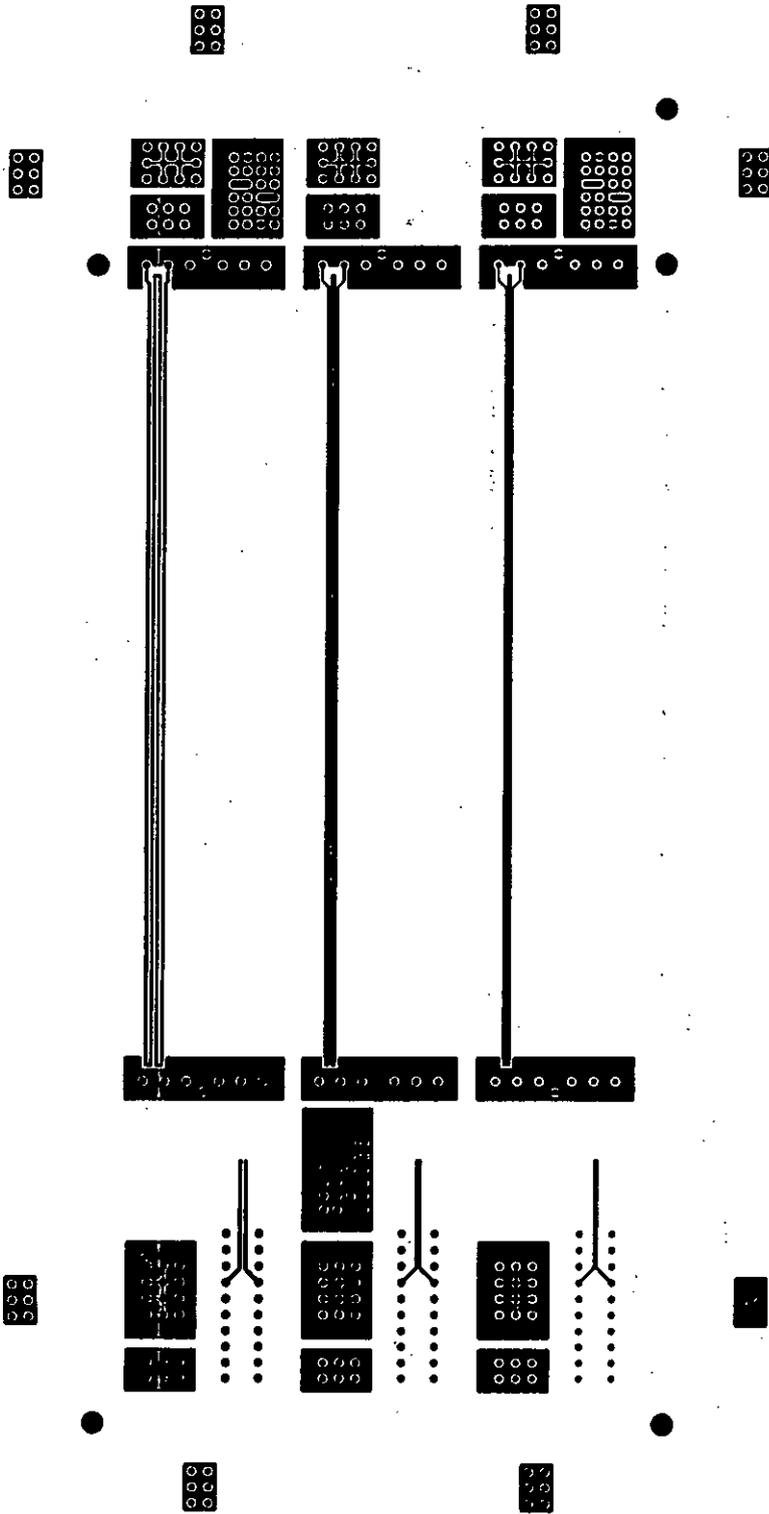
REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 6 - Continued

REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 7 - Continued

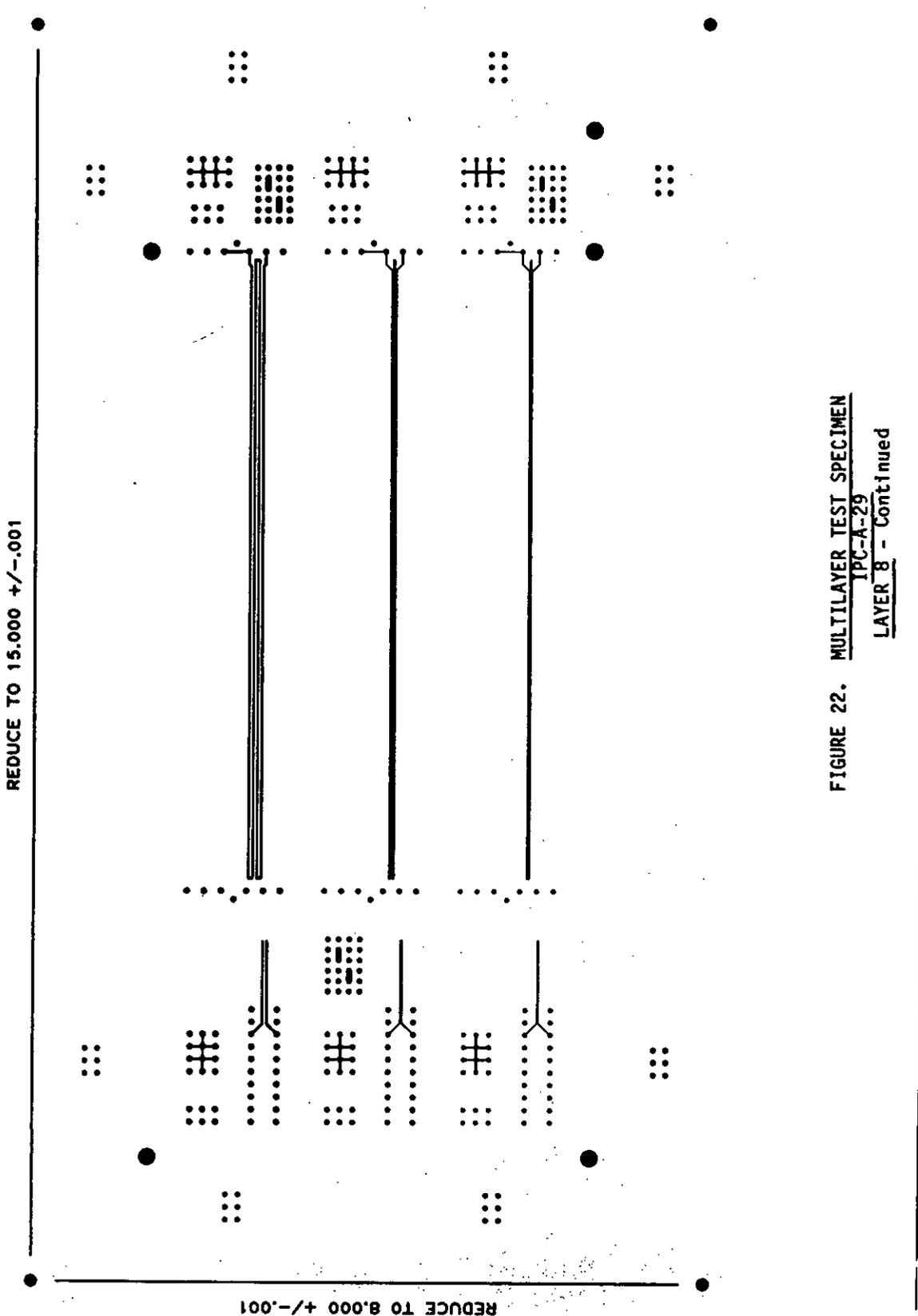


FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 8 - Continued

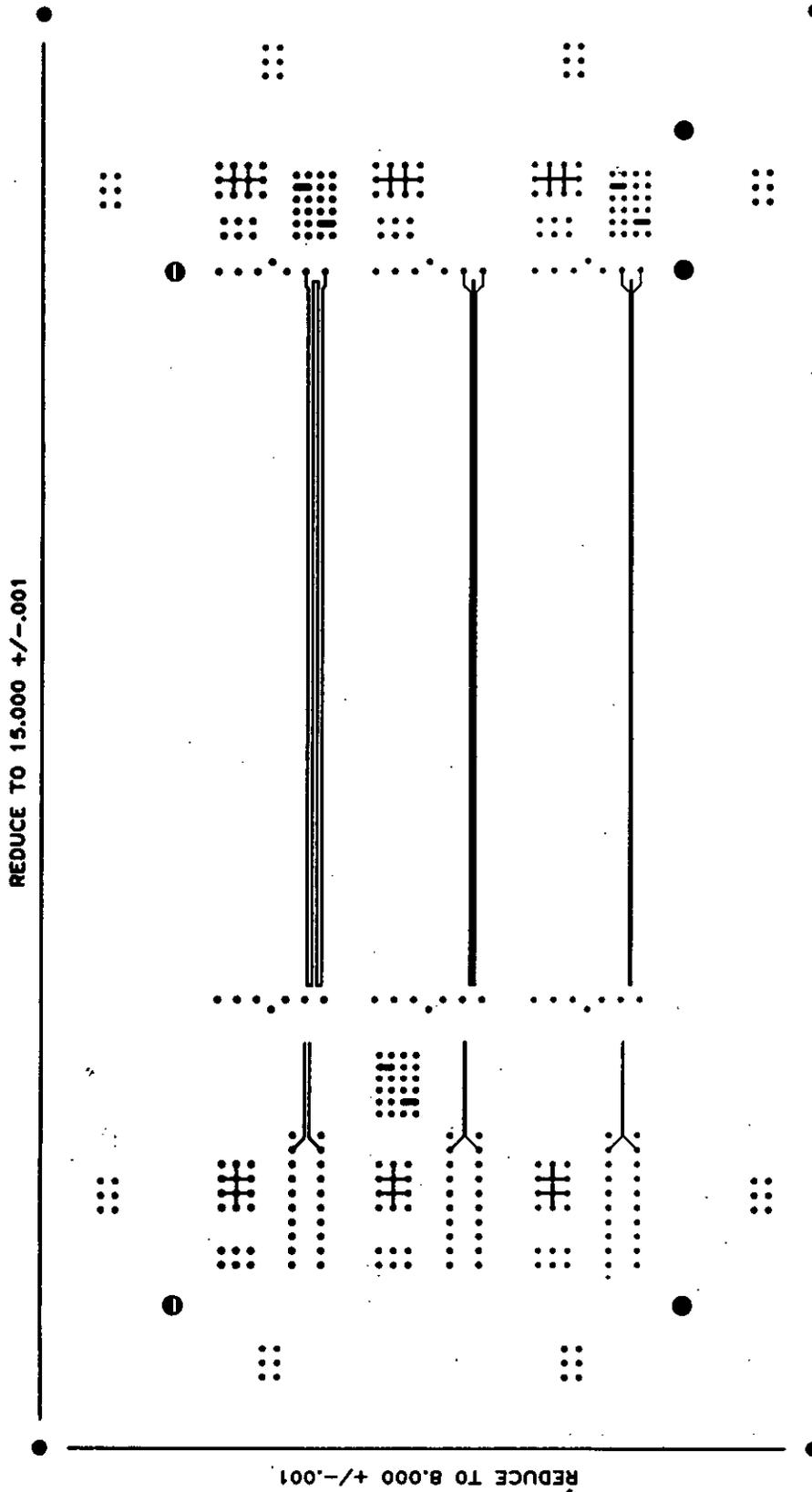
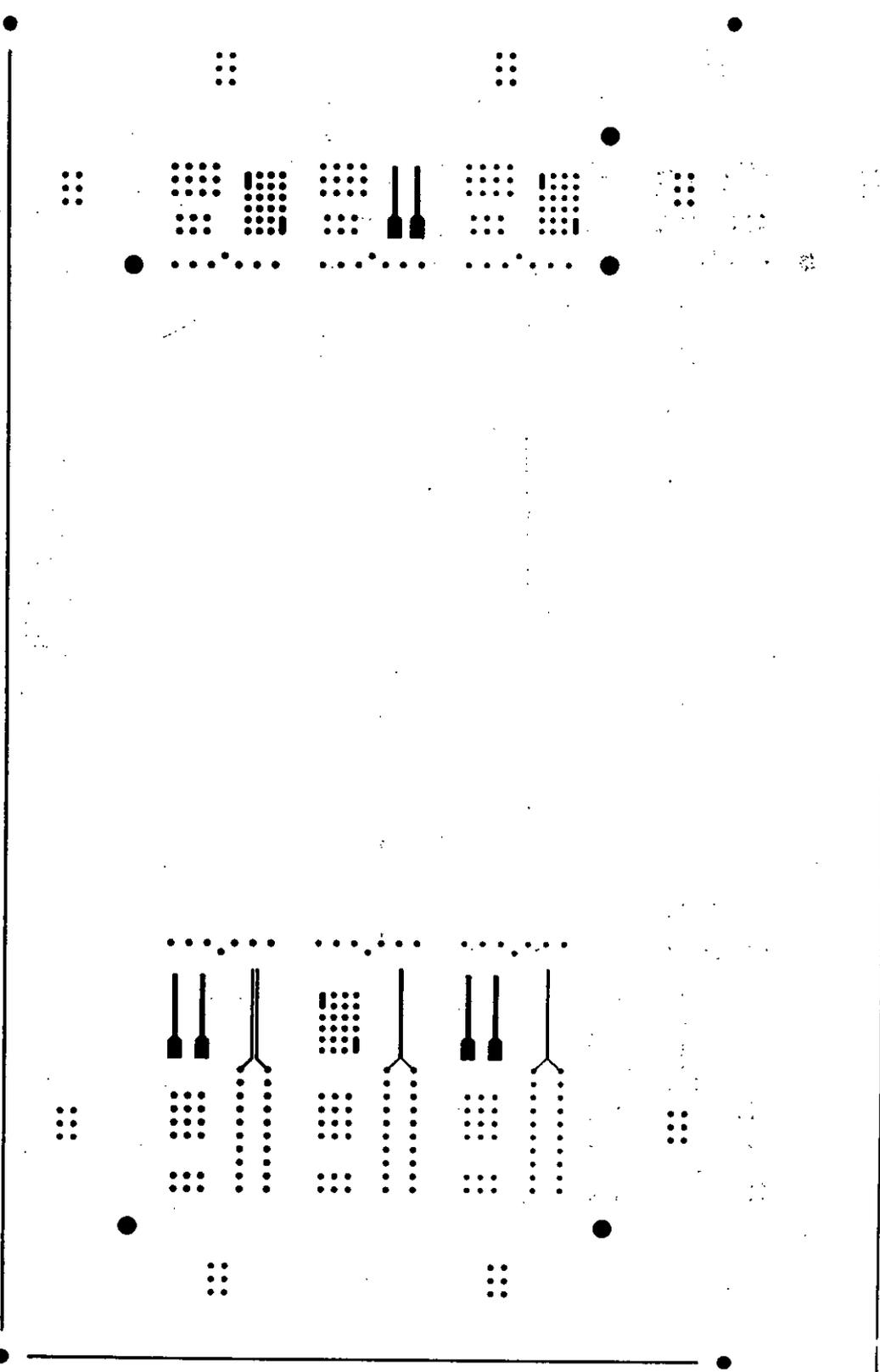


FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 9 - Continued

REDUCE TO 15.000 +/- .001



REDUCE TO 8.000 +/- .001

FIGURE 22. MULTILAYER TEST SPECIMEN
IPC-A-29
LAYER 10 - Continued

MIL-P-50884C
APPENDIX

HOLE LOCATION CHART											
PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM	PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM	PRI DATUM	SEC DATUM	'X' DIM	'Y' DIM
A	B	.000 (0.00)	.000 (0.00)	A	B	.725 (18.42)	2.400 (60.96)	A	B	.875 (22.23)	3.725 (94.62)
A	B	.000 (0.00)	5.250 (133.35)	A	B	.875 (22.23)	2.400 (60.96)	A	B	1.025 (26.04)	3.725 (94.62)
A	B	3.200 (81.28)	.000 (0.00)	A	B	1.025 (26.04)	2.400 (60.96)	A	B	1.175 (29.85)	3.725 (94.62)
A	B	.425 (10.80)	.475 (12.07)	A	B	1.175 (29.85)	2.400 (60.96)	A	B	1.325 (33.66)	3.725 (94.62)
A	B	.575 (14.61)	.475 (12.07)	A	B	1.325 (33.66)	2.400 (60.96)	A	B	1.475 (37.47)	3.725 (94.62)
A	B	.725 (18.42)	.475 (12.07)	A	B	1.475 (37.47)	2.400 (60.96)	A	B	1.625 (41.28)	3.725 (94.62)
A	B	.875 (22.23)	.475 (12.07)	A	B	1.625 (41.28)	2.400 (60.96)	A	B	1.775 (45.09)	3.725 (94.62)
A	B	1.025 (26.04)	.475 (12.07)	A	B	1.775 (45.09)	2.400 (60.96)	A	B	.425 (10.80)	4.025 (102.24)
A	B	1.175 (29.85)	.475 (12.07)	A	B	.425 (10.80)	2.825 (71.76)	A	B	.575 (14.61)	4.025 (102.24)
A	B	1.325 (33.66)	.475 (12.07)	A	B	.575 (14.61)	2.825 (71.76)	A	B	.725 (18.42)	4.025 (102.24)
A	B	1.475 (37.47)	.475 (12.07)	A	B	.725 (18.42)	2.975 (75.57)	A	B	.875 (22.23)	4.025 (102.24)
A	B	1.625 (41.28)	.475 (12.07)	A	B	.875 (22.23)	2.975 (75.57)	A	B	1.025 (26.04)	4.025 (102.24)
A	B	1.775 (45.09)	.475 (12.07)	A	B	.975 (24.61)	3.125 (79.38)	A	B	1.175 (29.85)	4.025 (102.24)
A	B	.425 (10.80)	.775 (19.69)	A	B	1.025 (26.04)	3.125 (79.38)	A	B	1.325 (33.66)	4.025 (102.24)
A	B	.575 (14.61)	.775 (19.69)	A	B	1.175 (29.85)	2.825 (71.76)	A	B	1.475 (37.47)	4.025 (102.24)
A	B	.725 (18.42)	.775 (19.69)	A	B	1.325 (33.66)	2.975 (75.57)	A	B	1.625 (41.28)	4.025 (102.24)
A	B	.875 (22.23)	.775 (19.69)	A	B	1.475 (37.47)	2.825 (71.76)	A	B	1.775 (45.09)	4.025 (102.24)
A	B	1.025 (26.04)	.775 (19.69)	A	B	1.625 (41.28)	2.975 (75.57)	A	B	.425 (10.80)	4.450 (113.03)
A	B	1.175 (29.85)	.775 (19.69)	A	B	1.775 (45.09)	2.975 (75.57)	A	B	.575 (14.61)	4.450 (113.03)
A	B	1.325 (33.66)	.775 (19.69)	A	B	1.825 (46.18)	3.125 (79.38)	A	B	.725 (18.42)	4.450 (113.03)
A	B	1.475 (37.47)	.775 (19.69)	A	B	1.975 (50.00)	3.125 (79.38)	A	B	.875 (22.23)	4.450 (113.03)
A	B	1.625 (41.28)	.775 (19.69)	A	B	2.125 (53.98)	3.125 (79.38)	A	B	1.025 (26.04)	4.450 (113.03)
A	B	1.775 (45.09)	.775 (19.69)	A	B	2.275 (57.95)	3.125 (79.38)	A	B	1.175 (29.85)	4.450 (113.03)
A	B	.425 (10.80)	1.200 (30.48)	A	B	2.425 (61.93)	3.125 (79.38)	A	B	1.325 (33.66)	4.450 (113.03)
A	B	.575 (14.61)	1.200 (30.48)	A	B	2.575 (65.90)	3.125 (79.38)	A	B	1.475 (37.47)	4.450 (113.03)
A	B	.725 (18.42)	1.350 (34.29)	A	B	2.725 (69.88)	3.125 (79.38)	A	B	1.625 (41.28)	4.450 (113.03)
A	B	.875 (22.23)	1.350 (34.29)	A	B	2.875 (73.85)	3.125 (79.38)	A	B	1.775 (45.09)	4.450 (113.03)
A	B	1.025 (26.04)	1.350 (34.29)	A	B	3.025 (77.83)	3.125 (79.38)	A	B	1.925 (49.00)	4.450 (113.03)
A	B	1.175 (29.85)	1.350 (34.29)	A	B	3.175 (81.81)	3.125 (79.38)	A	B	2.075 (52.98)	4.450 (113.03)
A	B	1.325 (33.66)	1.350 (34.29)	A	B	3.325 (85.79)	3.125 (79.38)	A	B	2.225 (56.95)	4.450 (113.03)
A	B	1.475 (37.47)	1.350 (34.29)	A	B	3.475 (89.77)	3.125 (79.38)	A	B	2.375 (60.93)	4.450 (113.03)
A	B	1.625 (41.28)	1.350 (34.29)	A	B	3.625 (93.75)	3.125 (79.38)	A	B	2.525 (64.90)	4.450 (113.03)
A	B	1.775 (45.09)	1.350 (34.29)	A	B	3.775 (97.73)	3.125 (79.38)	A	B	2.675 (68.88)	4.450 (113.03)
A	B	.425 (10.80)	1.500 (38.10)	A	B	3.925 (101.71)	3.125 (79.38)	A	B	2.825 (72.85)	4.450 (113.03)
A	B	.575 (14.61)	1.500 (38.10)	A	B	4.075 (105.69)	3.125 (79.38)	A	B	2.975 (76.83)	4.450 (113.03)
A	B	.725 (18.42)	1.500 (38.10)	A	B	4.225 (109.67)	3.125 (79.38)	A	B	3.125 (80.81)	4.450 (113.03)
A	B	.875 (22.23)	1.500 (38.10)	A	B	4.375 (113.65)	3.125 (79.38)	A	B	3.275 (84.79)	4.450 (113.03)
A	B	1.025 (26.04)	1.500 (38.10)	A	B	4.525 (117.63)	3.125 (79.38)	A	B	3.425 (88.77)	4.450 (113.03)
A	B	1.175 (29.85)	1.500 (38.10)	A	B	4.675 (121.61)	3.125 (79.38)	A	B	3.575 (92.75)	4.450 (113.03)
A	B	1.325 (33.66)	1.500 (38.10)	A	B	4.825 (125.59)	3.125 (79.38)	A	B	3.725 (96.73)	4.450 (113.03)
A	B	1.475 (37.47)	1.500 (38.10)	A	B	4.975 (129.57)	3.125 (79.38)	A	B	3.875 (100.71)	4.450 (113.03)
A	B	1.625 (41.28)	1.500 (38.10)	A	B	5.125 (133.55)	3.125 (79.38)	A	B	4.025 (104.69)	4.450 (113.03)
A	B	1.775 (45.09)	1.500 (38.10)	A	B	5.275 (137.53)	3.125 (79.38)	A	B	4.175 (108.67)	4.450 (113.03)
A	B	.425 (10.80)	1.650 (41.91)	A	B	5.425 (141.51)	3.125 (79.38)	A	B	4.325 (112.65)	4.450 (113.03)
A	B	.575 (14.61)	1.650 (41.91)	A	B	5.575 (145.49)	3.125 (79.38)	A	B	4.475 (116.63)	4.450 (113.03)
A	B	.725 (18.42)	1.650 (41.91)	A	B	5.725 (149.47)	3.125 (79.38)	A	B	4.625 (120.61)	4.450 (113.03)
A	B	.875 (22.23)	1.650 (41.91)	A	B	5.875 (153.45)	3.125 (79.38)	A	B	4.775 (124.59)	4.450 (113.03)
A	B	1.025 (26.04)	1.650 (41.91)	A	B	6.025 (157.43)	3.125 (79.38)	A	B	4.925 (128.57)	4.450 (113.03)
A	B	1.175 (29.85)	1.650 (41.91)	A	B	6.175 (161.41)	3.125 (79.38)	A	B	5.075 (132.55)	4.450 (113.03)
A	B	1.325 (33.66)	1.650 (41.91)	A	B	6.325 (165.39)	3.125 (79.38)	A	B	5.225 (136.53)	4.450 (113.03)
A	B	1.475 (37.47)	1.650 (41.91)	A	B	6.475 (169.37)	3.125 (79.38)	A	B	5.375 (140.51)	4.450 (113.03)
A	B	1.625 (41.28)	1.650 (41.91)	A	B	6.625 (173.35)	3.125 (79.38)	A	B	5.525 (144.49)	4.450 (113.03)
A	B	1.775 (45.09)	1.650 (41.91)	A	B	6.775 (177.33)	3.125 (79.38)	A	B	5.675 (148.47)	4.450 (113.03)
A	B	.425 (10.80)	1.800 (45.72)	A	B	6.925 (181.31)	3.125 (79.38)	A	B	5.825 (152.45)	4.450 (113.03)
A	B	.575 (14.61)	1.800 (45.72)	A	B	7.075 (185.29)	3.125 (79.38)	A	B	5.975 (156.43)	4.450 (113.03)
A	B	.725 (18.42)	1.800 (45.72)	A	B	7.225 (189.27)	3.125 (79.38)	A	B	6.125 (160.41)	4.450 (113.03)
A	B	.875 (22.23)	1.800 (45.72)	A	B	7.375 (193.25)	3.125 (79.38)	A	B	6.275 (164.39)	4.450 (113.03)
A	B	1.025 (26.04)	1.800 (45.72)	A	B	7.525 (197.23)	3.125 (79.38)	A	B	6.425 (168.37)	4.450 (113.03)
A	B	1.175 (29.85)	1.800 (45.72)	A	B	7.675 (201.21)	3.125 (79.38)	A	B	6.575 (172.35)	4.450 (113.03)
A	B	1.325 (33.66)	1.800 (45.72)	A	B	7.825 (205.19)	3.125 (79.38)	A	B	6.725 (176.33)	4.450 (113.03)
A	B	1.475 (37.47)	1.800 (45.72)	A	B	7.975 (209.17)	3.125 (79.38)	A	B	6.875 (180.31)	4.450 (113.03)
A	B	1.625 (41.28)	1.800 (45.72)	A	B	8.125 (213.15)	3.125 (79.38)	A	B	7.025 (184.29)	4.450 (113.03)
A	B	1.775 (45.09)	1.800 (45.72)	A	B	8.275 (217.13)	3.125 (79.38)	A	B	7.175 (188.27)	4.450 (113.03)
A	B	.425 (10.80)	1.950 (49.53)	A	B	8.425 (221.11)	3.125 (79.38)	A	B	7.325 (192.25)	4.450 (113.03)
A	B	.575 (14.61)	1.950 (49.53)	A	B	8.575 (225.09)	3.125 (79.38)	A	B	7.475 (196.23)	4.450 (113.03)
A	B	.725 (18.42)	1.950 (49.53)	A	B	8.725 (229.07)	3.125 (79.38)	A	B	7.625 (200.21)	4.450 (113.03)
A	B	.875 (22.23)	1.950 (49.53)	A	B	8.875 (233.05)	3.125 (79.38)	A	B	7.775 (204.19)	4.450 (113.03)
A	B	1.025 (26.04)	1.950 (49.53)	A	B	9.025 (237.03)	3.125 (79.38)	A	B	7.925 (208.17)	4.450 (113.03)
A	B	1.175 (29.85)	1.950 (49.53)	A	B	9.175 (241.01)	3.125 (79.38)	A	B	8.075 (212.15)	4.450 (113.03)
A	B	1.325 (33.66)	1.950 (49.53)	A	B	9.325 (245.00)	3.125 (79.38)	A	B	8.225 (216.13)	4.450 (113.03)
A	B	1.475 (37.47)	1.950 (49.53)	A	B	9.475 (248.98)	3.125 (79.38)	A	B	8.375 (220.11)	4.450 (113.03)
A	B	1.625 (41.28)	1.950 (49.53)	A	B	9.625 (252.96)	3.125 (79.38)	A	B	8.525 (224.09)	4.450 (113.03)
A	B	1.775 (45.09)	1.950 (49.53)	A	B	9.775 (256.94)	3.125 (79.38)	A	B	8.675 (228.07)	4.450 (113.03)
A	B	.425 (10.80)	2.100 (53.34)	A	B	9.925 (260.92)	3.125 (79.38)	A	B	8.825 (232.05)	4.450 (113.03)
A	B	.575 (14.61)	2.100 (53.34)	A	B	10.075 (264.90)	3.125 (79.38)	A	B	8.975 (236.03)	4.450 (113.03)
A	B	.725 (18.42)	2.100 (53.34)	A	B	10.225 (268.88)	3.125 (79.38)	A	B	9.125 (240.01)	4.450 (113.03)
A	B	.875 (22.23)	2.100 (53.34)	A	B	10.375 (272.86)	3.125 (79.38)	A	B	9.275 (244.00)	4.450 (113.03)
A	B	1.025 (26.04)	2.100 (53.34)	A	B	10.525 (276.84)	3.125 (79.38)	A	B	9.425 (247.98)	4.450 (113.03)
A	B	1.175 (29.85)	2.100 (53.34)	A	B	10.675 (280.82)	3.125 (79.38)	A	B	9.575 (251.96)	4.450 (113.03)
A	B	1.325 (33.66)	2.100 (53.34)	A	B	10.825 (284.80)	3.125 (79.38)	A	B	9.725 (255.94)	4.450 (113.03)
A	B	1.475 (37.47)	2.100 (53.34)	A	B	10.975 (288.78)	3.125 (79.38)	A	B	9.875 (259.92)	4.450 (113.03)
A	B	1.625 (41.28)	2.100 (53.34)	A	B	11.125 (292.76)	3.125 (79.38)	A	B	10.025 (263.90)	4.450 (113.03)
A	B	1.775 (45.09)	2.100 (53.34)	A	B	11.275 (296.74)	3.125 (79.38)	A	B	10.175 (267.88)	4.450 (113.03)
A	B	.425 (10.80)	2.250 (57.15)	A	B	11.425 (300.72)	3.125 (79.38)	A	B	10.325 (271.86)	4.450 (113.03)
A	B	.575 (14.61)	2.250 (57.15)	A	B	11.575 (304.70)	3.125 (79.38)	A	B	10.475 (275.84)	4.450 (113.03)
A	B	.725 (18.42)	2.250 (57.15)	A	B	11.725 (308.68)	3.125 (79.38)	A	B	10.625 (279.82)	4.450 (113.03)
A	B	.875 (22.23)	2.250 (57.15)	A	B	11.875 (312.66)	3.125 (79.38)	A	B	10.775 (283.80)	4.450 (113.03)
A	B	1.025 (26.04)	2.250 (57.15)	A	B	12.025 (316.64)	3.125 (79.38)	A	B	10.925 (287.78)	4.450 (113.03)
A	B	1.175 (29.85)	2.250 (57.15)	A	B	12.175 (320.62)	3.125 (79.38)	A	B	11.075 (291.76)	4.450 (113.03)
A	B	1.325 (33.66)	2.250 (57.15)	A	B	12.325 (324.60)	3.125 (79.38)	A	B	11.225 (295.74)	4.450 (113.03)
A	B	1.475 (37.47)	2.250 (57.15)	A	B	12.475 (328.58)	3.125 (79.38)	A	B	11.375 (299.72)	4.450 (113.03)
A	B	1.625 (41.28)	2.250 (57.15)	A	B	12.625 (332.56)	3.125 (79.38)	A	B	11.525 (303.70)	4.450 (113.03)
A	B	1.775 (45.09)									

