

INCH-POUND

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SUPERSEDING
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(See 6.8)

MILITARY SPECIFICATION
ASSEMBLIES, ELECTRICAL BACKPLANE,
PRINTED-WIRING, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for printed-wiring electrical backplane assemblies consisting of rigid printed-wiring boards on which separately manufactured compliant-component parts have been added.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, D.C. 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5998

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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1.2 Classification. Printed-wiring electrical backplane assemblies shall be of the following types.

- (a) Type 2 - Double-sided printed-wiring electrical backplane assemblies.
- (b) Type 3 - Multilayer printed-wiring electrical backplane assemblies.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MILITARY

- MIL-P-116 - Preservation, Methods of.
- MIL-C-28754/39- Connectors, Electrical, Modular, Connector, Type III, Keying Pegs.
- MIL-C-28859 - Connector Component Parts, Electrical Backplane, Printed-Wiring, General Specification for.
- MIL-C-28859/1 - Connector Component Parts, Electrical Backplane, Printed Wiring Compliant Pin.
- MIL-C-28859/2 - Connector, Component Parts, Electrical Backplane, Printed Wiring, Housing.
- MIL-C-28859/3 - Connector, Component Parts, Electrical Backplane, Printed Wiring, Compliant Pin, Feed-Through.
- MIL-C-28859/4 - Connector, Component Parts, Electrical Backplane, Printed Wiring, Compliant Pin, Feed-To.
- MIL-C-28859/5 - Connector Component Parts, Electrical Backplane, Printed Wiring, Low Insertion Force (LIF), Compliant Contact.

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- MIL-I-43553 - Ink, Marking, Epoxy Base.
- MIL-I-46058 - Insulating Compound, Electrical (For Coating Printed Circuit Assemblies).
- MIL-P-55110 - Printed-Wiring Boards, General Specification for.

STANDARDS

MILITARY

- DOD-STD-100 - Engineering Drawing Practices.
- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
- MIL-STD-275 - Printed-Wiring for Electrical Equipment
- MIL-STD-1344 - Test Methods for Electrical Connectors.
- MIL-STD-2119 - Printed-Wiring Electrical Backplane Assemblies.
- MIL-STD-45662 - Calibration Systems Requirements.
- MIL-STD-55330 - Connectors, Electrical and Fiber Optic, Packaging of.

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Ave., Philadelphia, PA 19120-5099.)

2.1.2 Other Government drawings. The following other Government drawings form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS

- Naval Avionics Center Drawing No. - SKDGH-0001
- Naval Avionics Center Drawing No. - SKDGH-0002

(Application for copies should be addressed to the Naval Avionics Center, Code 814, 6000 East 21st Street, Indianapolis, IN 46219-2189.)

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2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are Department of Defense (DoD) adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

Y32.16 - Standard Reference Designations for Electrical and Electronics Parts and Equipments.

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018-3308.)

INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)

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

(Application for copies should be addressed to the Institute for Interconnecting and Packaging Electronic Circuits, 7380 North Lincoln Ave., Lincolnwood, IL 60646.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other information services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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3. REQUIREMENTS

3.1 General requirements. Printed-wiring electrical backplane assemblies furnished under this specification shall be products which meet the requirements of MIL-STD-2119 and the backplane assembly drawing (see 6.2). The printed-wiring electrical backplane assembly drawing shall be in accordance with DOD-STD-100. In the event of conflict between MIL-STD-2119 and the backplane assembly drawing, the latter shall govern.

3.2 Qualification. Printed-wiring electrical backplane assemblies furnished under this specification shall be from manufacturers who are authorized by the qualifying activity for listing on the applicable qualified manufacturers list at the time of award of contract (see 4.5 and 6.3).

3.3 Material. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

3.3.1 Compliant components. The compliant components shall be in accordance with MIL-C-28859.

3.3.2 Housing and keying pegs. The housing (insulator) shall be in accordance with MIL-C-28859/2 specification sheet, and the keying pegs shall be in accordance with MIL-C-28754/39.

3.3.3 Printed-wiring backplane. Type 2 and type 3 printed-wiring electrical backplane assemblies shall use rigid printed-wiring boards in accordance with MIL-P-55110 and the backplane assembly drawing.

3.3.4 Conformal coating and solder mask. Conformal coating or solder mask shall be in accordance with MIL-I-46058 or IPC-SM-840, Class 3, respectively.

3.3.5 Marking ink. Marking ink shall be an epoxy base ink conforming to MIL-I-43553.

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3.4 Design and construction. Printed-wiring electrical backplane assemblies are composed of housings, compliant components, a rigid printed-wiring board, and, if specified, keying pegs. The printed-wiring backplane assemblies shall meet the requirements of the assembly drawing and the following requirements of 3.4.1 through 3.4.4.

3.4.1 Housing. The assembled housing dimensions shall be in accordance with figure 1.

3.4.2 Compliant components. The compliant component height above the printed-wiring board shall be in accordance with figure 1.

3.4.3 Compliant contact component and housing assembly. The compliant contact component and housing assembly shall be in accordance with the standards established on figure 2 when visually inspected at a magnification of 5-10 power. Figure 2A is the preferred condition. Figures 2B through 2D are unacceptable conditions. If more than 5 percent of the receptacle contacts display any conditions depicted on figures 2E through 2H, the backplane assembly is unacceptable.

3.4.4 Wrappost tail tip position. All wrappost tail tip positions shall be within a positional tolerance of 0.020 inch (0.508 mm) diameter to specified datums on the backplane assembly drawing.

3.5 Mechanical requirements.

3.5.1 Compliant component retention. The compliant components installed in the rigid printed-wiring board shall meet the following requirements. There shall be no conductive debris anywhere on the assembly.

3.5.1.1 Initial. After initial insertion of the compliant component into the rigid printed-wiring board, the pushout force shall be a minimum of 7.5 pounds (33.4 newton) and a maximum of 45 pounds (200 newton), when tested in accordance with 4.7.3.1.

3.5.1.2 Conditioned. After conditioning in accordance with 4.7.3.1.1, the pushout force shall be a minimum of 7.5 pounds (33.4 newton).

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3.5.1.3 Compliant component torque. When tested as specified in 4.7.3.2, the compliant component shall withstand a minimum torque of 3 ounce-inches (0.02 newton-meter). Following removal of the applied torque, no displacement or deformation of the compliant component shall be visible.

3.5.2 Plated-through hole integrity. When microsectioned in accordance with 4.7.3.5, plated-through holes containing compliant components shall meet the following requirements.

3.5.2.1 Hole deformation. The average plated-through hole deformation shall be no greater than 0.0015 inch (0.0038 cm), when measured from the drilled hole. The absolute maximum deformation shall be 0.002 inch (0.005 cm) (see figure 3).

3.5.2.2 Hole wall damage. The minimum average copper thickness remaining between the compliant components and the printed-wiring laminate shall not be less than 0.0003 inch (0.0008 cm). In addition, there shall be no copper cracks or other interplane separations from the hole wall barrel or separations between the printed-wiring board laminate and the plated copper barrel. The sample shall be viewed in the vertical plane to ensure that no copper cracks, separations between conductor interfaces, or laminate-to-copper separations have occurred.

3.5.3 Housing retention. The housing retention shall be as specified in MIL-C-28859/2 (see 4.7.3.3). When housings are removed, they shall be replaced with an unused housing and the removed housing discarded.

3.5.4 Keying peg retention. When tested in accordance with 4.7.3.4, the keying pegs installed in the housing shall withstand a removal force of 5 pounds (22 newtons) minimum.

3.5.5 Bow and twist. The maximum allowable bow and twist shall be 1.5 percent when tested in accordance with 4.7.3.6.

3.5.6 Engaging and separating forces. The mechanical requirements for standard insertion force and Low Insertion Force (LIF) contacts are in accordance with 3.5.6.1 and 3.5.6.2.

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3.5.6.1 Standard insertion engaging and separating force. When tested as specified in 4.7.3.7, the force to engage the tuning fork shall be 6 ounces (1.7 newtons) maximum, and the force to separate shall be 2 ounces (0.6 newtons) minimum.

3.5.6.2 LIF engaging and separating force. When tested as specified in 4.7.3.7, the average force to engage shall be 2.25 ounces (0.63 newtons) maximum per contact for complete insertion. Separation force shall be 4.00 ounces (1.12 newtons) maximum per contact.

3.5.7 LIF normal force. The average normal force shall be greater than 3.5 ounces (0.98 newtons) with random reading of not less than 3.00 ounces (0.84 newtons) allowed when tested as specified in 4.7.3.8.

3.6 Electrical requirements.

3.6.1 Printed-wiring backplane to compliant component resistance. When the printed-wiring electrical backplane assemblies are tested as specified in 4.7.2.1 and the applicable figure, the voltage drop shall not exceed 6 millivolts (mV) for type 2 assemblies (see figure 4), and 20 mV for type 3 assemblies (see figure 5).

3.6.2 Insulation resistance. When printed-wiring electrical backplane assemblies are tested as specified in 4.7.2.2, the insulation resistance shall be as specified in table II.

TABLE II. Insulation resistance.

| Resistance (megohms) Component to component | | |
|--|-----------------------------|----------------------|
| Before humidity | Within 1 hour after removal | After 2 hours drying |
| 10,000 | 10 | 500 |

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3.6.3 Dielectric withstanding voltage. There shall be no evidence of arcing, breakdown or damage when tested as specified in 4.7.2.3.

3.6.4 Circuitry.

3.6.4.1 Circuit continuity. There shall be no open circuits in the specimen when tested as specified in 4.7.2.4.1.

3.6.4.2 Circuit shorts. There shall be no short circuits in the specimen when tested as specified in 4.7.2.4.2.

3.7 Environmental requirements.

3.7.1 Temperature cycling. The printed-wiring electrical backplane assembly shall show no evidence of cracking, fracturing, delamination or other damage detrimental to the operation of the assembly when tested as specified in 4.7.4.1.

3.7.2 Life. The printed-wiring electrical backplane assembly shall exhibit no evidence of cracks, burns, delamination or other visual or mechanical damage when tested as specified in 4.7.4.5.

3.7.3 Temperature-altitude. There shall be no evidence of cracks, burns, or other visible or dimensional damage which could cause electrical or mechanical breakdown of the printed-wiring electrical backplane assembly when tested as specified in 4.7.4.2. In addition, at the completion of the temperature-altitude test, the assembly shall meet the requirements of 3.6.2 (before humidity) and 3.6.3.

3.7.4 Vibration. There shall be no cracking or breaking, nor shall there be any loosening of parts, or other visible damage when printed-wiring electrical backplane assemblies are tested as specified in 4.7.4.3. There shall be no loss of electrical continuity of any of the contact circuits of more than 0.1 microsecond during test. Connectors shall meet the requirements of 3.5.1 and 3.6.1.

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3.7.5 Shock (specified pulse). There shall be no breakage or loosening of contacts, cracking of inserts, nor other visible or dimensional damage which could cause electrical or mechanical breakdown when printed-wiring electrical backplane assemblies are tested as specified in 4.7.4.4. There shall be no loss of electrical continuity of any of the contact circuits of more than 0.1 microsecond during test. Connectors shall meet the requirements of 3.5.1 and 3.6.1.

3.7.6 Humidity. The printed-wiring backplane assemblies shall conform to the requirements of 3.6.2 and 3.6.3 when tested as specified in 4.7.4.6.

3.8 Conformal coating and solder mask.

3.8.1 Coverage. Printed-wiring backplane assemblies shall be coated in all areas specified in the assembly master drawing. Conformal coating shall be in accordance with MIL-I-46058 or solder mask, when specified, shall be in accordance with IPC-SM-840, Class 3. Only MIL-I-46058, Type UR conformal coating will be allowed in the plated-through hole.

3.8.2 Thickness. Unless otherwise specified on the assembly drawing, the conformal coating thickness of type ER, and AR shall be 0.003 plus or minus 0.002 inch (0.080 plus or minus 0.050 mm); UR shall be 0.001 to 0.003 inch (0.025 to 0.080 mm); SR shall be 0.005 plus or minus 0.003 inch (0.13 plus or minus 0.08 mm); and XY shall be 0.0005 to 0.002 inch (0.0127 to 0.051 mm) when measured on a flat unencumbered surface.

3.8.3 Appearance. Coated assemblies shall have no visible blisters, cracking, crazing, mealing, peeling, or wrinkles. A pinhole or bubble and/or a combination of pinhole(s) and bubble(s) may bridge up to 50 percent of the distance between conductors, provided that the minimum dielectric withstanding capability is not violated. There shall be no evidence of reversion or corrosion.

3.9 Marking. Printed-wiring electrical backplane assemblies shall be marked in accordance with MIL-STD-2119. All assemblies shall be identified for traceability throughout the groups A and B testing.

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3.10 Cleanliness. The backplane shall be free of ionic and other contaminants prior to the application of the conformal coating or solder mask when tested as specified in 4.7.5. Testing shall be prior to the application of conformal coating or solder mask.

3.10.1 Resistivity of solvent extract. The resistivity of uncoated backplanes shall not be less than 2,000,000 ohm-centimeters when tested as specified in 4.7.5.

3.11 Workmanship. Printed-wiring electrical backplane assemblies shall be uniform in quality and appearance. They shall be clean and free of dirt, foreign matter, oil, fingerprints, corrosion, salts, flux residues, and contaminants.

4. QUALITY ASSURANCE PROVISIONS.

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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4.1.2 Suppliers certification.

4.1.2.1 Certification requirements. Certification shall consist of an evaluation of the supplier's equipment, facilities, records, and controls which are used to determine the repeatability of the manufacturing and testing processes.

4.1.2.2 Processes requiring certification. The following processes (if used in the manufacturing of components) shall be certified to their applicable specifications in accordance with 4.1.2.1 and this paragraph:

(a) Component and housing assembly. See 3.4.3.

4.1.2.3 Certification approval. Process certification shall be approved by the qualifying activity.

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

- (a) Materials inspection (see 4.4).
- (b) Qualification inspection (see 4.5).
- (c) Quality conformance inspection (see 4.6).

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.1 through 4.7.4.6 of this document.

4.3.1 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.

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4.3.2 Inspection of packaging. Except when commercial packaging is specified, the sampling and inspection of the preservation packaging and interior package marking shall be in accordance with the group A and B quality conformance inspection requirements of MIL-P-116. The sampling and inspection of the packing and marking for shipment and storage shall be in accordance with the quality assurance provisions of the applicable container specification and the marking requirements of MIL-STD-129. The inspection of commercial packaging shall be as specified in the contract or purchase order (see 6.2).