MIL-P-50884C
APPENDIX

HOLE LOCATION CHART											
PRI DATUM	SEC DATUM	X DIM	Y DIM	PRI DATUM	SEC DATUM	X DIM	Y DIM	PRI DATUM	SEC DATUM	X DIM	Y DIM
A	C	000 (000)	000 (000)	A	C	.525 (13.34)	2.825 (71.76)	A	C	.800 (20.32)	4.450 (118.11)
A	C	000 (000)	5.250 (133.35)	A	C	.375 (9.53)	2.975 (75.57)	A	C	.950 (24.13)	4.650 (118.11)
A	C	1.450 (36.83)	000 (000)	A	C	.525 (13.34)	2.975 (75.57)	A	C	1.100 (27.94)	4.650 (118.11)
A	C	000 (000)	.450 (11.43)	A	C	.375 (9.53)	3.125 (79.38)	A	C	.800 (20.32)	4.800 (121.92)
A	C	000 (000)	.650 (16.51)	A	C	.525 (13.34)	3.125 (79.38)	A	C	.950 (24.13)	4.800 (121.92)
A	C	000 (000)	.850 (21.59)	A	C	.000 (20.32)	2.725 (69.22)	A	C	1.100 (27.94)	4.800 (121.92)
A	C	000 (000)	1.150 (29.21)	A	C	.950 (24.13)	2.725 (69.22)				
A	C	000 (000)	1.350 (34.29)	A	C	1.100 (27.94)	2.725 (69.22)				
A	C	000 (000)	1.550 (39.37)	A	C	.800 (20.32)	2.875 (73.03)				
A	C	.100 (2.54)	1.000 (25.40)	A	C	.950 (24.13)	2.875 (73.03)				
A	C	.375 (9.53)	.375 (9.53)	A	C	1.100 (27.94)	2.875 (73.03)				
A	C	.500 (12.70)	.375 (9.53)	A	C	.800 (20.32)	3.025 (76.84)				
A	C	.625 (15.88)	.375 (9.53)	A	C	.950 (24.13)	3.025 (76.84)				
A	C	.750 (19.05)	.375 (9.53)	A	C	1.100 (27.94)	3.025 (76.84)				
A	C	.875 (22.23)	.375 (9.53)	A	C	.800 (20.32)	3.175 (80.65)				
A	C	1.000 (25.40)	.375 (9.53)	A	C	.950 (24.13)	3.175 (80.65)				
A	C	.375 (9.53)	.500 (12.70)	A	C	1.100 (27.94)	3.175 (80.65)				
A	C	.500 (12.70)	.500 (12.70)	A	C	000 (000)	3.700 (93.98)				
A	C	.625 (15.88)	.500 (12.70)	A	C	000 (000)	3.900 (99.06)				
A	C	.750 (19.05)	.500 (12.70)	A	C	000 (000)	4.100 (104.14)				
A	C	.875 (22.23)	.500 (12.70)	A	C	000 (000)	4.400 (111.76)				
A	C	1.000 (25.40)	.500 (12.70)	A	C	.000 (000)	4.600 (116.84)				
A	C	.375 (9.53)	.625 (15.88)	A	C	000 (000)	4.800 (121.92)				
A	C	.500 (12.70)	.625 (15.88)	A	C	.100 (2.54)	4.250 (107.95)				
A	C	.625 (15.88)	.625 (15.88)	A	C	.375 (9.53)	3.625 (92.08)				
A	C	.750 (19.05)	.625 (15.88)	A	C	.500 (12.70)	3.625 (92.08)				
A	C	.875 (22.23)	.625 (15.88)	A	C	.625 (15.88)	3.625 (92.08)				
A	C	1.000 (25.40)	.625 (15.88)	A	C	.750 (19.05)	3.625 (92.08)				
A	C	.375 (9.53)	.750 (19.05)	A	C	.875 (22.23)	3.625 (92.08)				
A	C	.500 (12.70)	.750 (19.05)	A	C	1.000 (25.40)	3.625 (92.08)				
A	C	.625 (15.88)	.750 (19.05)	A	C	.375 (9.53)	3.750 (95.25)				
A	C	.750 (19.05)	.750 (19.05)	A	C	.500 (12.70)	3.750 (95.25)				
A	C	.875 (22.23)	.750 (19.05)	A	C	.625 (15.88)	3.750 (95.25)				
A	C	1.000 (25.40)	.750 (19.05)	A	C	.750 (19.05)	3.750 (95.25)				
A	C	.375 (9.53)	1.200 (30.48)	A	C	.875 (22.23)	3.750 (95.25)				
A	C	.525 (13.34)	1.200 (30.48)	A	C	1.000 (25.40)	3.750 (95.25)				
A	C	.375 (9.53)	1.350 (34.29)	A	C	.375 (9.53)	3.875 (98.43)				
A	C	.525 (13.34)	1.350 (34.29)	A	C	.500 (12.70)	3.875 (98.43)				
A	C	.375 (9.53)	1.500 (38.10)	A	C	.625 (15.88)	3.875 (98.43)				
A	C	.525 (13.34)	1.500 (38.10)	A	C	.750 (19.05)	3.875 (98.43)				
A	C	.800 (20.32)	1.100 (27.94)	A	C	.875 (22.23)	3.875 (98.43)				
A	C	.950 (24.13)	1.100 (27.94)	A	C	1.000 (25.40)	3.875 (98.43)				
A	C	1.100 (27.94)	1.100 (27.94)	A	C	.375 (9.53)	4.000 (101.60)				
A	C	.800 (20.32)	1.250 (31.75)	A	C	.500 (12.70)	4.000 (101.60)				
A	C	.950 (24.13)	1.250 (31.75)	A	C	.625 (15.88)	4.000 (101.60)				
A	C	1.100 (27.94)	1.250 (31.75)	A	C	.750 (19.05)	4.000 (101.60)				
A	C	.800 (20.32)	1.400 (35.56)	A	C	.875 (22.23)	4.000 (101.60)				
A	C	.950 (24.13)	1.400 (35.56)	A	C	1.000 (25.40)	4.000 (101.60)				
A	C	1.100 (27.94)	1.400 (35.56)	A	C	.375 (9.53)	4.450 (113.03)				
A	C	.800 (20.32)	1.550 (39.37)	A	C	.525 (13.34)	4.450 (113.03)				
A	C	.950 (24.13)	1.550 (39.37)	A	C	.375 (9.53)	4.600 (116.84)				
A	C	1.100 (27.94)	1.550 (39.37)	A	C	.525 (13.34)	4.600 (116.84)				
A	C	000 (000)	2.075 (52.71)	A	C	.375 (9.53)	4.750 (120.65)				
A	C	000 (000)	2.275 (57.79)	A	C	.525 (13.34)	4.750 (120.65)				
A	C	000 (000)	2.475 (62.87)	A	C	.800 (20.32)	4.350 (110.49)				
A	C	000 (000)	2.775 (70.49)	A	C	.950 (24.13)	4.350 (110.49)				
A	C	000 (000)	2.975 (75.57)	A	C	1.100 (27.94)	4.350 (110.49)				
A	C	000 (000)	3.175 (80.65)	A	C	.800 (20.32)	4.500 (114.30)				
A	C	.100 (2.54)	2.625 (66.68)	A	C	.950 (24.13)	4.500 (114.30)				
A	C	.375 (9.53)	2.825 (71.76)	A	C	1.100 (27.94)	4.500 (114.30)				

FIGURE 22. Multilayer test specimen IPC-A-29 - Continued.

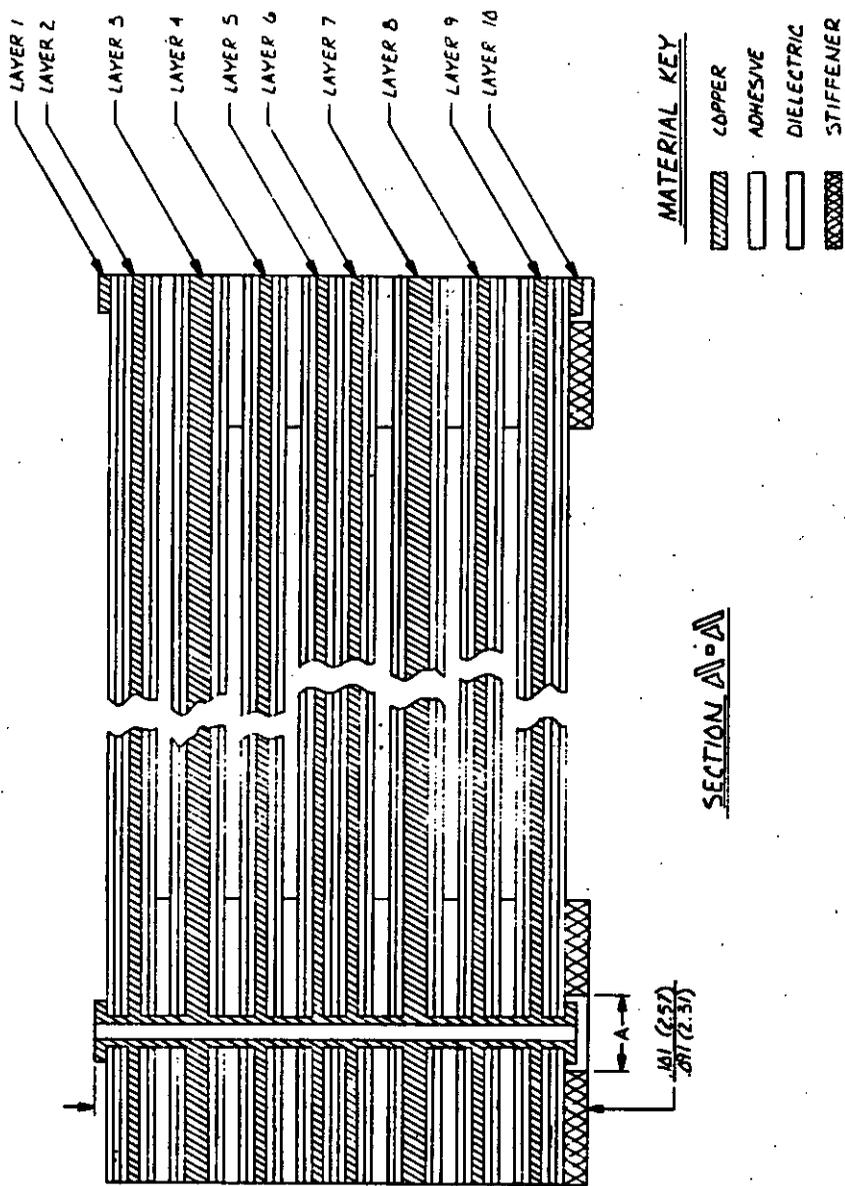


FIGURE 22. Multilayer test specimen IPC-A-29 - Continued.

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. Dimensions are in inches.
2. Metric equivalents are in parentheses.
3. Metric equivalents are given for general information only.
4. Unless otherwise specified tolerances are $\pm .03$ (0.8 mm) for two place decimals and $\pm .010$ (0.25 mm) for three place decimals.
5. Interpret drawing per MIL-D-1000.
6. Fabricate per MIL-P-50884.
7. Flex clad material shall be IPC-FC-241A/O-X-XXIX-CFW7-1S/0, class 3.
8. Flex clad material shall be IPC-FC-241A/O-X-XXIX-CFW7-2S/0, class 3.
9. Flex clad material shall be IPC-FC-241A/O-X-XXIX-CFW7-1S/1S, class 3.
10. Adhesive material shall be IPC-FC-233/O-X-XXXX-X, class 3. Thickness is at manufacturer's discretion.
11. Dielectric material shall be IPC-FC-232A/O-X-XXIX-1/0, class 3.
12. Stiffner shall be plastic sheet per MIL-P-13949, .032 (0.81 mm) thick.
13. The "A" coupons around the outer periphery of the board, are for manufacturing purposes only. They do not need to be shipped with finished boards.
14. All holes are within ϕ .005 (0.13 mm) and are located on a .025 (0.64 mm) grid pattern.
15. Use artwork master no. IPC-B-29/50884, layers 1-10.
16. All plated thru holes shall be electrolytically copper plated to .001 (0.25 mm) minimum per paragraph 3.3.10 and 3.7.2.
17. All exposed copper shall be tin-lead plated and fused or solder coated per paragraph 3.3.11 and 3.7.2.
18. Manufacturer is required to check dimensionally all hole locations prior to shipment.
19. Stiffner to be bonded to layer 10 side.

FIGURE 22. Multilayer test specimen IPC-A-29 - Continued.