4.4 Materials inspection. Materials inspections shall consist of qualification supported by verifying data that the materials listed in table III, used in fabricating the printed-wiring electrical backplane assemblies, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

TABLE III. Materials inspection.

| Material | Requirement paragraph | Applicable specification |
|-----------------------|-----------------------|--------------------------|
| Printed-wiring boards | 3.3.3 | MIL-P-55110 |
| Compliant components | 3.3.1 | MIL-C-28859 |
| Housings | 3.3.2 | MIL-C-28859 |
| Keying pegs | 3.3.2 | MIL-C-28754/39 |
| Coating | 3.3.4 | |
| Solder Mask | | IPC-SM-840, Class 3 |
| Conformal | | MIL-I-46058 |
| Marking ink | 3.3.5 | MIL-I-43553 |

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4.5 Qualification inspection. Contractor's qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3 and table IV) on test specimens produced with material, equipment, and procedures that will be used in subsequent production.

TABLE IV. Qualification inspection.

| Examination or test | Requirement paragraph | Method paragraph | Number of samples to be inspected 4/ | Number of defects allowed | Measurements per sample | | |
|---------------------------------|-------------------------------|------------------|---|---------------------------|-------------------------|----|----|
| | | | | | Sample | | |
| | | | | | 1 | 2 | 3 |
| <u>Subgroup I</u> | | | | | | | |
| Design and construction | 3.1, 3.3, 3.4, 3.8, 3.9, 3.10 | 4.7.1 4.7.3.6 | 3 | 0 | 1/ | 1/ | 1/ |
| Pwb to component resistance | 3.6.1 | 4.7.2.1 | | | 20 | 20 | 20 |
| Dielectric withstanding voltage | 3.6.3 | 4.7.2.3 | | | 1/ | 1/ | 1/ |
| Insulation resistance | 3.6.2 | 4.7.2.2 | | | 1/ | 1/ | 1/ |

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TABLE IV. Qualification inspection - Continued.

| Examination or test | Require- ment paragraph | Method paragraph | Number of samples to be inspected 4/ | Number of defects allowed | Measurements per sample | | |
|--|-------------------------------|---------------------|---|------------------------------------|----------------------------|----|----|
| | | | | | Sample | | |
| | | | | | 1 | 2 | 3 |
| <u>Subgroup I</u> - Cont | | | | | | | |
| Engaging and separating forces | | | | | | | |
| Standard | 3.5.6.1 | 4.7.3.7 | 3 | 0 | 1/ | 1/ | 1/ |
| LIF | 3.5.6.2 | 4.7.3.7 | | | 1/ | 1/ | 1/ |
| LIF normal force | 3.5.7 | 4.7.3.8 | | | 1/ | 1/ | 1/ |
| Compliant component retention | 3.5.1 | 4.7.3.1 | | | 10 | 10 | 10 |
| Housing retention | 3.5.3 | 4.7.3.3 | | | 2 | 2 | 2 |
| Keying peg retention | 3.5.4 | 4.7.3.4 | | | 2 | 2 | 2 |
| Compliant component torque (wrappost) | 3.5.1.3 | 4.7.3.2 | | | 5 | 5 | 5 |
| <u>Subgroup II</u> | | | | | | | |
| Life | 3.7.2 | 4.7.4.5 | 1 | 0 | 1/ | | |
| Pwb to component resistance | 3.6.1 | 4.7.2.1 | | | 20 | | |

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TABLE IV. Qualification inspection - Continued.

| Examination or test | Require- ment paragraph | Method paragraph | Number of samples to be inspected 4/ | Number of defects allowed | Measurements per sample | | |
|--------------------------------------|-------------------------------|---------------------|---|------------------------------------|----------------------------|----|---|
| | | | | | Sample | | |
| | | | | | 1 | 2 | 3 |
| <u>Subgroup II</u> - Cont | | | 1 | 0 | | | |
| Engaging and separating forces | | | | | | | |
| Standard | 3.5.6.1 | 4.7.3.7 | | | 1/ | | |
| LIF | 3.5.6.2 | 4.7.3.7 | | | 1/ | | |
| LIF normal force | 3.5.7 | 4.7.3.8 | | | 1/ | | |
| Compliant component retention | 3.5.1 | 4.7.3.1 | | | 10 | | |
| <u>Subgroup III</u> | | | 1 | 0 | | | |
| Temperature cycling | 3.7.1 | 4.7.4.1 | | | | 1/ | |
| Pwb to component resistance | 3.6.1 | 4.7.2.1 | | | | 20 | |
| Temperature altitude | 3.7.3 | 4.7.4.2 | | | | 1/ | |
| Insulation resistance | 3.6.2 | 4.7.2.2 | | | | 1/ | |
| Dielectric with- standing voltage | 3.6.3 | 4.7.2.3 | | 1/ | | | |

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TABLE IV. Qualification inspection - Continued.

| Examination or test | Require- ment paragraph | Method paragraph | Number of samples to be inspected 4/ | Number of defects allowed | Measurements per sample | | |
|------------------------------------|-------------------------------|---------------------|---|------------------------------------|----------------------------|----------|---|
| | | | | | Sample | | |
| | | | | | 1 | 2 | 3 |
| <u>Subgroup III</u> - Cont | | | | | | | |
| Engaging and separating forces | | | | | | | |
| Standard | 3.5.6.1 | 4.7.3.7 | 1 | 0 | | 1/ | |
| LIF | 3.5.6.2 | 4.7.3.7 | | | | 1/ | |
| LIF normal force | 3.5.7 | 4.7.3.8 | | | | 1/ | |
| Compliant compo- nent retention | 3.5.1 | 4.7.3.1 | | | | 2/ | |
| Plated-through hole integrity | 3.5.2 | 4.7.3.5 | | | | 2/ 3/ | |
| <u>Subgroup IV</u> | | | | | | | |
| Vibration | 3.7.4 | 4.7.4.3 | 1 | 0 | | 1/ | |
| Compliant compo- nent retention | 3.5.1 | 4.7.3.1 | | | | 10 | |
| Pwb to component resistance | 3.6.1 | 4.7.2.1 | | | | 20 | |
| Shock (specified pulse) | 3.7.5 | 4.7.4.4 | | | | 1/ | |

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TABLE IV. Qualification inspection - Continued.

| Examination or test | Require- ment paragraph | Method paragraph | Number of samples to be inspected <u>4/</u> | Number of defects allowed | Measurements per sample | | |
|--------------------------------------|-------------------------------|---------------------|--|------------------------------------|----------------------------|---|-----------|
| | | | | | Sample | | |
| | | | | | 1 | 2 | 3 |
| <u>Subgroup IV</u> - Cont | | | | | | | |
| Compliant compo- nent retention | 3.5.1 | 4.7.3.1 | 1 | 0 | | | <u>2/</u> |
| Pwb to component resistance | 3.6.1 | 4.7.2.1 | | | | | 20 |
| Humidity | 3.7.6 | 4.7.4.6 | | | | | <u>1/</u> |
| Insulation resistance | 3.6.2 | 4.7.2.2 | | | | | <u>1/</u> |
| Dielectric with- standing voltage | 3.6.3 | 4.7.2.3 | | | | | <u>1/</u> |
| Plated-through hole integrity | 3.5.2 | 4.7.3.5 | | | | | <u>3/</u> |

1/ Per test method paragraph.

2/ Type 2, 10 measurements; type 3, 20 measurements.

3/ 10 horizontal and 10 vertical microsections for type 3.

4/ The three samples tested in subgroup I are divided for testing under subgroups II, III and IV.

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4.5.1 Sample size. The contractor shall assemble five qualification samples for each type (see 1.2) and base material of printed-wiring electrical backplane assembly for which qualification is desired. The qualification sample shall conform to the requirements of Naval Avionics Center Drawing No. SKDGH-0002 (see figure 6) for double sided backplanes (type 2) and Naval Avionics Center Drawing No. SKDGH-0001 (see figure 7) for multilayer backplanes (type 3). Each sample shall contain representative qualified parts from each specification sheet of MIL-C-28859, the keying pegs of MIL-C-28754/39, and the type of conformal coating for which the manufacturer intends to qualify as a contractor. Three qualification samples shall be tested at a laboratory acceptable to the Government, and two shall be filed and retained as reference samples by the contractor. The laboratory test report and the three tested qualification samples shall be submitted to the cognizant qualification organization (see 6.3) for verification and approval.

4.5.2 Inspection routine. Qualification inspection shall consist of the examinations and tests specified in table IV in the sequence shown. Qualification of a particular type and base material will be extended to cover all conductor patterns of that type and base material produced.

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

4.5.4 Retention of qualification. To retain qualification, the contractor shall forward a report at 12-month intervals to the cognizant qualification organization. The cognizant qualification 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 the number of lots that have passed and the number that have failed. The failed lots which have been reworked shall be identified and the results of testing performed on the reworked failed lots shall be reported. An accounting shall be made of all inspection lots.

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- (b) A summary of the results of tests for group B quality conformance inspection tests performed and completed during a 12-month interval.
- (c) Failure to submit the report within 30 days after the end of each 12-month interval shall result in loss of qualification.
- (d) If the summary of the test results indicates nonconformance to specification requirements, and corrective action acceptable to the procuring activity and to the cognizant qualification organization has not been taken, action shall be taken to remove qualification. In addition to the periodic submission of inspection data, the contractor shall immediately notify the cognizant qualifying agency when the inspection data indicates failure of the product to meet the requirements of this specification with corrective action acceptable to the procuring activity and to the cognizant qualification organization taken. In the event that no production occurred during the reporting interval, the contractor shall be required to requalify (see 4.5).

4.5.5 In-process inspection. In-process inspection shall consist of the test specified in table V immediately prior to the application of conformal coating or solder mask.

TABLE V. In-process inspection.

| Test | Requirement paragraph | Method paragraph |
|--|-----------------------|------------------|
| Cleanliness and resistivity of solvent extract | 3.10 and 3.10.1 | 4.7.5 |

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4.5.5.1 Sampling plan. Two production backplanes or quality conformance test coupons shall be randomly selected from each lot and subjected to the test of table V immediately prior to the application of conformal coating or solder mask.

4.5.5.2 Rejected lots. When a lot is rejected as a result of a failure to pass the test specified in table V, the contractor shall withdraw the lot, take corrective action in connection with the cleaning materials and procedures, reclean the lot prior to application of conformal coating or solder mask, and resubmit the lot to the test in table V with the sampling increased to five production backplanes or quality conformance test coupons.

4.6 Quality conformance inspection. Quality conformance inspection shall consist of examinations or tests on deliverable backplanes and quality conformance test coupons.

4.6.1 Inspection lot. An inspection lot shall consist of all assemblies having the same part number produced under the same conditions and offered for inspection at one time.

4.6.2 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspection. Delivery of products which have passed the group A inspection shall not be delayed pending the results of the group B inspection (see 6.7.3).

4.6.2.1 Group A inspection. Group A inspection shall consist of the examinations specified in table VI.

4.6.2.2 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The Acceptable Quality Level (AQL) shall be as specified in table VI. Major or minor defects shall be as defined in MIL-STD-105.

4.6.2.3 Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection, and shall not thereafter be tendered for acceptance unless the former rejection or requirement of correction is disclosed. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

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TABLE VI. Group A inspection.

| Examination or test | Requirement paragraph | Method paragraph | Insp Level | AQL (per-cent def) | | Sample deliver-able back-plane | Coupon | Measure-ment per sample |
|--|-------------------------------|------------------|------------|--------------------|-----------|--------------------------------|--------|-------------------------|
| | | | | Maj | Min | | | |
| Design and construction | 3.1, 3.3, 3.4, 3.8, 3.9, 3.10 | 4.7.1, 4.7.3.6 | II | 0.10 | 0.15 | X | | <u>2/</u> |
| Continuity and shorts (when specified) | 3.6.4 | 4.7.2.4 | 100% | | | | | |
| Insulation resistance | 3.6.2 | 4.7.2.2 | II | 0.10 | 0.15 | | X | <u>2/</u> <u>7/</u> |
| Engaging and separating forces | | | | | | | | |
| Standard | 3.5.6.1 | 4.7.3.7 | 100% | <u>5/</u> | <u>5/</u> | X | | 10 |
| LIF | 3.5.6.2 | 4.7.3.7 | 100% | <u>5/</u> | <u>5/</u> | X | | 10 |
| LIF normal force | 3.5.7 | 4.7.3.8 | 100% | <u>5/</u> | <u>5/</u> | X | | 50 |
| Housing retention | 3.5.3 | 4.7.3.3 | <u>2/</u> | 0.10 | 0.15 | | X | 3 |
| Keying peg retention | 3.5.4 | 4.7.3.4 | <u>1/</u> | 0.10 | 0.15 | | X | 6 |

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TABLE VI. Group A inspection - Continued.

| Examination or test | Requirement paragraph | Method paragraph | Insp Level | AQL (per cent def) | | Sample deliverable back-plane | Coupon | Measurement per sample |
|------------------------------------|-----------------------|------------------|------------|--------------------|------|-------------------------------|--------|------------------------|
| | | | | Maj | Min | | | |
| Compliant component retention, Min | 3.5.1 | 4.7.3.1 | 100% | 1/ | 1/ | X 4/ | | 5 6/ |
| Compliant component retention, Max | 3.5.1 | 4.7.3.1 | 1/ | 1/ | 1/ | | X 4/ | 5 |
| Plated-through hole integrity | 3.5.2 | 4.7.3.5 | 1/ | 1/3/ | 1/3/ | | X | 3/ |

- 1/ A quantity of coupons determined by MIL-STD-105, level II, based on total number of coupons.
- 2/ Per test method paragraph.
- 3/ For each coupon tested, microsection 5 holes horizontal for type II; 5 holes horizontal and 5 holes vertical for type III.
- 4/ Minimum pushout determined on backplane; maximum/minimum determined on coupon after conditioning.
- 5/ 10 contacts per delivered board.
- 6/ One of each corner and center of each board.
- 7/ If continuity and shorts testing are required, insulation resistance testing may be omitted.

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4.6.3 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table VII, in the order shown.

TABLE VII. Group B inspection.

| Examination or test | Requirement paragraph | Method paragraph | No. of samples to be inspected | Measurements per sample |
|---------------------------------|-----------------------|------------------|--------------------------------|-------------------------|
| Temperature cycling | 3.7.1 | 4.7.4.1 | 1 | <u>1/</u> |
| Pwb to component resistance | 3.6.1 | 4.7.2.1 | | 20 |
| Temperature altitude | 3.7.3 | 4.7.4.2 | | <u>1/</u> |
| Insulation resistance | 3.6.2 | 4.7.2.2 | | <u>1/</u> |
| Dielectric withstanding voltage | 3.6.3 | 4.7.2.3 | | <u>1/</u> |
| Compliant component retention | 3.5.1 | 4.7.3.1 | | <u>2/</u> |
| Plated-through hole integrity | 3.5.2 | 4.7.3.5 | | <u>2/ 3/</u> |
| Vibration | 3.7.4 | 4.7.4.3 | 1 | <u>1/</u> |
| Compliant component retention | 3.5.1 | 4.7.3.1 | | <u>2/</u> |

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TABLE VII. Group B inspection - Continued.

| Examination or test | Requirement paragraph | Method paragraph | No. of samples to be inspected | Measurements per sample |
|---------------------------------|-----------------------|------------------|--------------------------------|-------------------------|
| Pwb to component resistance | 3.6.1 | 4.7.2.1 | 1 | 20 |
| Shock | 3.7.5 | 4.7.4.4 | | 1/ |
| Compliant component retention | 3.5.1 | 4.7.3.1 | | 2/ |
| Pwb to component resistance | 3.6.1 | 4.7.2.1 | | 20 |
| Humidity | 3.7.6 | 4.7.4.6 | | 1/ |
| Insulation resistance | 3.6.2 | 4.7.2.2 | | 1/ |
| Dielectric withstanding voltage | 3.6.3 | 4.7.2.3 | | 1/ |
| Plated-through hole integrity | 3.5.2 | 4.7.3.5 | | 3/ |

1/ Per test paragraph.

2/ Type 2, 10 measurements; type 3, 20 measurements.

3/ For each sample tested, microsection 10 holes horizontal for type II; 10 holes horizontal and 10 holes vertical for type III.

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4.6.3.1 Sampling plan. On a six-month basis, two quality control test coupons of each board type and base material produced shall be selected from lots which have passed group A inspection for group B inspection. The AQL shall be: accept on zero (0), reject on one (1) failure. Traceability of the quality conformance test coupon to the inspection lot shall be maintained.

4.6.3.2 Rejected lots. If the coupons from an inspection lot fail to pass group B inspection, the contractor 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 corrective action has been taken, group B inspection shall be repeated on additional coupons. 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 qualifying activity.

4.7 Visual and mechanical methods of examination and test.

4.7.1 Design and construction examination. Completed printed-wiring electrical backplane assemblies shall be examined to verify that the materials, design and construction, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.8, 3.9, 3.10 and 3.11).

4.7.2 Electrical testing.

4.7.2.1 Printed-wiring backplane to compliant component resistance. The test sample shall conform to the requirements of 3.6.1 when tested as shown in figure 5 or 6. The following details shall apply:

- (a) Method of connection: See figures 5 and 6.
- (b) Test current: Three amperes.
- (c) Twenty contacts per sample shall be tested.

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4.7.2.2 Insulation resistance. Printed-wiring electrical backplane assemblies shall meet requirements of 3.6.2 when tested in accordance with method 3003 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Test voltage: 100 V, direct current (dc), plus or minus 5 percent.
- (b) Test points: Between adjacent electrically isolated circuit paths.
- (c) Insulation resistance: See table II.

4.7.2.3 Dielectric withstanding voltage. Compliant components and housings shall meet requirements of 3.6.3 when tested in accordance with method 3001 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Test voltage: 500 volts, dc.
- (b) Test points: Between adjacent electrically isolated circuit paths.

4.7.2.4 Circuitry (see 3.6.4).

4.7.2.4.1 Continuity testing. 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 groups of conductors. The current passed through the conductors shall not exceed those specified in MIL-STD-275 for the smallest conductor in the circuit.

4.7.2.4.2 Short testing. A test 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. For manual testing, the voltage shall be 250 volts minimum and shall be applied for a minimum of 5 seconds. When automated test equipment is used, the applied breakdown test voltage shall be twice the

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maximum rated voltage on the board. If the maximum rated voltage on the board is not specified in the master drawing, the voltage rating of the board (for this test) shall be based on spacing between conductors in accordance with table I of MIL-STD-275.

4.7.3 Mechanical testing.

4.7.3.1 Compliant component retention. Compliant components shall meet requirements of 3.5.1 when tested in accordance with method 2007 of MIL-STD-1344. After initial insertion, a minimum of 7.5 pounds (33 newtons) and a maximum of 45 pounds (200 newtons) of vertical force shall be applied to the compliant component tail perpendicular to the printed wiring backplane assembly. The compliant component shall have been displaced from the original position within the range of force specified.

4.7.3.1.1 Conditioning. After removal of the initial compliant component following the test of 4.7.3.1, the hole shall be conditioned further by the insertion and removal of a second virgin compliant component in the same hole followed by the insertion of a third virgin compliant component in the same hole. The minimum pushout force shall conform to the requirement of 3.5.1.2 following the insertion of the third virgin compliant component.

4.7.3.2 Compliant component torque. Compliant components shall meet requirements of 3.5.1.3 when tested in accordance with method 211 of MIL-STD-202, test condition E. Three inch-ounces (0.021 newton-meter) of torque shall be applied to the compliant component tail.

4.7.3.3 Housing retention force. The capability of the housing to be retained by the compliant contact components shall be measured in a test set-up similar to that shown on figure 8, and shall meet requirements of 3.5.3. The load required to remove the housing shall be as specified on the applicable specification sheet.

4.7.3.4 Keying peg retention. Keying peg retention shall be established by applying a load of 5 pounds (22 newtons) for 10 seconds to the surface of the keying peg opposite to that in which it was inserted into the housing. The keying peg shall not have moved from its original installed position (see 3.5.4).

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4.7.3.5 Plated-through hole integrity. After hole conditioning as specified in 4.7.3.1.1, compliant contacts contained in plated-through holes shall be microsectioned as specified herein to determine conformance to paragraph 3.5.2. Suggested method of microsection appears in figure 9.

- (a) Double-sided printed-wiring boards. Ten plated-through holes containing compliant components shall be microsectioned in the horizontal plane and examined for conformance to 3.5.2. At least two different levels of hole depth shall be viewed and measurements shall be taken at the entrance to the hole and half-way down the compliant section. It is not mandatory that the same hole be viewed at both levels.
- (b) Multilayer printed-wiring board. Ten plated-through holes containing compliant contacts shall be microsectioned in both the vertical and horizontal planes. In both the horizontal and vertical planes, the microsectioned sample shall be examined for conformance to 3.5.2. On the vertical plane, the sample shall additionally be viewed to ensure that no copper cracks, separations between conductive interfaces, or laminate-to-copper separations have occurred. Samples shall be viewed at magnification of 400X to resolve questionable copper thickness interfaces between the contact and printed-wiring laminate.

4.7.3.6 Bow and twist. The printed-wiring backplane assembly shall be supported at three points that define flat horizontal surface with the convex surface of the assembly upward, meeting requirements of 3.5.5. The maximum vertical displacement of the printed wiring board (the vertical distance from the lowest point to the maximum height of the convex surface) shall then be determined. This height divided by the length of the longest side shall be considered the bow (warp). The twist of the assembly shall be determined, using the same procedure described above, by measuring the difference in the height between the lowest corner of the printed wiring board and the highest corner and dividing this measurement by the length of the longest side.

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4.7.3.7 Engaging and separating force. Compliant contacts shall meet requirements of 3.5.6.1 or 3.5.6.2 when tested in accordance with method 2014 of MIL-STD-1344. The engaging and separating forces shall be determined using the test blade specified in MIL-C-28859. The number of contacts tested shall be 5 percent per test specimen.

4.7.3.8 LIF normal force. Fifty different contacts shall be removed from the assembled backplane. The normal force measurements shall be performed on contact sets which were tested under 4.7.3.7. Normal force shall be measured using equipment which directly indicated the force exerted by each tine or the average force exerted by both tines when the gap between the contact points is 0.0200 plus or minus 0.0002 inch (0.5080 plus or minus 0.0051 mm). Any equipment used for this test must be capable of direct correlation with normal force measurements using conventional force versus deflection techniques. The forces shall meet the requirements of 3.5.7.

4.7.4 Environments.

4.7.4.1 Temperature cycling. Printed-wiring backplane electrical assemblies (qualification test sample or coupon as applicable) shall meet requirements of 3.7.1 when tested in accordance with method 1003 of MIL-STD-1344, test condition A-3. The following details and exceptions shall apply:

- (a) Test to 400 cycles.
- (b) Following testing, assemblies shall meet the requirements of 3.6.1.

4.7.4.2 Temperature-altitude testing. Printed-wiring electrical backplane assemblies (qualification test sample or coupon as applicable) shall meet requirements of 3.7.3 when tested in accordance with MIL-STD-202, method 105, condition D, "Barometric Pressure (reduced)"; the assemblies shall meet the requirements of 3.6.2 and 3.6.3. During the last half hour of testing, 30 VDC shall be applied between adjacent contacts.

4.7.4.3 Vibration testing. Printed-wiring backplane electrical assemblies (qualification test sample or coupon as applicable) shall meet requirements of 3.7.4 when tested in accordance with method 2005 (conditions III and VE, 15 min per axis) of MIL-STD-1344. The following details and exceptions shall apply:

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- (a) A sample shall be mated to a suitable connector and supporting structure. Continuity shall be monitored during testing (100 nanosecond discontinuity maximum).
- (b) On coupons, discontinuity shall be monitored over two groups of eight contacts each. Make use of the circuit pattern on coupons to monitor in series.
- (c) On qualification test samples, discontinuity shall be monitored over two groups of twenty contacts each. Each group shall be connected in series.

4.7.4.4 Shock (specified pulse) testing. Printed-wiring backplane electrical assemblies (qualification test sample or coupon as applicable) shall meet requirements of 3.7.5 when tested in accordance with method 2004 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) A sample shall be mated to a suitable connector and supporting structure. Continuity shall be monitored during testing (100 nanosecond discontinuity maximum).
- (b) Test condition: G
- (c) Following testing, assemblies shall meet the requirements of 3.5.1, 3.5.2 and 3.6.1.

4.7.4.5 Temperature life. Printed-wiring backplane electrical assemblies (qualification test sample or coupon as applicable) shall meet the requirements of 3.7.2 when tested in accordance with method 1005 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Test condition: 125 plus or minus 3°C.
- (b) Test time condition: D.
- (c) Following testing, assemblies shall meet the requirements of 3.5.1 and 3.6.1.

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4.7.4.6 Humidity. Printed-wiring backplane electrical assemblies (qualification test sample or coupon as applicable) shall meet requirements of 3.7.6 when tested in accordance with method 1002, type II, of MIL-STD-1344. The following exception shall apply: Steps 7A and 7B are not required.

4.7.5 Cleanliness and resistivity of solvent extract (see 3.10 and 3.10.1). The cleanliness and resistivity of solvent extract test and the approved testing method of MIL-P-55110 shall be used to determine the cleanliness of the backplane.

5. PACKAGING.

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-STD-55330 (see 6.2).

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Printed-wiring electrical backplane assemblies covered by this specification are intended for use in ground support, airborne, and shipboard electronic equipment.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of the specification.
- (b) Title, revision letter, and drawing number of the applicable assembly drawing for the printed-wiring electrical backplane.
- (c) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1).
- (d) Tools (as required).
 - (1) Insertion and removal tools.

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- (e) Marking, levels of preservation, and packaging and packing required (see 5.1).

6.3 Qualification. With respect to manufacturers requiring qualification, awards will be made only to manufacturers which are, at the time of award of contract, qualified for inclusion in the Qualified Manufacturers List QML No. 28870 whether or not such manufacturers have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Manufacturers List is the Naval Sea Systems Command, SEA-55Z3, Department of the Navy, Washington, D.C. 20362-5101. However, information pertaining to qualification of manufacturers may be obtained from the Naval Avionics Center, Code 814, 6000 East 21st Street, Indianapolis, IN 46219-2189.

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

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

6.4.2 Printed-wiring electrical backplane assembly. The printed-wiring electrical backplane assembly is an interconnection device having terminals (such as wrappost for solderless wrapped connections) on one side and having connector receptacles on the other. The wrappost terminals provide point-to-point electrical interconnection capability external to the backplane. The point-to-point electrical intraconnections may also be provided by printed-wiring inside the backplane.

6.5 Contact insertion and removal tool. When applicable, a tool or tools will be provided by the contractor with qualification samples to assist in the insertion and removal of the contacts (see 3.1).

6.6 Plastic bags. Where plastic bags are used for packaging printed-wiring electrical backplane assemblies, they shall be clean and free from ionic contaminants.

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6.7 Subject term (key word) listing.

Compliant components
Mother board
Rigid printed circuit boards.