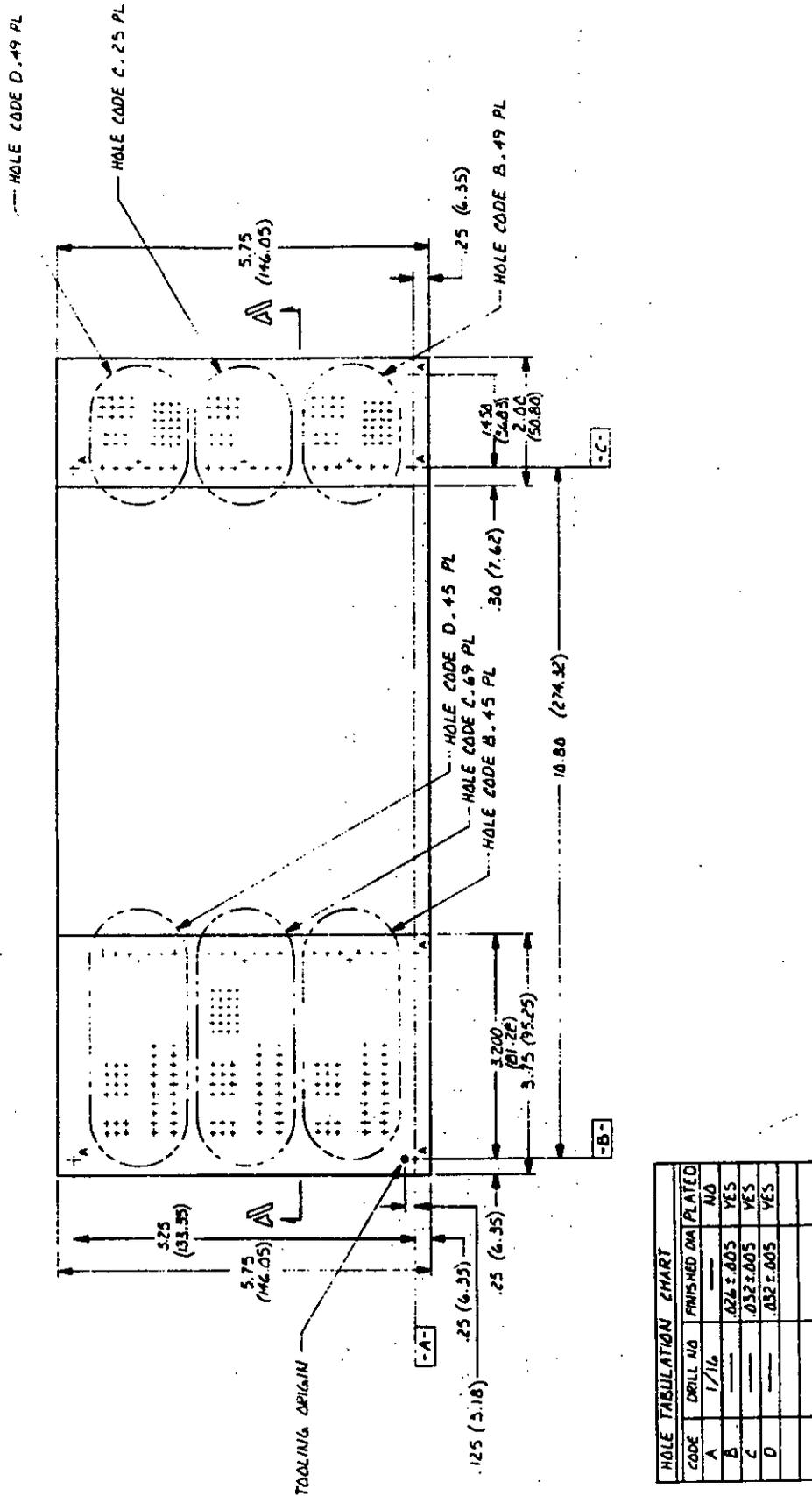


FIGURE 22. Multilayer test specimen IPC-A-29 - Continued.

MIL-P-50884C
APPENDIX

HOLE LOCATION CHART											
PR1 DATUM	SEC DATUM	X' DIM	Y' DIM	PR1 DATUM	SEC DATUM	X' DIM	Y' DIM	PR1 DATUM	SEC DATUM	X' DIM	Y' DIM
A	B	.000 (0.00)	.000 (0.00)	A	B	.725 (18.42)	2.400 (60.96)	A	B	.875 (22.23)	3.725 (94.62)
A	B	.000 (0.00)	5.350 (133.35)	A	B	.875 (22.23)	2.400 (60.96)	A	B	1.025 (26.04)	3.725 (94.62)
A	B	3.200 (81.28)	.000 (0.00)	A	B	1.025 (26.04)	2.400 (60.96)	A	B	1.175 (29.85)	3.725 (94.62)
A	B	.425 (10.80)	.475 (12.07)	A	B	1.175 (29.85)	2.400 (60.96)	A	B	1.325 (33.66)	3.725 (94.62)
A	B	.575 (14.61)	.475 (12.07)	A	B	1.325 (33.66)	2.400 (60.96)	A	B	1.475 (37.47)	3.725 (94.62)
A	B	.725 (18.42)	.475 (12.07)	A	B	1.475 (37.47)	2.400 (60.96)	A	B	1.625 (41.28)	3.725 (94.62)
A	B	.875 (22.23)	.475 (12.07)	A	B	1.625 (41.28)	2.400 (60.96)	A	B	1.775 (45.09)	3.725 (94.62)
A	B	1.025 (26.04)	.475 (12.07)	A	B	1.775 (45.09)	2.400 (60.96)	A	B	.425 (10.80)	4.025 (102.24)
A	B	1.175 (29.85)	.475 (12.07)	A	B	.425 (10.80)	2.825 (71.76)	A	B	.575 (14.61)	4.025 (102.24)
A	B	1.325 (33.66)	.475 (12.07)	A	B	.575 (14.61)	2.825 (71.76)	A	B	.725 (18.42)	4.025 (102.24)
A	B	1.475 (37.47)	.475 (12.07)	A	B	.725 (18.42)	2.975 (75.57)	A	B	.875 (22.23)	4.025 (102.24)
A	B	1.625 (41.28)	.475 (12.07)	A	B	.875 (22.23)	2.975 (75.57)	A	B	1.025 (26.04)	4.025 (102.24)
A	B	1.775 (45.09)	.475 (12.07)	A	B	.925 (10.80)	2.975 (75.57)	A	B	1.175 (29.85)	4.025 (102.24)
A	B	1.925 (49.09)	.475 (12.07)	A	B	1.025 (26.04)	2.975 (75.57)	A	B	1.325 (33.66)	4.025 (102.24)
A	B	.425 (10.80)	.775 (19.69)	A	B	1.175 (29.85)	2.825 (71.76)	A	B	1.475 (37.47)	4.025 (102.24)
A	B	.575 (14.61)	.775 (19.69)	A	B	1.325 (33.66)	2.825 (71.76)	A	B	1.625 (41.28)	4.025 (102.24)
A	B	.725 (18.42)	.775 (19.69)	A	B	1.475 (37.47)	2.825 (71.76)	A	B	1.775 (45.09)	4.025 (102.24)
A	B	.875 (22.23)	.775 (19.69)	A	B	1.625 (41.28)	2.825 (71.76)	A	B	.425 (10.80)	4.450 (113.03)
A	B	1.025 (26.04)	.775 (19.69)	A	B	1.775 (45.09)	2.825 (71.76)	A	B	.575 (14.61)	4.450 (113.03)
A	B	1.175 (29.85)	.775 (19.69)	A	B	1.925 (49.09)	2.825 (71.76)	A	B	.725 (18.42)	4.450 (113.03)
A	B	1.325 (33.66)	.775 (19.69)	A	B	2.075 (53.09)	2.825 (71.76)	A	B	.875 (22.23)	4.450 (113.03)
A	B	1.475 (37.47)	.775 (19.69)	A	B	2.225 (57.09)	2.825 (71.76)	A	B	1.025 (26.04)	4.450 (113.03)
A	B	1.625 (41.28)	.775 (19.69)	A	B	2.375 (61.09)	2.825 (71.76)	A	B	1.175 (29.85)	4.450 (113.03)
A	B	1.775 (45.09)	.775 (19.69)	A	B	2.525 (65.09)	2.825 (71.76)	A	B	1.325 (33.66)	4.450 (113.03)
A	B	1.925 (49.09)	.775 (19.69)	A	B	2.675 (69.09)	2.825 (71.76)	A	B	1.475 (37.47)	4.450 (113.03)
A	B	.425 (10.80)	1.200 (30.48)	A	B	2.825 (73.09)	2.825 (71.76)	A	B	1.625 (41.28)	4.450 (113.03)
A	B	.575 (14.61)	1.200 (30.48)	A	B	2.975 (77.09)	2.825 (71.76)	A	B	1.775 (45.09)	4.450 (113.03)
A	B	.725 (18.42)	1.200 (30.48)	A	B	3.125 (81.09)	2.825 (71.76)	A	B	1.925 (49.09)	4.450 (113.03)
A	B	.875 (22.23)	1.200 (30.48)	A	B	3.275 (85.09)	2.825 (71.76)	A	B	2.075 (53.09)	4.450 (113.03)
A	B	1.025 (26.04)	1.200 (30.48)	A	B	3.425 (89.09)	2.825 (71.76)	A	B	2.225 (57.09)	4.450 (113.03)
A	B	1.175 (29.85)	1.200 (30.48)	A	B	3.575 (93.09)	2.825 (71.76)	A	B	2.375 (61.09)	4.450 (113.03)
A	B	1.325 (33.66)	1.200 (30.48)	A	B	3.725 (97.09)	2.825 (71.76)	A	B	2.525 (65.09)	4.450 (113.03)
A	B	1.475 (37.47)	1.200 (30.48)	A	B	3.875 (101.09)	2.825 (71.76)	A	B	2.675 (69.09)	4.450 (113.03)
A	B	1.625 (41.28)	1.200 (30.48)	A	B	4.025 (105.09)	2.825 (71.76)	A	B	2.825 (73.09)	4.450 (113.03)
A	B	1.775 (45.09)	1.200 (30.48)	A	B	4.175 (109.09)	2.825 (71.76)	A	B	2.975 (77.09)	4.450 (113.03)
A	B	1.925 (49.09)	1.200 (30.48)	A	B	4.325 (113.09)	2.825 (71.76)	A	B	3.125 (81.09)	4.450 (113.03)
A	B	.425 (10.80)	1.350 (34.29)	A	B	4.475 (117.09)	2.825 (71.76)	A	B	3.275 (85.09)	4.450 (113.03)