6.8 Changes from previous issues. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Navy - SH
Army - ER
Air Force - 85

Review activity:

Navy - OS
DLA - ES

User activities:

Navy - AS, MC, CG

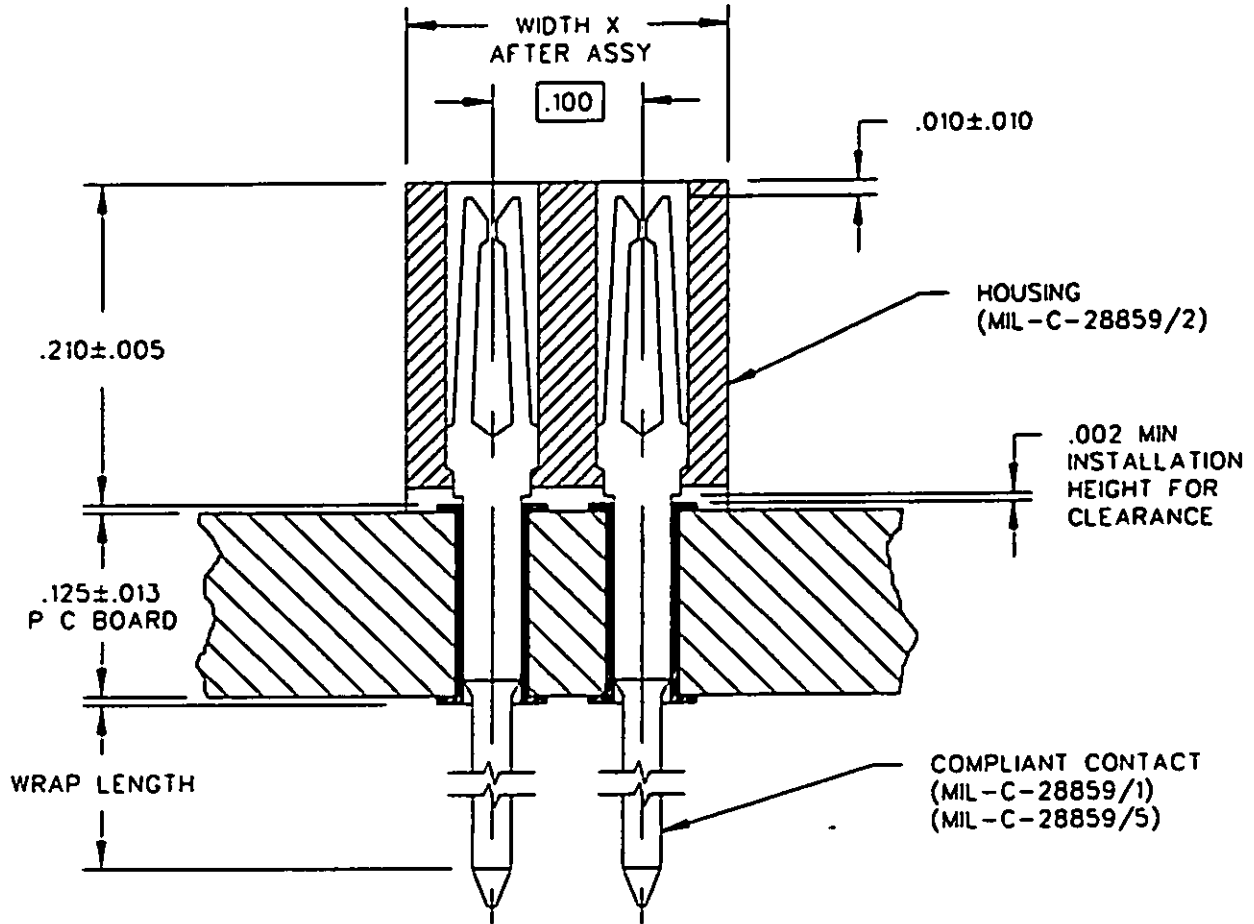
Preparing activity:

Navy - SH

Agent: NW

(Project 5998-0004)

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DIMENSIONS

| Contact Rows | Pitch | Width X |
|--------------|-------|-----------|
| 2 | 0.3 | 0.215 Max |
| 3 | 0.4 | 0.315 Max |
| 4 | 0.5 | 0.415 Max |
| 5 | 0.6 | 0.515 Max |

FIGURE 1. Cross-sectional view of printed-wiring electrical backplane assembly.

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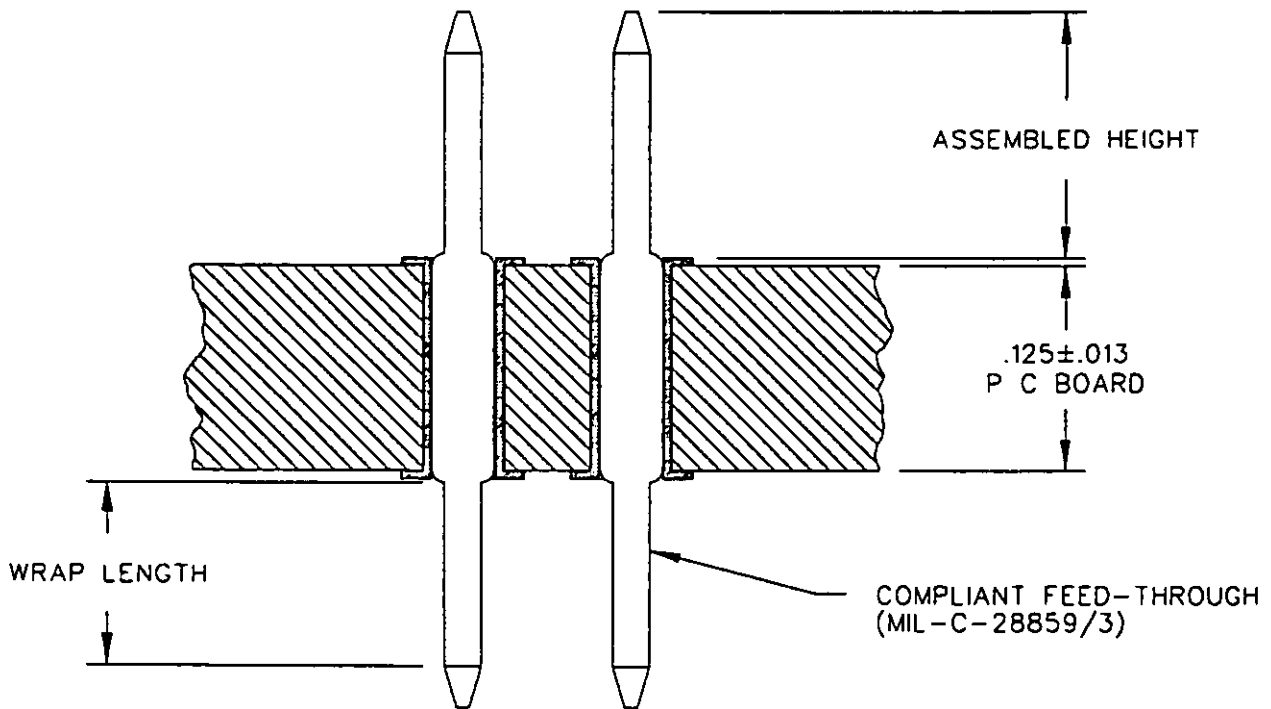
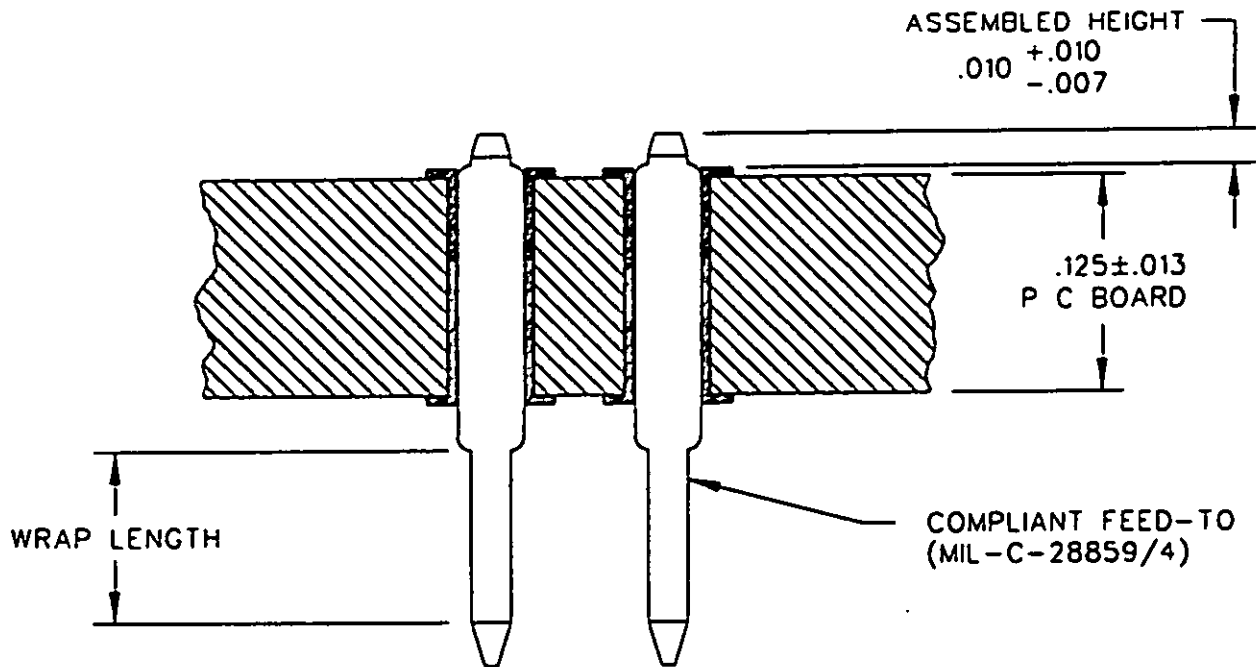


FIGURE 1. Cross-sectional view of printed-wiring electrical backplane assembly - Continued.

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NOTE:

1. Dimensions are in inches.

FIGURE 1. Cross-sectional view of printed-wiring electrical backplane assembly - Continued.

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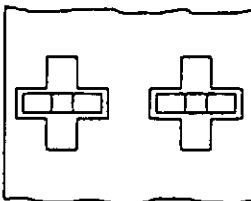


FIGURE 2A. Idealized condition.
(NO SCALE)

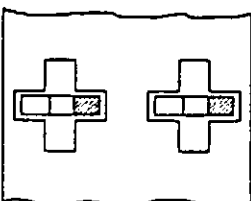


FIGURE 2B. Either line broken.
(NO SCALE)
UNACCEPTABLE

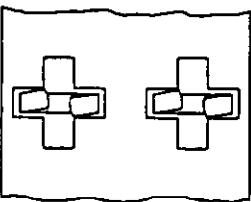


FIGURE 2C. Both contact lines twisted.
(NO SCALE)
UNACCEPTABLE

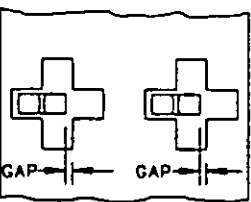


FIGURE 2D. Uncentered contact with gap.
(NO SCALE)
UNACCEPTABLE

FIGURE 2. Compliant contact and housing workmanship standards.

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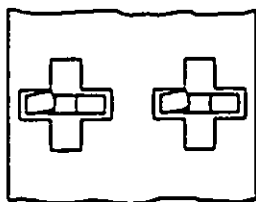


FIGURE 2E. Single contact line twisted.
(NO SCALE) (5%)

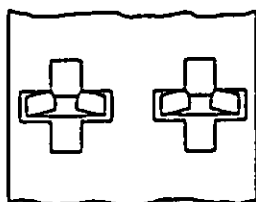


FIGURE 2F. Contact line against housing.
(NO SCALE) (5%)

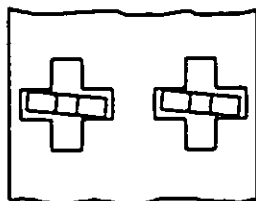


FIGURE 2G. Contact orientation not central to cruciform.
(NO SCALE) (5%)

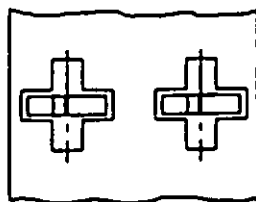
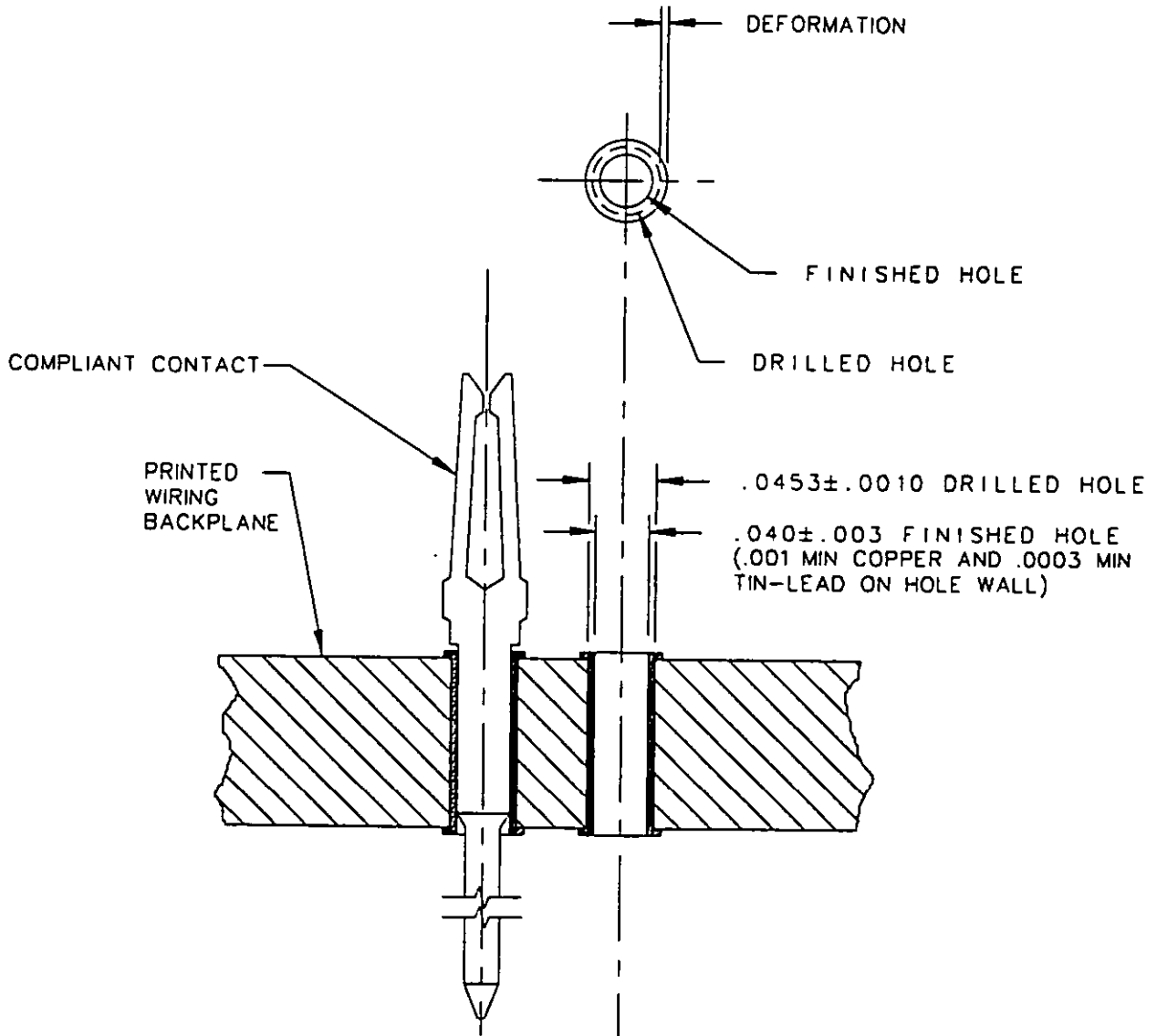


FIGURE 2H. Uncentered contact.
(NO SCALE) (5%)

FIGURE 2. Compliant contact and housing workmanship standards - Continued.

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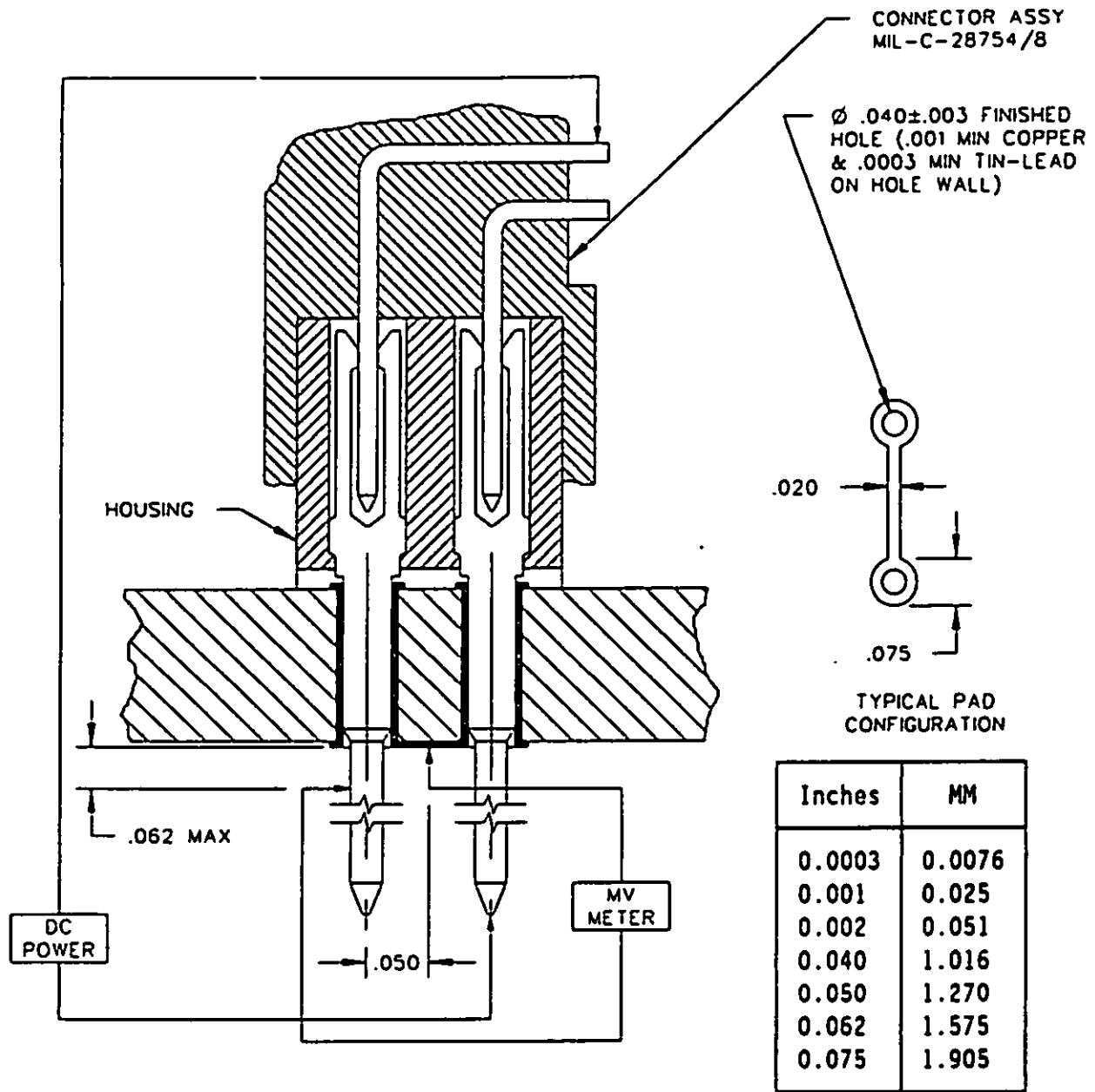


NOTE:

1. Dimensions are in inches.

FIGURE 3. Plated - through hole deformation.

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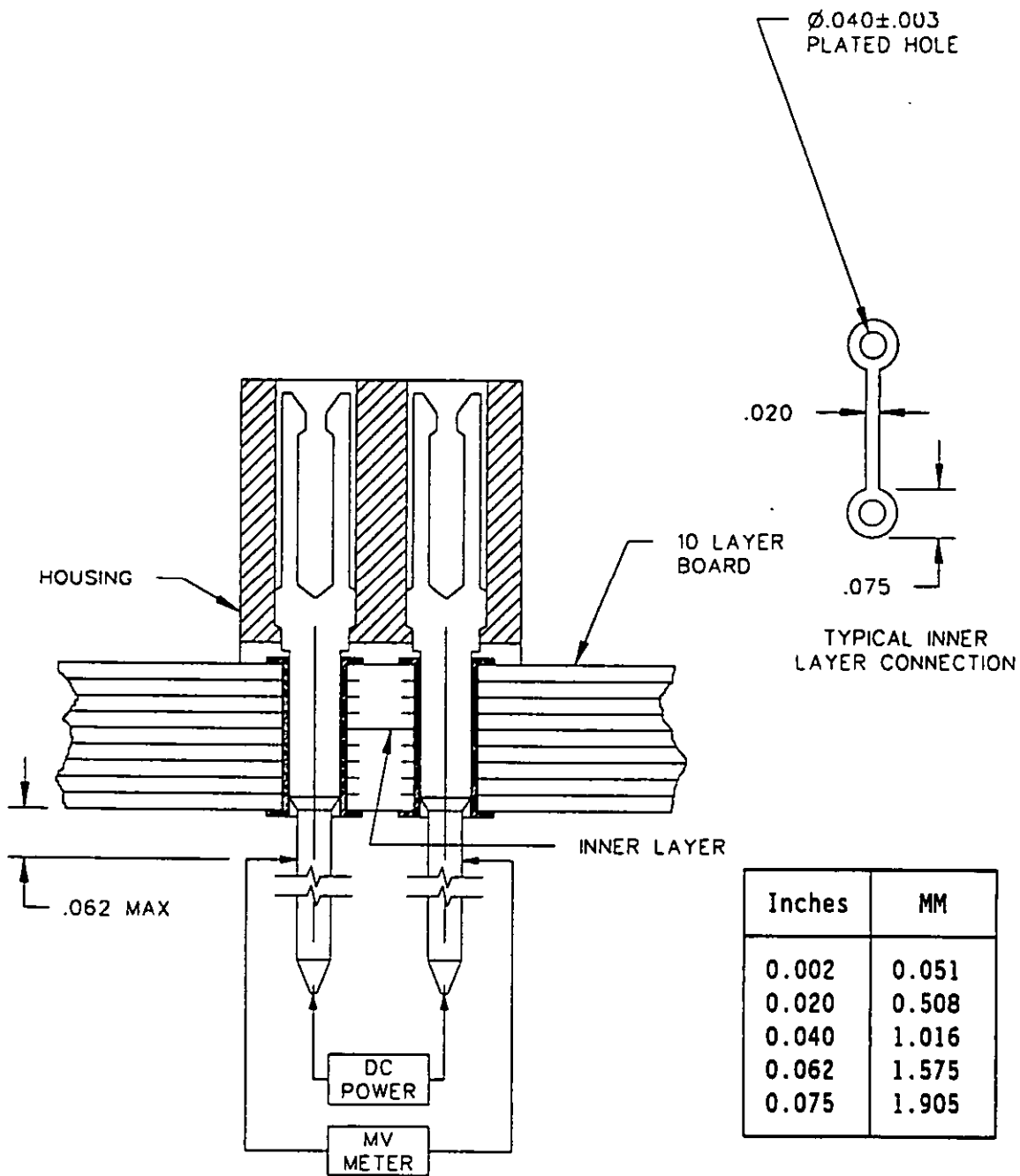
TYPICAL MEASUREMENT

NOTE:

- Dimensions are in inches. Metric equivalents are given for information only.

FIGURE 4. Contact to plated-through hole resistance (double sided boards).

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NOTE:

1. Dimensions are in inches. Metric equivalents are given for information only.

FIGURE 5. Contact to inner layer-resistance (multilayer boards).

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| REVISIONS | | DATE APPROVED | |
|-----------|--------------------------|---------------|------|
| NO | DESCRIPTION | BY | DATE |
| 1 | REVISED PER (C/M BAR...) | ... | ... |

| NO | | REVISED PER (C/M BAR...) | |
|----|-------------|--------------------------|------|
| NO | DESCRIPTION | BY | DATE |
| 1 | ... | ... | ... |
| 2 | ... | ... | ... |
| 3 | ... | ... | ... |
| 4 | ... | ... | ... |
| 5 | ... | ... | ... |
| 6 | ... | ... | ... |
| 7 | ... | ... | ... |
| 8 | ... | ... | ... |
| 9 | ... | ... | ... |
| 10 | ... | ... | ... |
| 11 | ... | ... | ... |
| 12 | ... | ... | ... |
| 13 | ... | ... | ... |
| 14 | ... | ... | ... |
| 15 | ... | ... | ... |

| PARTS LIST | | | |
|------------|-----|-----|-------------|
| NO | REV | QTY | DESCRIPTION |
| 1 | 0 | 1 | ... |
| 2 | 0 | 1 | ... |
| 3 | 0 | 1 | ... |
| 4 | 0 | 1 | ... |
| 5 | 0 | 1 | ... |
| 6 | 0 | 1 | ... |
| 7 | 0 | 1 | ... |
| 8 | 0 | 1 | ... |
| 9 | 0 | 1 | ... |
| 10 | 0 | 1 | ... |
| 11 | 0 | 1 | ... |
| 12 | 0 | 1 | ... |
| 13 | 0 | 1 | ... |
| 14 | 0 | 1 | ... |
| 15 | 0 | 1 | ... |

REQUIREMENTS:

- The circuit board printed wiring shall comply with the following requirements:
 - a. Minimum thickness: .003 inch
 - b. Minimum diameter: .003 inch
 - c. Minimum spacing: .003 inch
 - d. Minimum hole diameter: .003 inch
- Plating: No plating.
- Surface finish: Matte.
- Drill holes: All drill holes shall be drilled with a twist drill bit.
- Drill hole diameter: All drill holes shall be drilled to a tolerance of ±.0005 inch.
- Drill hole depth: All drill holes shall be drilled to a tolerance of ±.0005 inch.
- Drill hole chamfer: All drill holes shall be chamfered with a 45-degree chamfer.
- Drill hole burrs: All drill holes shall be free of burrs.
- Drill hole cleanliness: All drill holes shall be free of debris.
- Drill hole inspection: All drill holes shall be inspected for size, depth, and cleanliness.

FIGURE 6. Double sided board, qualification inspection sample.

MIL-A-28870A

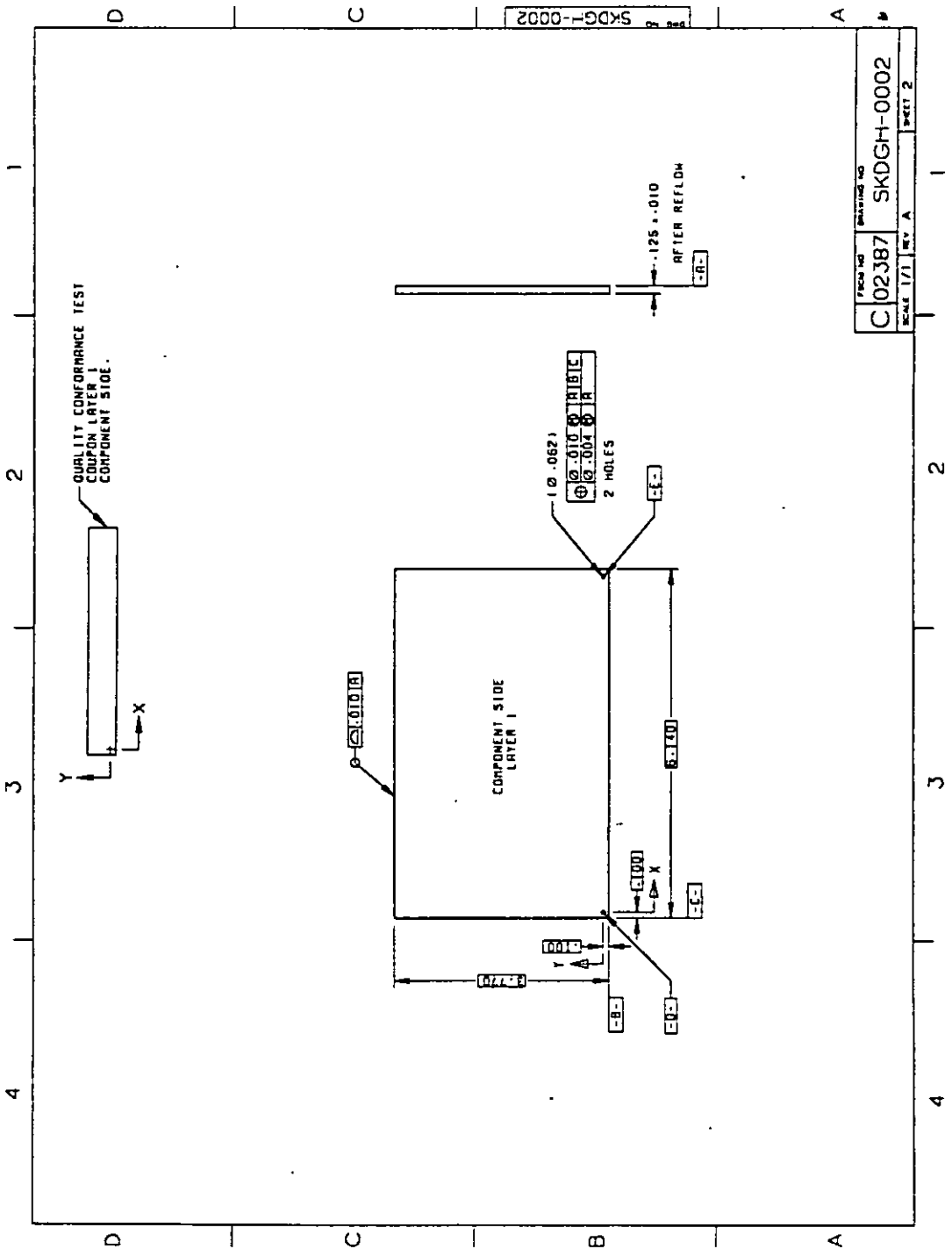


FIGURE 6. Double sided board, qualification inspection sample - Continued.