A	B	.575 (14.61)	1.350 (34.29)	A	B	4.625 (121.09)	2.825 (71.76)	A	B	3.425 (89.09)	4.450 (113.03)
A	B	.725 (18.42)	1.350 (34.29)	A	B	4.775 (125.09)	2.825 (71.76)	A	B	3.575 (93.09)	4.450 (113.03)
A	B	.875 (22.23)	1.350 (34.29)	A	B	4.925 (129.09)	2.825 (71.76)	A	B	3.725 (97.09)	4.450 (113.03)
A	B	1.025 (26.04)	1.350 (34.29)	A	B	5.075 (133.09)	2.825 (71.76)	A	B	3.875 (101.09)	4.450 (113.03)
A	B	1.175 (29.85)	1.350 (34.29)	A	B	5.225 (137.09)	2.825 (71.76)	A	B	4.025 (105.09)	4.450 (113.03)
A	B	1.325 (33.66)	1.350 (34.29)	A	B	5.375 (141.09)	2.825 (71.76)	A	B	4.175 (109.09)	4.450 (113.03)
A	B	1.475 (37.47)	1.350 (34.29)	A	B	5.525 (145.09)	2.825 (71.76)	A	B	4.325 (113.09)	4.450 (113.03)
A	B	1.625 (41.28)	1.350 (34.29)	A	B	5.675 (149.09)	2.825 (71.76)	A	B	4.475 (117.09)	4.450 (113.03)
A	B	1.775 (45.09)	1.350 (34.29)	A	B	5.825 (153.09)	2.825 (71.76)	A	B	4.625 (121.09)	4.450 (113.03)
A	B	1.925 (49.09)	1.350 (34.29)	A	B	5.975 (157.09)	2.825 (71.76)	A	B	4.775 (125.09)	4.450 (113.03)
A	B	.425 (10.80)	1.500 (38.10)	A	B	6.125 (161.09)	2.825 (71.76)	A	B	4.925 (129.09)	4.450 (113.03)
A	B	.575 (14.61)	1.500 (38.10)	A	B	6.275 (165.09)	2.825 (71.76)	A	B	5.075 (133.09)	4.450 (113.03)
A	B	.725 (18.42)	1.500 (38.10)	A	B	6.425 (169.09)	2.825 (71.76)	A	B	5.225 (137.09)	4.450 (113.03)
A	B	.875 (22.23)	1.500 (38.10)	A	B	6.575 (173.09)	2.825 (71.76)	A	B	5.375 (141.09)	4.450 (113.03)
A	B	1.025 (26.04)	1.500 (38.10)	A	B	6.725 (177.09)	2.825 (71.76)	A	B	5.525 (145.09)	4.450 (113.03)
A	B	1.175 (29.85)	1.500 (38.10)	A	B	6.875 (181.09)	2.825 (71.76)	A	B	5.675 (149.09)	4.450 (113.03)
A	B	1.325 (33.66)	1.500 (38.10)	A	B	7.025 (185.09)	2.825 (71.76)	A	B	5.825 (153.09)	4.450 (113.03)
A	B	1.475 (37.47)	1.500 (38.10)	A	B	7.175 (189.09)	2.825 (71.76)	A	B	5.975 (157.09)	4.450 (113.03)
A	B	1.625 (41.28)	1.500 (38.10)	A	B	7.325 (193.09)	2.825 (71.76)	A	B	6.125 (161.09)	4.450 (113.03)
A	B	1.775 (45.09)	1.500 (38.10)	A	B	7.475 (197.09)	2.825 (71.76)	A	B	6.275 (165.09)	4.450 (113.03)
A	B	1.925 (49.09)	1.500 (38.10)	A	B	7.625 (201.09)	2.825 (71.76)	A	B	6.425 (169.09)	4.450 (113.03)
A	B	3.200 (81.28)	1.000 (25.40)	A	B	7.775 (205.09)	2.825 (71.76)	A	B	6.575 (173.09)	4.450 (113.03)
A	B	3.200 (81.28)	.450 (11.43)	A	B	7.925 (209.09)	2.825 (71.76)	A	B	6.725 (177.09)	4.450 (113.03)
A	B	3.200 (81.28)	.850 (21.59)	A	B	8.075 (213.09)	2.825 (71.76)	A	B	6.875 (181.09)	4.450 (113.03)
A	B	3.200 (81.28)	1.150 (29.21)	A	B	8.225 (217.09)	2.825 (71.76)	A	B	7.025 (185.09)	4.450 (113.03)
A	B	3.200 (81.28)	1.350 (34.29)	A	B	8.375 (221.09)	2.825 (71.76)	A	B	7.175 (189.09)	4.450 (113.03)
A	B	3.200 (81.28)	1.550 (39.37)	A	B	8.525 (225.09)	2.825 (71.76)	A	B	7.325 (193.09)	4.450 (113.03)
A	B	.425 (10.80)	2.100 (53.34)	A	B	8.675 (229.09)	2.825 (71.76)	A	B	7.475 (197.09)	4.450 (113.03)
A	B	.575 (14.61)	2.100 (53.34)	A	B	8.825 (233.09)	2.825 (71.76)	A	B	7.625 (201.09)	4.450 (113.03)
A	B	.725 (18.42)	2.100 (53.34)	A	B	8.975 (237.09)	2.825 (71.76)	A	B	7.775 (205.09)	4.450 (113.03)
A	B	.875 (22.23)	2.100 (53.34)	A	B	9.125 (241.09)	2.825 (71.76)	A	B	7.925 (209.09)	4.450 (113.03)
A	B	1.025 (26.04)	2.100 (53.34)	A	B	9.275 (245.09)	2.825 (71.76)	A	B	8.075 (213.09)	4.450 (113.03)
A	B	1.175 (29.85)	2.100 (53.34)	A	B	9.425 (249.09)	2.825 (71.76)	A	B	8.225 (217.09)	4.450 (113.03)
A	B	1.325 (33.66)	2.100 (53.34)	A	B	9.575 (253.09)	2.825 (71.76)	A	B	8.375 (221.09)	4.450 (113.03)
A	B	1.475 (37.47)	2.100 (53.34)	A	B	9.725 (257.09)	2.825 (71.76)	A	B	8.525 (225.09)	4.450 (113.03)
A	B	1.625 (41.28)	2.100 (53.34)	A	B	9.875 (261.09)	2.825 (71.76)	A	B	8.675 (229.09)	4.450 (113.03)
A	B	1.775 (45.09)	2.100 (53.34)	A	B	10.025 (265.09)	2.825 (71.76)	A	B	8.825 (233.09)	4.450 (113.03)
A	B	.425 (10.80)	2.400 (60.96)	A	B	10.175 (269.09)	2.825 (71.76)	A	B	8.975 (237.09)	4.450 (113.03)
A	B	.575 (14.61)	2.400 (60.96)	A	B	10.325 (273.09)	2.825 (71.76)	A	B	9.125 (241.09)	4.450 (113.03)