MIL-A-28870A

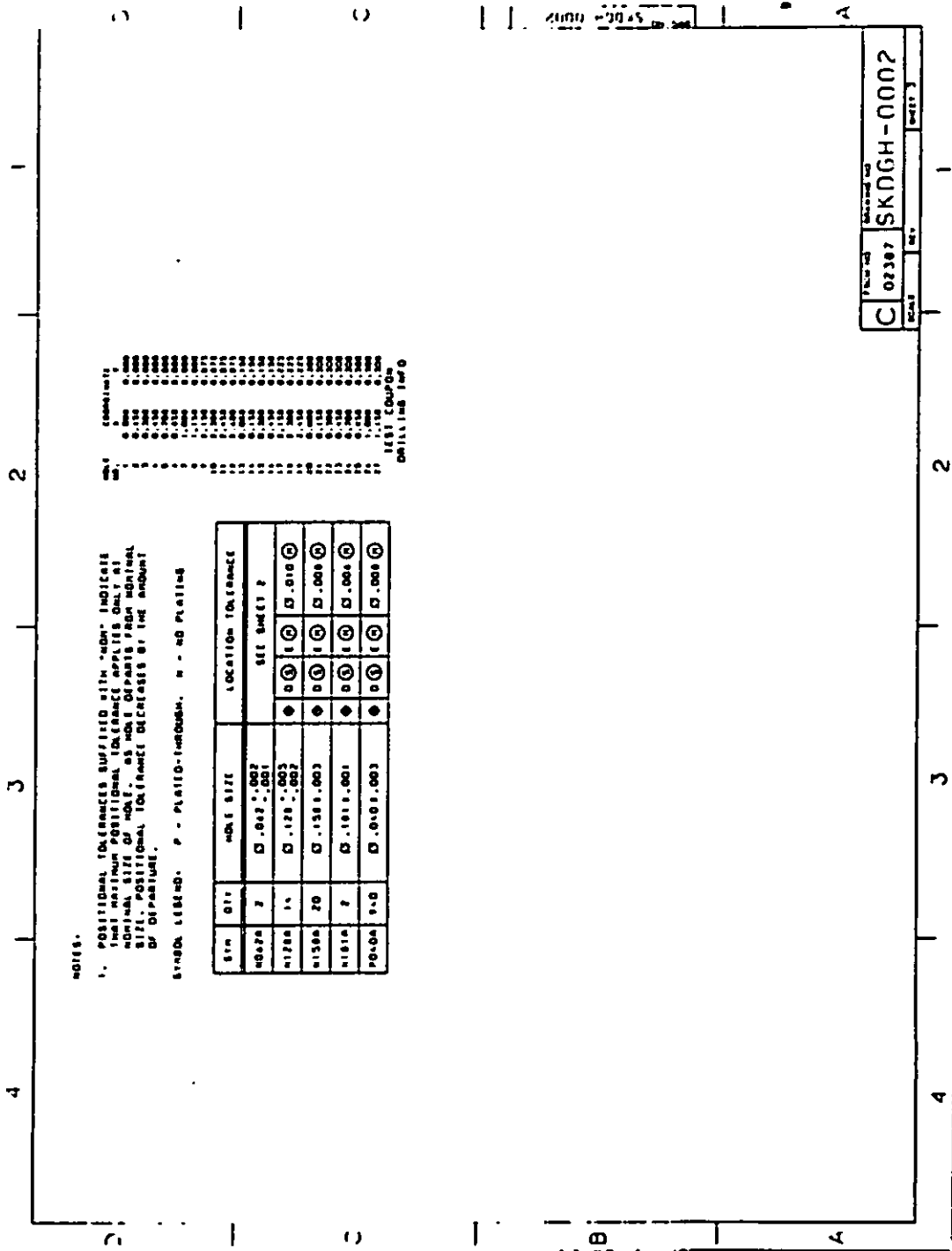


FIGURE 6. Double sided board, qualification inspection sample - Continued.

2000--002

| C 02307 SKDGH-0002 | | Sheet 3 | |
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| Part No. | Rev. | Part No. | Rev. |
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| 10002 | 1 | 10002 | 1 |
| 10003 | 1 | 10003 | 1 |
| 10004 | 1 | 10004 | 1 |
| 10005 | 1 | 10005 | 1 |
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| 10099 | 1 | 10099 | 1 |
| 10100 | 1 | 10100 | 1 |

FIGURE 6. Double sided board, qualification inspection sample - Continued.

MIL-A-28870A

| MIL-SPEC NO. | MIL-SPEC TITLE | COMPLIANCE | MIL-SPEC NO. | MIL-SPEC TITLE | COMPLIANCE | DRAWING NO. | |
|--------------|----------------|------------|--------------|----------------|------------|-------------|-------|
| | | | | | | SCALE | REV. |
| 781 | PCB008 | 2-118 | 781 | PCB008 | 2-118 | C | 02307 |
| 782 | PCB009 | 2-119 | 782 | PCB009 | 2-119 | SKDGH-0002 | |
| 783 | PCB010 | 2-120 | 783 | PCB010 | 2-120 | PART 6 | |
| 784 | PCB011 | 2-121 | 784 | PCB011 | 2-121 | | |
| 785 | PCB012 | 2-122 | 785 | PCB012 | 2-122 | | |
| 786 | PCB013 | 2-123 | 786 | PCB013 | 2-123 | | |
| 787 | PCB014 | 2-124 | 787 | PCB014 | 2-124 | | |
| 788 | PCB015 | 2-125 | 788 | PCB015 | 2-125 | | |
| 789 | PCB016 | 2-126 | 789 | PCB016 | 2-126 | | |
| 790 | PCB017 | 2-127 | 790 | PCB017 | 2-127 | | |
| 791 | PCB018 | 2-128 | 791 | PCB018 | 2-128 | | |
| 792 | PCB019 | 2-129 | 792 | PCB019 | 2-129 | | |
| 793 | PCB020 | 2-130 | 793 | PCB020 | 2-130 | | |
| 794 | PCB021 | 2-131 | 794 | PCB021 | 2-131 | | |
| 795 | PCB022 | 2-132 | 795 | PCB022 | 2-132 | | |
| 796 | PCB023 | 2-133 | 796 | PCB023 | 2-133 | | |
| 797 | PCB024 | 2-134 | 797 | PCB024 | 2-134 | | |
| 798 | PCB025 | 2-135 | 798 | PCB025 | 2-135 | | |
| 799 | PCB026 | 2-136 | 799 | PCB026 | 2-136 | | |
| 800 | PCB027 | 2-137 | 800 | PCB027 | 2-137 | | |
| 801 | PCB028 | 2-138 | 801 | PCB028 | 2-138 | | |
| 802 | PCB029 | 2-139 | 802 | PCB029 | 2-139 | | |
| 803 | PCB030 | 2-140 | 803 | PCB030 | 2-140 | | |
| 804 | PCB031 | 2-141 | 804 | PCB031 | 2-141 | | |
| 805 | PCB032 | 2-142 | 805 | PCB032 | 2-142 | | |
| 806 | PCB033 | 2-143 | 806 | PCB033 | 2-143 | | |
| 807 | PCB034 | 2-144 | 807 | PCB034 | 2-144 | | |
| 808 | PCB035 | 2-145 | 808 | PCB035 | 2-145 | | |
| 809 | PCB036 | 2-146 | 809 | PCB036 | 2-146 | | |
| 810 | PCB037 | 2-147 | 810 | PCB037 | 2-147 | | |
| 811 | PCB038 | 2-148 | 811 | PCB038 | 2-148 | | |
| 812 | PCB039 | 2-149 | 812 | PCB039 | 2-149 | | |
| 813 | PCB040 | 2-150 | 813 | PCB040 | 2-150 | | |
| 814 | PCB041 | 2-151 | 814 | PCB041 | 2-151 | | |
| 815 | PCB042 | 2-152 | 815 | PCB042 | 2-152 | | |
| 816 | PCB043 | 2-153 | 816 | PCB043 | 2-153 | | |
| 817 | PCB044 | 2-154 | 817 | PCB044 | 2-154 | | |
| 818 | PCB045 | 2-155 | 818 | PCB045 | 2-155 | | |
| 819 | PCB046 | 2-156 | 819 | PCB046 | 2-156 | | |
| 820 | PCB047 | 2-157 | 820 | PCB047 | 2-157 | | |
| 821 | PCB048 | 2-158 | 821 | PCB048 | 2-158 | | |
| 822 | PCB049 | 2-159 | 822 | PCB049 | 2-159 | | |
| 823 | PCB050 | 2-160 | 823 | PCB050 | 2-160 | | |
| 824 | PCB051 | 2-161 | 824 | PCB051 | 2-161 | | |
| 825 | PCB052 | 2-162 | 825 | PCB052 | 2-162 | | |
| 826 | PCB053 | 2-163 | 826 | PCB053 | 2-163 | | |
| 827 | PCB054 | 2-164 | 827 | PCB054 | 2-164 | | |
| 828 | PCB055 | 2-165 | 828 | PCB055 | 2-165 | | |
| 829 | PCB056 | 2-166 | 829 | PCB056 | 2-166 | | |
| 830 | PCB057 | 2-167 | 830 | PCB057 | 2-167 | | |
| 831 | PCB058 | 2-168 | 831 | PCB058 | 2-168 | | |
| 832 | PCB059 | 2-169 | 832 | PCB059 | 2-169 | | |
| 833 | PCB060 | 2-170 | 833 | PCB060 | 2-170 | | |
| 834 | PCB061 | 2-171 | 834 | PCB061 | 2-171 | | |
| 835 | PCB062 | 2-172 | 835 | PCB062 | 2-172 | | |
| 836 | PCB063 | 2-173 | 836 | PCB063 | 2-173 | | |
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| 838 | PCB065 | 2-175 | 838 | PCB065 | 2-175 | | |
| 839 | PCB066 | 2-176 | 839 | PCB066 | 2-176 | | |
| 840 | PCB067 | 2-177 | 840 | PCB067 | 2-177 | | |
| 841 | PCB068 | 2-178 | 841 | PCB068 | 2-178 | | |
| 842 | PCB069 | 2-179 | 842 | PCB069 | 2-179 | | |
| 843 | PCB070 | 2-180 | 843 | PCB070 | 2-180 | | |
| 844 | PCB071 | 2-181 | 844 | PCB071 | 2-181 | | |
| 845 | PCB072 | 2-182 | 845 | PCB072 | 2-182 | | |
| 846 | PCB073 | 2-183 | 846 | PCB073 | 2-183 | | |
| 847 | PCB074 | 2-184 | 847 | PCB074 | 2-184 | | |
| 848 | PCB075 | 2-185 | 848 | PCB075 | 2-185 | | |
| 849 | PCB076 | 2-186 | 849 | PCB076 | 2-186 | | |
| 850 | PCB077 | 2-187 | 850 | PCB077 | 2-187 | | |

FIGURE 6. Double sided board, qualification inspection sample - Continued.

MIL-A-28870A

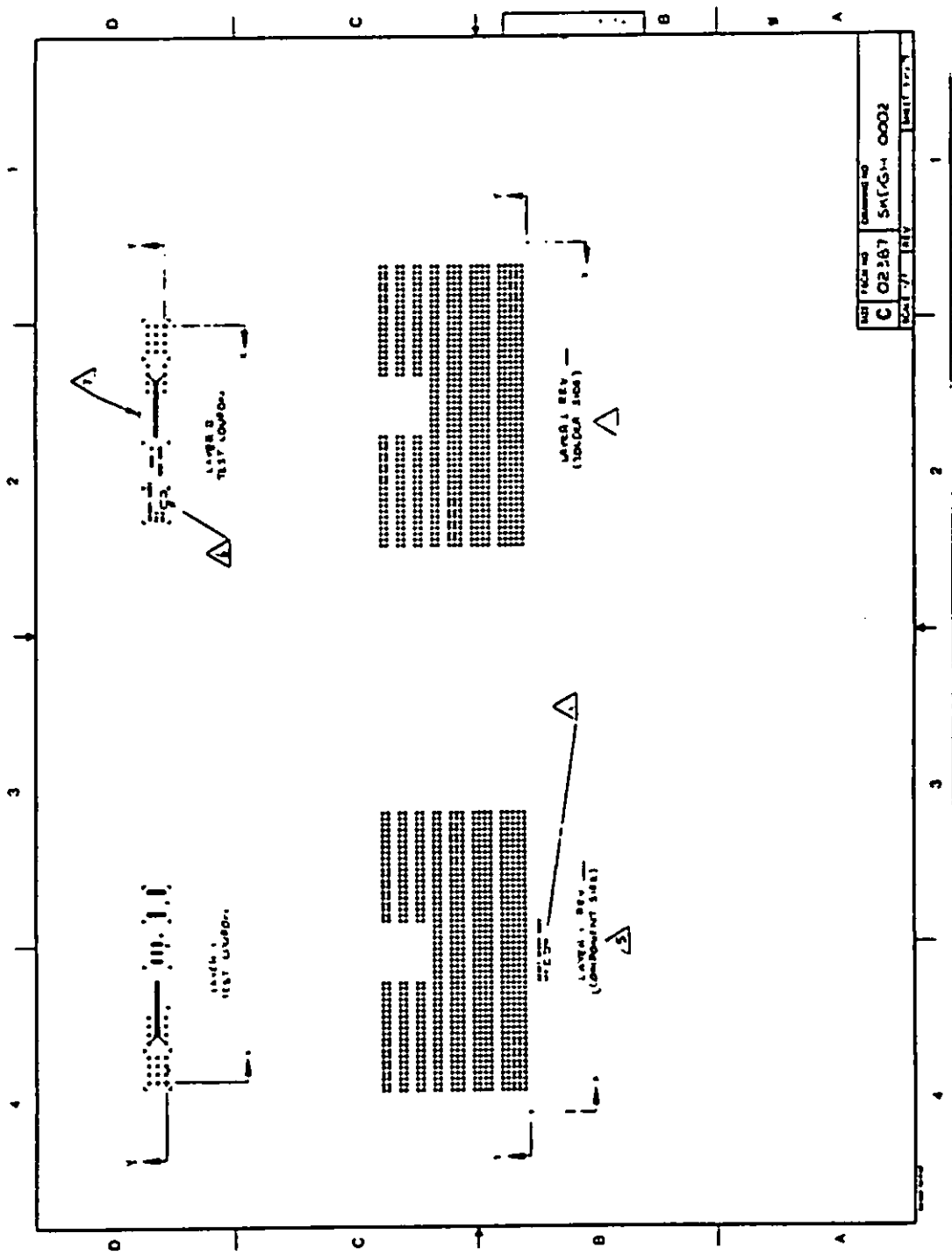


FIGURE 6. Double sided board, qualification inspection sample - Continued.

MIL-A-28870A

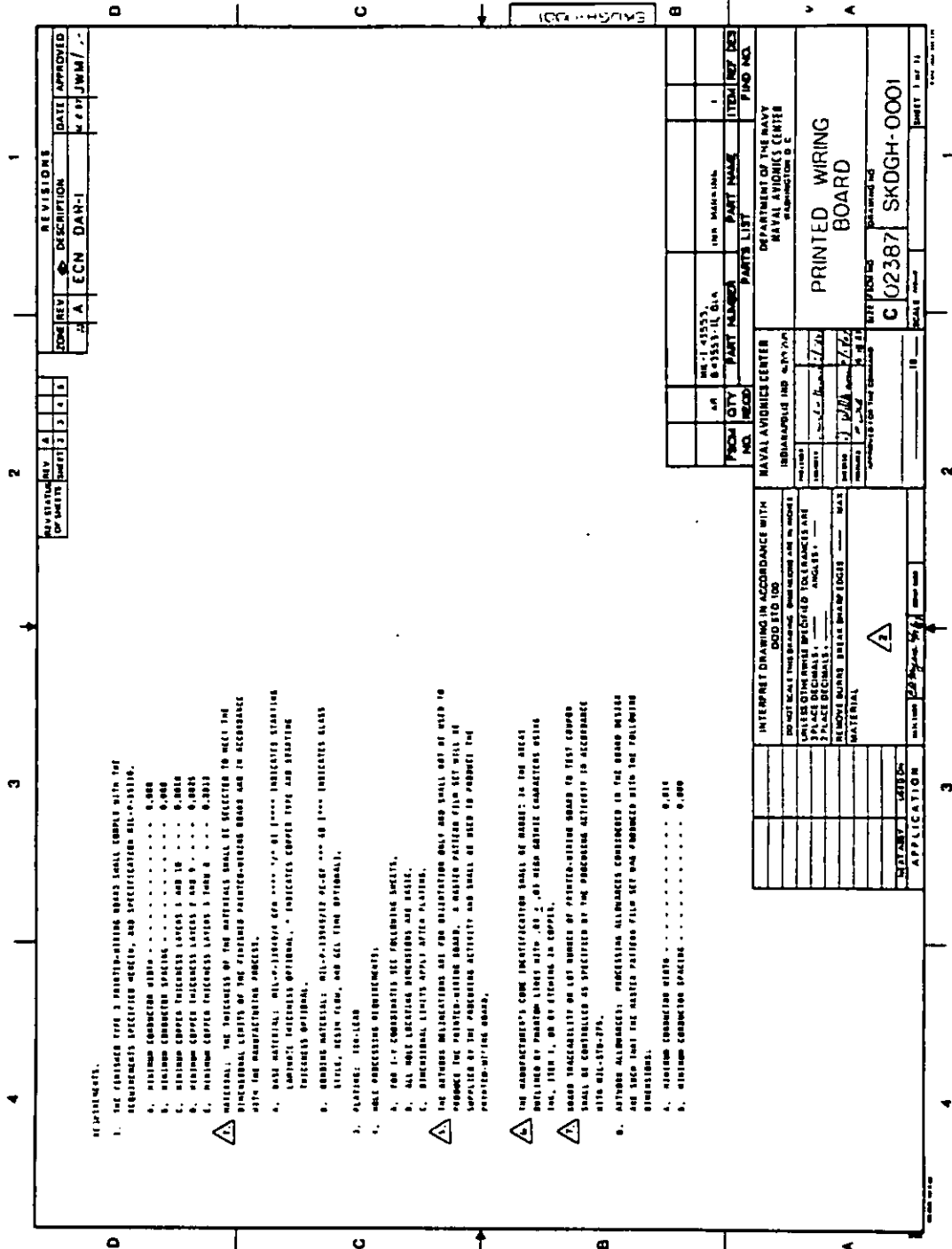


FIGURE 7. Multilayer board, qualification inspection sample.

MIL-A-28870A

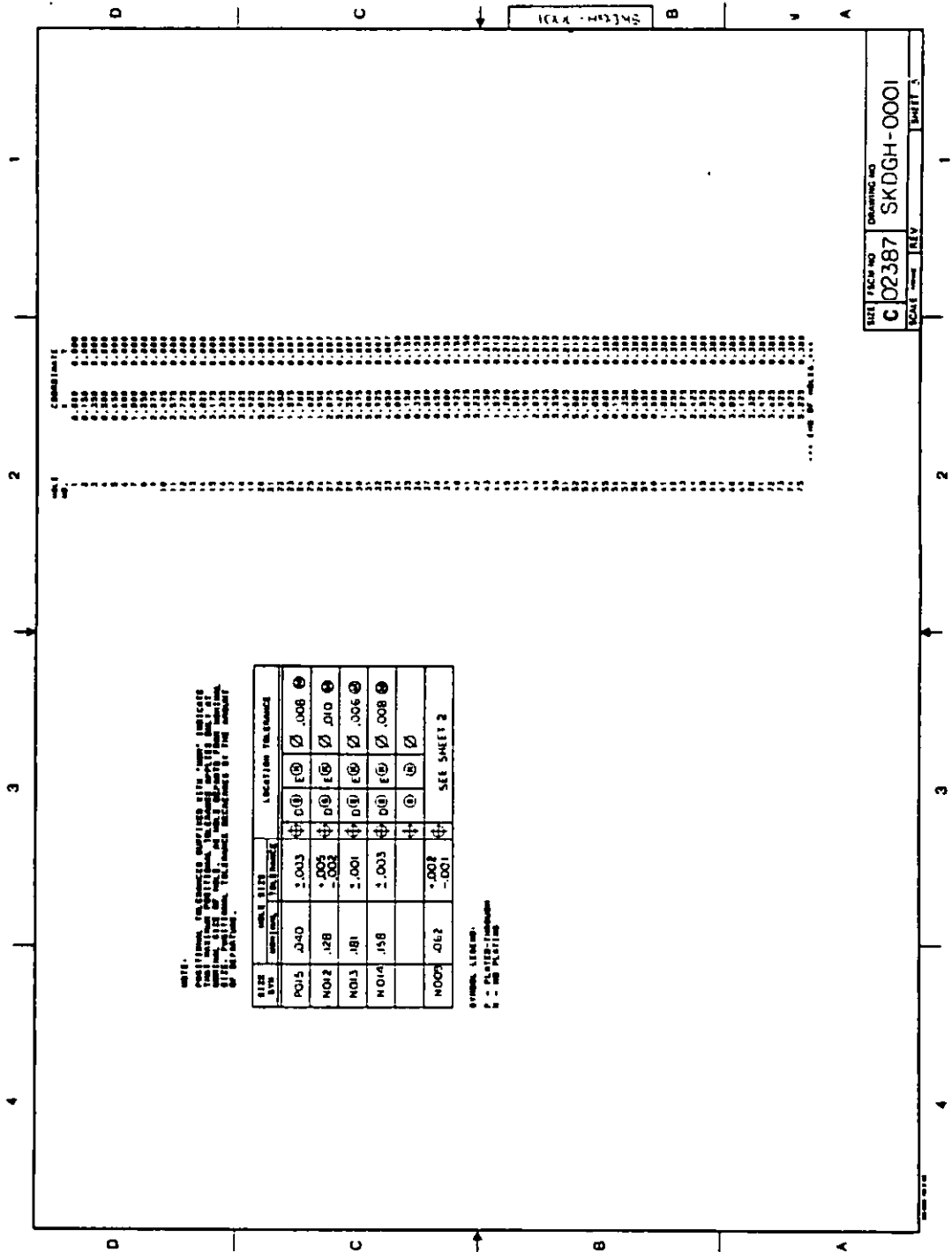


FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

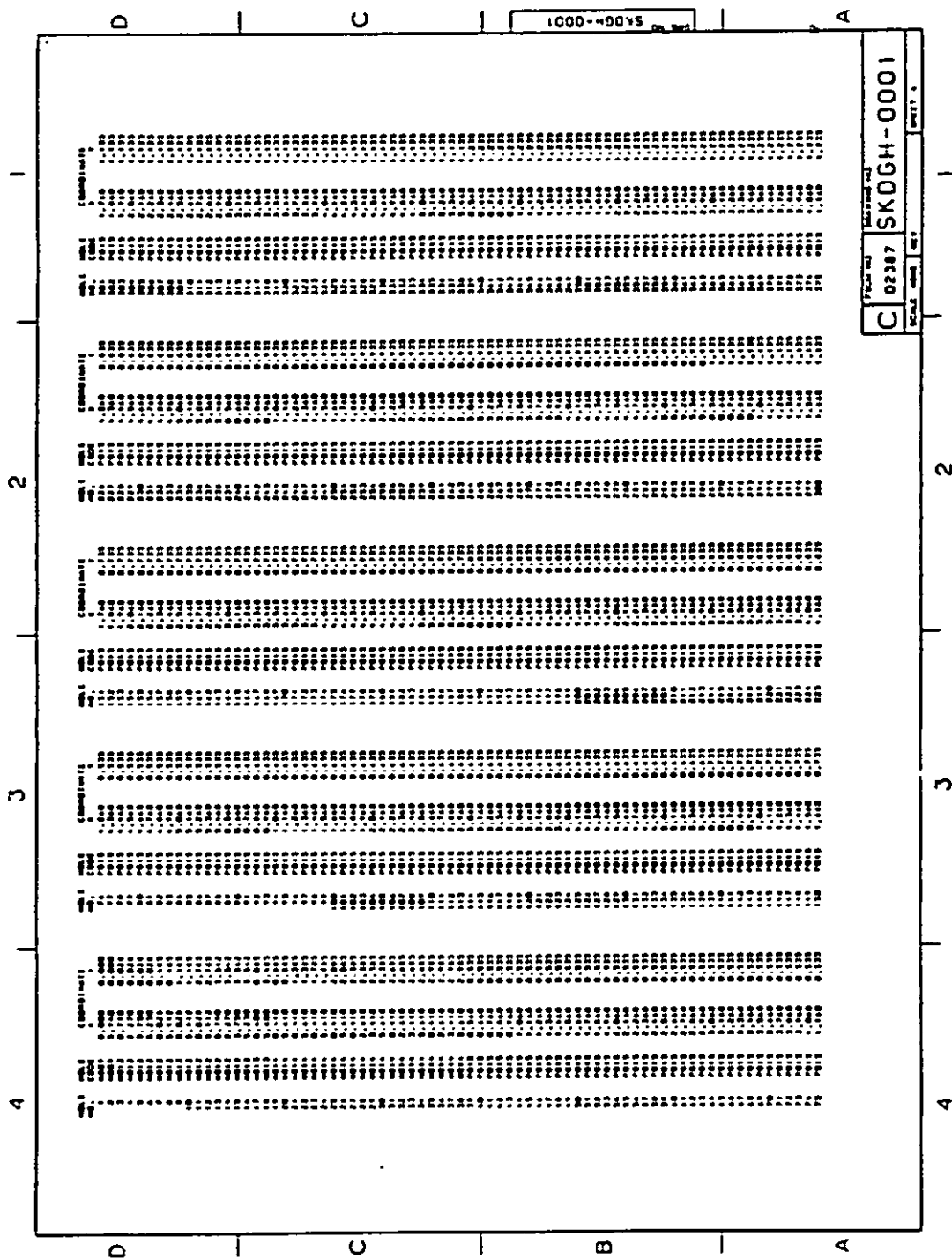


FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

1000-8905 SKDGH-0001

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| 4 | D | MIL-COMPLIANCE | 377 | P015 | 1-100 | 377 | P015 | 1-100 | 377 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 378 | P015 | 1-100 | 378 | P015 | 1-100 | 378 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 379 | P015 | 1-100 | 379 | P015 | 1-100 | 379 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 380 | P015 | 1-100 | 380 | P015 | 1-100 | 380 | P015 | 1-100 |
| 3 | D | MIL-COMPLIANCE | 381 | P015 | 1-100 | 381 | P015 | 1-100 | 381 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 382 | P015 | 1-100 | 382 | P015 | 1-100 | 382 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 383 | P015 | 1-100 | 383 | P015 | 1-100 | 383 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 384 | P015 | 1-100 | 384 | P015 | 1-100 | 384 | P015 | 1-100 |
| 2 | D | MIL-COMPLIANCE | 385 | P015 | 1-100 | 385 | P015 | 1-100 | 385 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 386 | P015 | 1-100 | 386 | P015 | 1-100 | 386 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 387 | P015 | 1-100 | 387 | P015 | 1-100 | 387 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 388 | P015 | 1-100 | 388 | P015 | 1-100 | 388 | P015 | 1-100 |
| 1 | D | MIL-COMPLIANCE | 389 | P015 | 1-100 | 389 | P015 | 1-100 | 389 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 390 | P015 | 1-100 | 390 | P015 | 1-100 | 390 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 391 | P015 | 1-100 | 391 | P015 | 1-100 | 391 | P015 | 1-100 |
| | | MIL-COMPLIANCE | 392 | P015 | 1-100 | 392 | P015 | 1-100 | 392 | P015 | 1-100 |