FIGURE 22. Multilayer test specimen IPC-A-29 - Continued.

HOLE LOCATION CHART											
PR1 DATUM	SEC DATUM	X' DIM	Y' DIM	PR1 DATUM	SEC DATUM	X' DIM	Y' DIM	PR1 DATUM	SEC DATUM	X' DIM	Y' DIM
A	C	.000 (0.00)	.000 (0.00)	A	C	.525 (13.34)	2.825 (71.76)	A	C	.800 (20.32)	4.650 (118.11)
A	C	.000 (0.00)	5.250 (133.35)	A	C	.375 (9.53)	2.975 (75.57)	A	C	.950 (24.13)	4.650 (118.11)
A	C	1.450 (36.83)	.000 (0.00)	A	C	.525 (13.34)	2.975 (75.57)	A	C	1.100 (27.94)	4.650 (118.11)
A	C	.000 (0.00)	.453 (11.43)	A	C	.375 (9.53)	3.125 (79.38)	A	C	.800 (20.32)	4.800 (121.92)
A	C	.000 (0.00)	.650 (16.51)	A	C	.525 (13.34)	3.125 (79.38)	A	C	.950 (24.13)	4.800 (121.92)
A	C	.000 (0.00)	.850 (21.59)	A	C	.000 (0.00)	2.725 (69.22)	A	C	1.100 (27.94)	4.800 (121.92)
A	C	.000 (0.00)	1.150 (29.21)	A	C	.950 (24.13)	2.725 (69.22)				
A	C	.000 (0.00)	1.350 (34.29)	A	C	1.100 (27.94)	2.725 (69.22)				
A	C	.000 (0.00)	1.550 (39.37)	A	C	.800 (20.32)	2.875 (73.03)				
A	C	.100 (2.54)	1.000 (25.40)	A	C	.950 (24.13)	2.875 (73.03)				
A	C	.375 (9.53)	.375 (9.53)	A	C	1.100 (27.94)	2.875 (73.03)				
A	C	.500 (12.70)	.375 (9.53)	A	C	.800 (20.32)	3.025 (76.84)				
A	C	.625 (15.88)	.375 (9.53)	A	C	.950 (24.13)	3.025 (76.84)				
A	C	.750 (19.05)	.375 (9.53)	A	C	1.100 (27.94)	3.025 (76.84)				
A	C	.875 (22.23)	.375 (9.53)	A	C	.800 (20.32)	3.175 (80.65)				
A	C	1.000 (25.40)	.375 (9.53)	A	C	.950 (24.13)	3.175 (80.65)				
A	C	.375 (9.53)	.500 (12.70)	A	C	1.100 (27.94)	3.175 (80.65)				
A	C	.500 (12.70)	.500 (12.70)	A	C	.000 (0.00)	3.700 (93.98)				
A	C	.625 (15.88)	.500 (12.70)	A	C	.000 (0.00)	3.900 (99.06)				
A	C	.750 (19.05)	.500 (12.70)	A	C	.000 (0.00)	4.100 (104.14)				
A	C	.875 (22.23)	.500 (12.70)	A	C	.000 (0.00)	4.400 (111.76)				
A	C	1.000 (25.40)	.500 (12.70)	A	C	.000 (0.00)	4.600 (116.84)				
A	C	.375 (9.53)	.625 (15.88)	A	C	.000 (0.00)	4.800 (121.92)				
A	C	.500 (12.70)	.625 (15.88)	A	C	.100 (2.54)	4.250 (107.95)				
A	C	.625 (15.88)	.625 (15.88)	A	C	.375 (9.53)	3.625 (92.08)				
A	C	.750 (19.05)	.625 (15.88)	A	C	.500 (12.70)	3.625 (92.08)				
A	C	.875 (22.23)	.625 (15.88)	A	C	.625 (15.88)	3.625 (92.08)				
A	C	1.000 (25.40)	.625 (15.88)	A	C	.750 (19.05)	3.625 (92.08)				
A	C	.375 (9.53)	.750 (19.05)	A	C	.875 (22.23)	3.625 (92.08)				
A	C	.500 (12.70)	.750 (19.05)	A	C	1.000 (25.40)	3.625 (92.08)				
A	C	.625 (15.88)	.750 (19.05)	A	C	.375 (9.53)	3.750 (95.25)				
A	C	.750 (19.05)	.750 (19.05)	A	C	.500 (12.70)	3.750 (95.25)				
A	C	.875 (22.23)	.750 (19.05)	A	C	.625 (15.88)	3.750 (95.25)				
A	C	1.000 (25.40)	.750 (19.05)	A	C	.750 (19.05)	3.750 (95.25)				
A	C	.375 (9.53)	1.200 (30.48)	A	C	.875 (22.23)	3.750 (95.25)				
A	C	.525 (13.34)	1.200 (30.48)	A	C	1.000 (25.40)	3.750 (95.25)				
A	C	.375 (9.53)	1.350 (34.29)	A	C	.375 (9.53)	3.875 (98.43)				
A	C	.525 (13.34)	1.350 (34.29)	A	C	.500 (12.70)	3.875 (98.43)				
A	C	.375 (9.53)	1.500 (38.10)	A	C	.625 (15.88)	3.875 (98.43)				
A	C	.525 (13.34)	1.500 (38.10)	A	C	.750 (19.05)	3.875 (98.43)				
A	C	.800 (20.32)	1.100 (27.94)	A	C	.875 (22.23)	3.875 (98.43)				
A	C	.950 (24.13)	1.100 (27.94)	A	C	1.000 (25.40)	3.875 (98.43)				
A	C	1.100 (27.94)	1.100 (27.94)	A	C	.375 (9.53)	4.000 (101.60)				
A	C	.800 (20.32)	1.250 (31.75)	A	C	.500 (12.70)	4.000 (101.60)				
A	C	.950 (24.13)	1.250 (31.75)	A	C	.625 (15.88)	4.000 (101.60)				
A	C	1.100 (27.94)	1.250 (31.75)	A	C	.750 (19.05)	4.000 (101.60)				
A	C	.800 (20.32)	1.400 (35.56)	A	C	.875 (22.23)	4.000 (101.60)				
A	C	.950 (24.13)	1.400 (35.56)	A	C	1.000 (25.40)	4.000 (101.60)				
A	C	1.100 (27.94)	1.400 (35.56)	A	C	.375 (9.53)	4.450 (113.03)				
A	C	.800 (20.32)	1.550 (39.37)	A	C	.525 (13.34)	4.450 (113.03)				
A	C	.950 (24.13)	1.550 (39.37)	A	C	.375 (9.53)	4.600 (116.84)				
A	C	1.100 (27.94)	1.550 (39.37)	A	C	.525 (13.34)	4.600 (116.84)				
A	C	.000 (0.00)	2.075 (52.71)	A	C	.375 (9.53)	4.750 (120.65)				
A	C	.000 (0.00)	2.275 (57.79)	A	C	.525 (13.34)	4.750 (120.65)				
A	C	.000 (0.00)	2.475 (62.87)	A	C	.800 (20.32)	4.350 (110.49)				
A	C	.000 (0.00)	2.775 (70.49)	A	C	.950 (24.13)	4.350 (110.49)				
A	C	.000 (0.00)	2.975 (75.57)	A	C	1.100 (27.94)	4.350 (110.49)				
A	C	.000 (0.00)	3.175 (80.65)	A	C	.800 (20.32)	4.500 (114.30)				
A	C	.100 (2.54)	2.625 (66.68)	A	C	.950 (24.13)	4.500 (114.30)				
A	C	.375 (9.53)	2.825 (71.76)	A	C	1.100 (27.94)	4.500 (114.30)				

FIGURE 22. Multilayer test specimen IPC-A-29 - Continued.

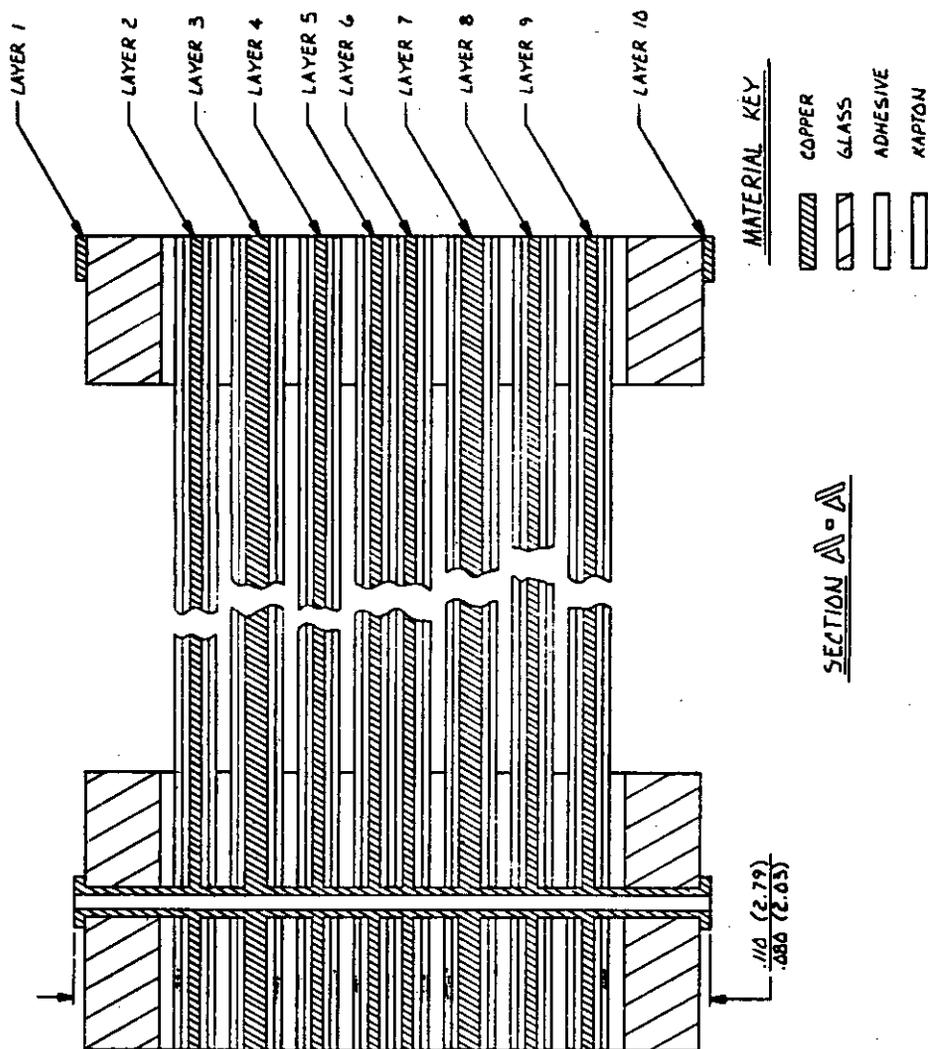


FIGURE 22. Multilayer test specimen IPC-A-29 - Continued.

- NOTES: (UNLESS OTHERWISE SPECIFIED)
1. Dimensions are in inches.
 2. Metric equivalents are in parentheses.
 3. Metric equivalents are given for general information only.
 4. Unless otherwise specified tolerances are ± 0.03 (0.8 mm) for two place decimals and ± 0.10 (0.25 mm) for three place decimals.
 5. Interpret drawing per MIL-D-1000.
 6. Fabricate per MIL-P-50884.
 7. Flex clad material shall be IPC-FC-241A/O-X-XXIX-CFW7-1S/0, class 3.
 8. Flex clad material shall be IPC-FC-241A/O-X-XXIX-CFW7-2S/0S, class 3.
 9. Flex clad material shall be IPC-FC-241A/O-X-XXIX-CFW7-1S/1S, class 3.
 10. Adhesive material shall be IPC-FC-233/O-X-XXXX-X, class 3. Thickness is at manufacturers discretion.
 11. Dielectric material shall be IPC-FC-232A/O-X-XXIX-1/0, class 3.
 12. Rigid clad material shall be GEN or GIN 1000 C1/00A1A per MIL-P-13949.
 13. The "A" coupons around the outer periphery of the board, are for manufacturing purposes only. They do not need to be shipped with finished boards.
 14. All holes are within ϕ .005 (0.13 mm) and are located on a .025 (0.64 mm) grid pattern.
 15. Use artwork master no. IPC-B-29/50884, layers 1-10.
 16. All plated thru holes shall be electrolytically copper plated to .001 (0.25 mm) minimum per paragraph 3.3.10 and 3.7.2.
 17. All exposed copper shall be tin-lead plated and fused or solder coated per paragraph 3.3.11 and 3.7.2.
 18. Manufacturer is required to check dimensionally all hole locations prior to shipment.

FIGURE 22. Multilayer test specimen IPC-A-29 - Continued.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

ATL-P-50884C

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

VENDOR

USER

MANUFACTURER

OTHER (Specify): _____

3b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

DD FORM 1426
82 MAR

PREVIOUS EDITION IS OBSOLETE.

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