| | |
|-----------|------------|
| FIGURE NO | SKDGH-0001 |
| SCALE | 1:1 |
| REV | 1 |

FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

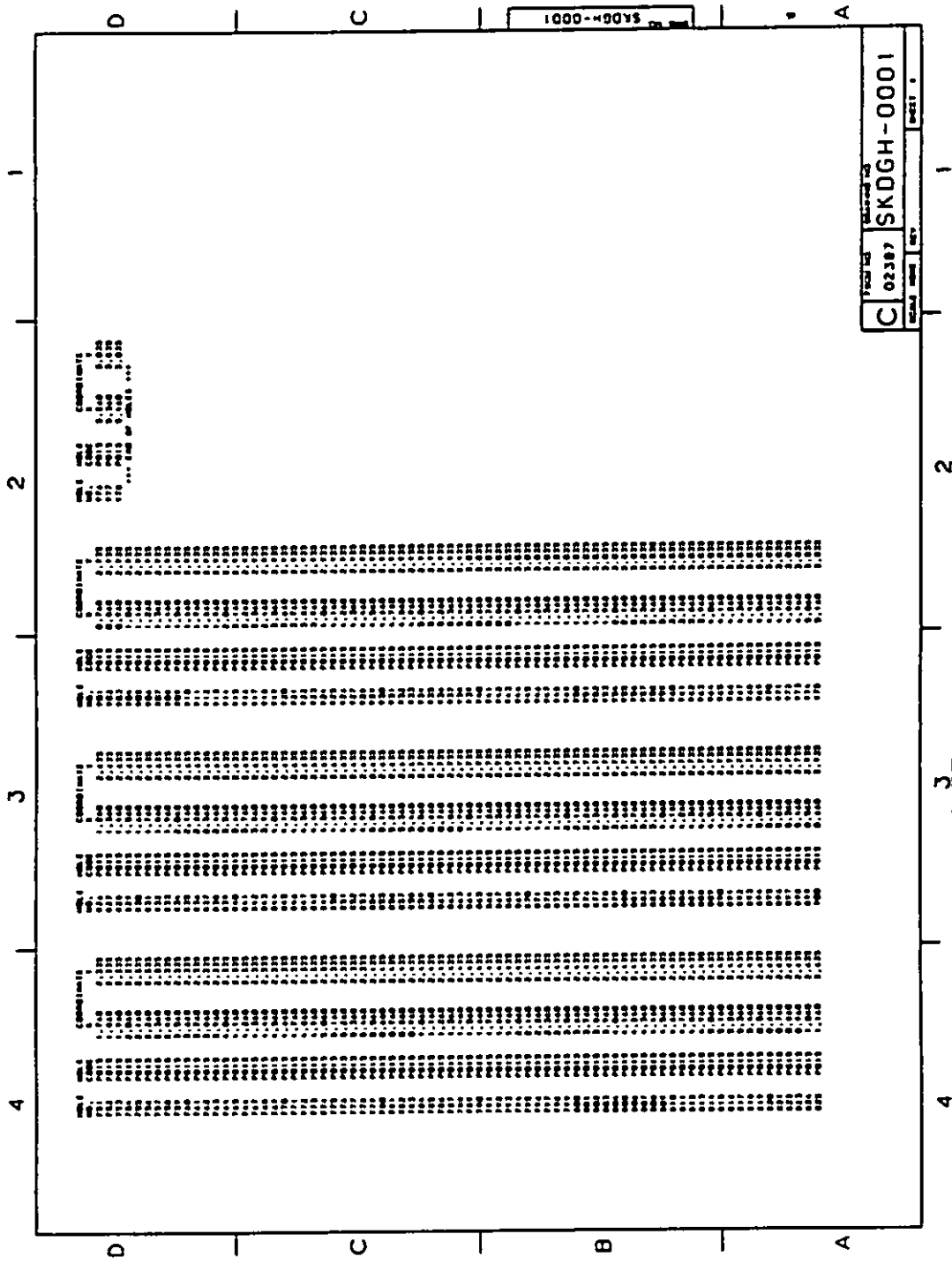


FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

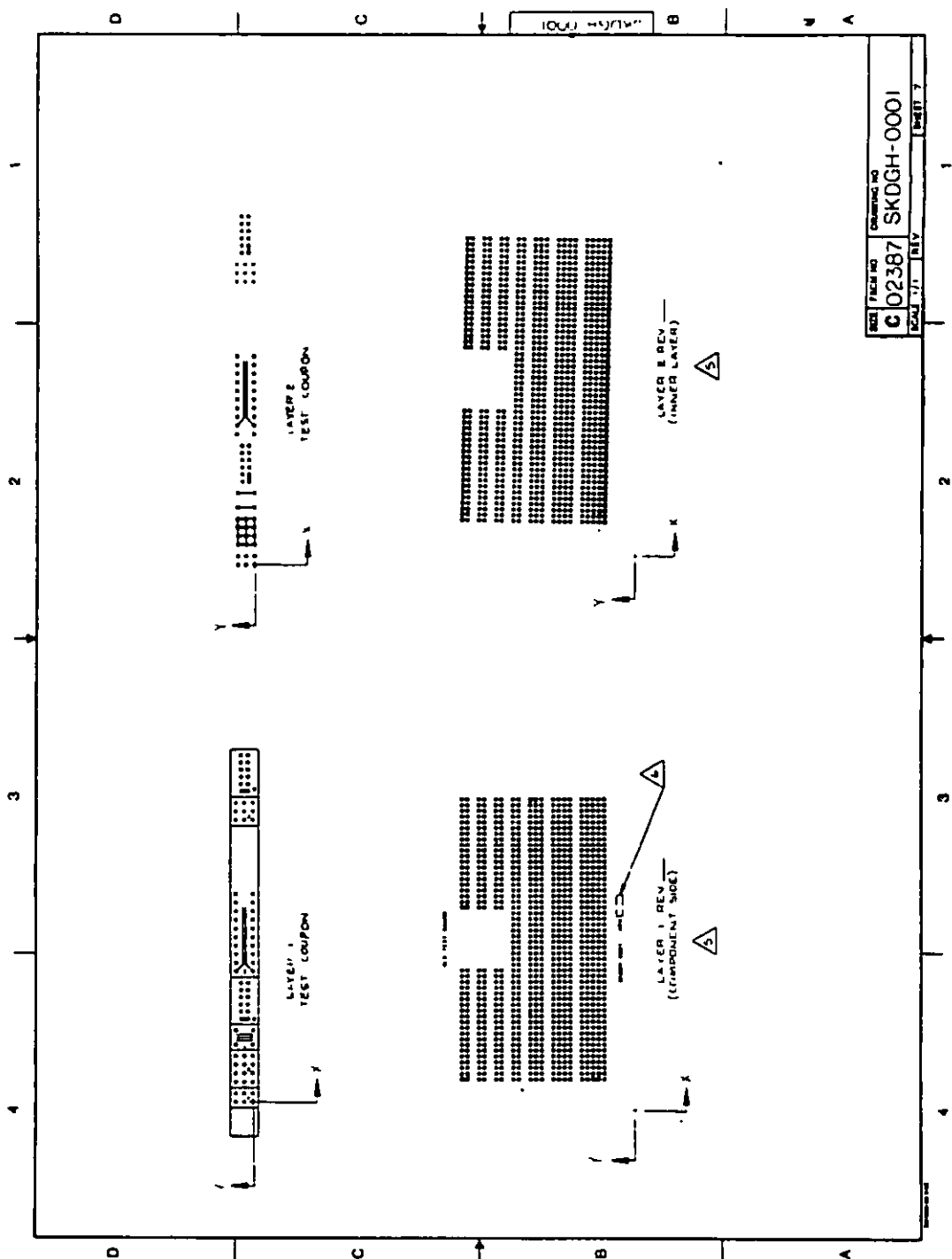


FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

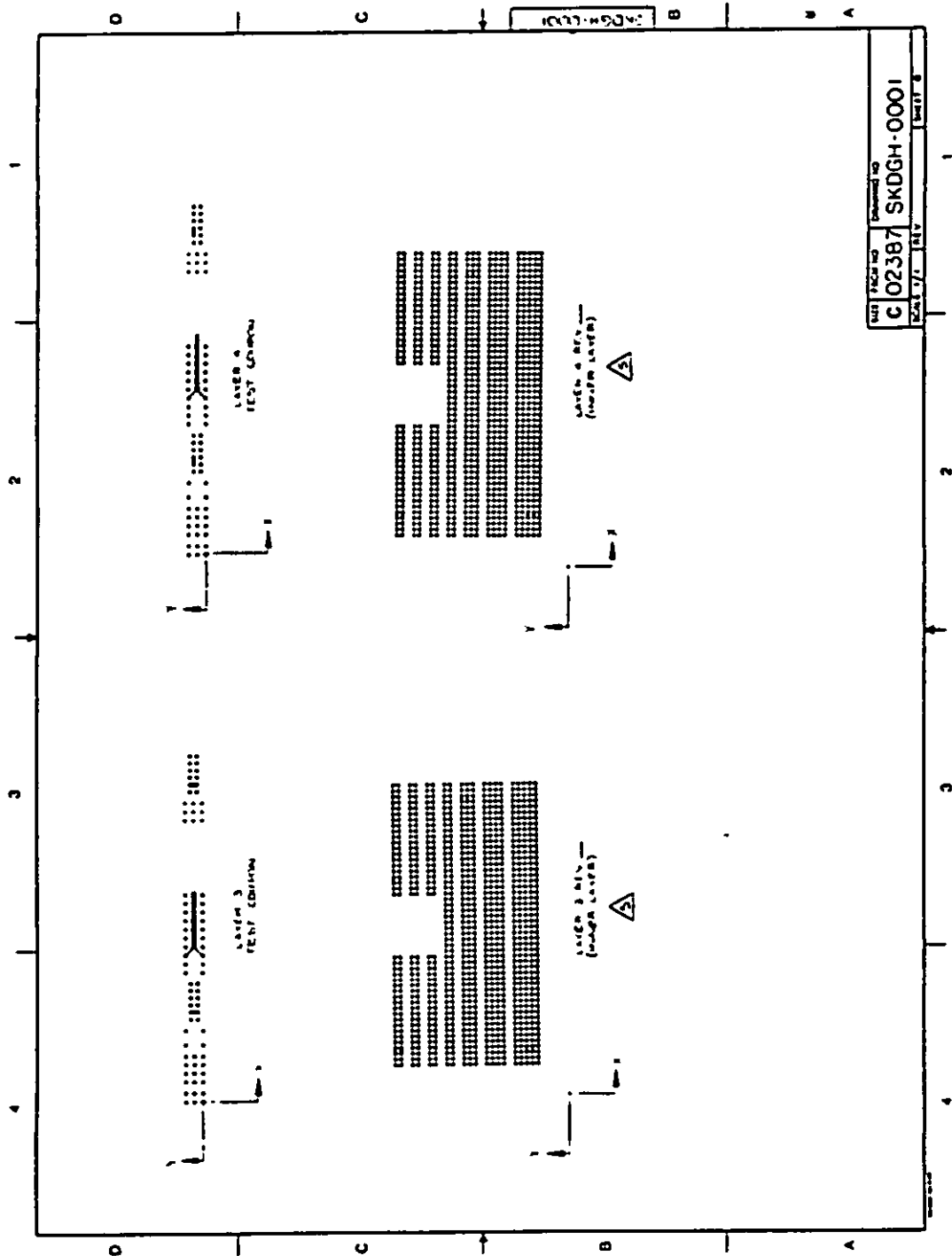


FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

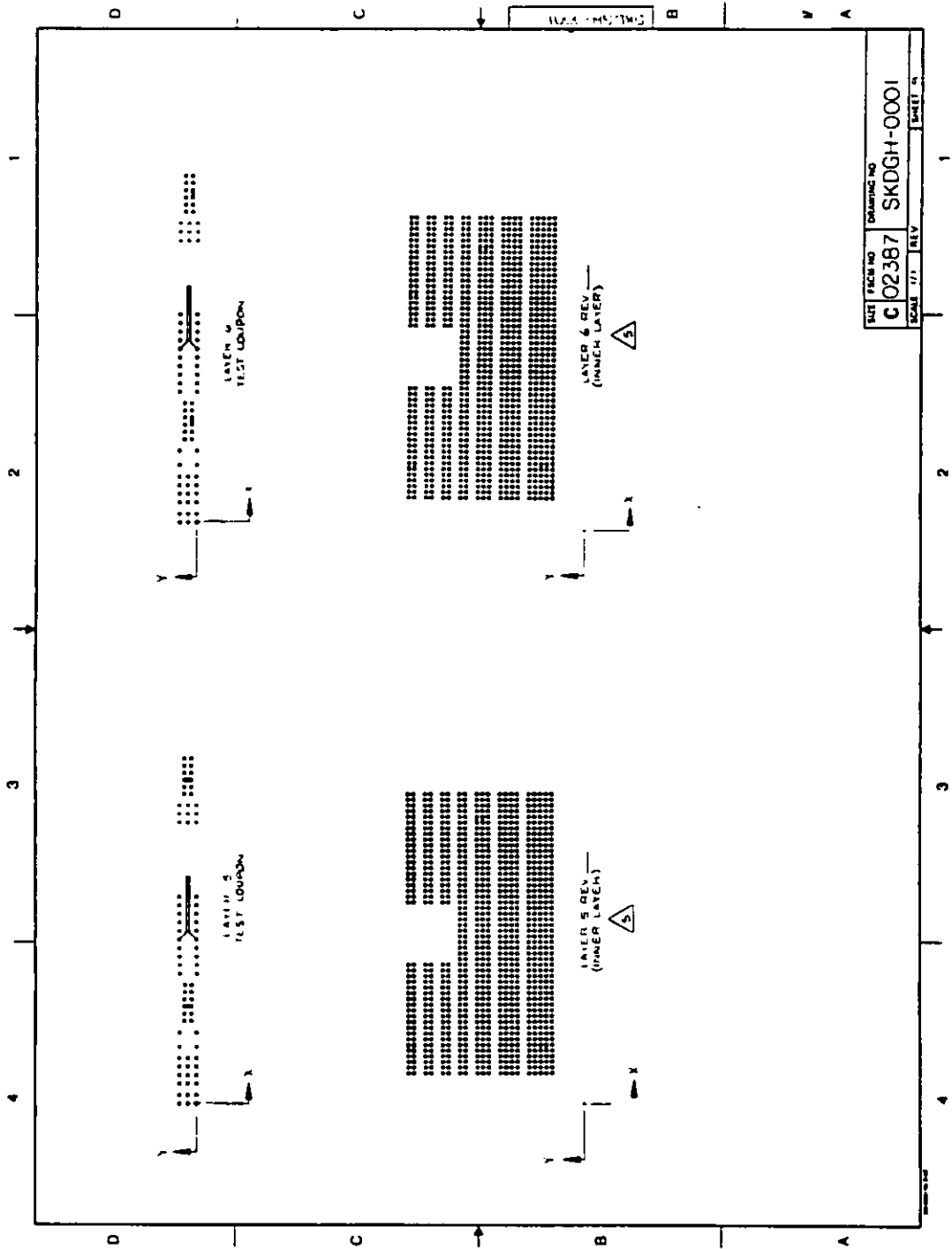


FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

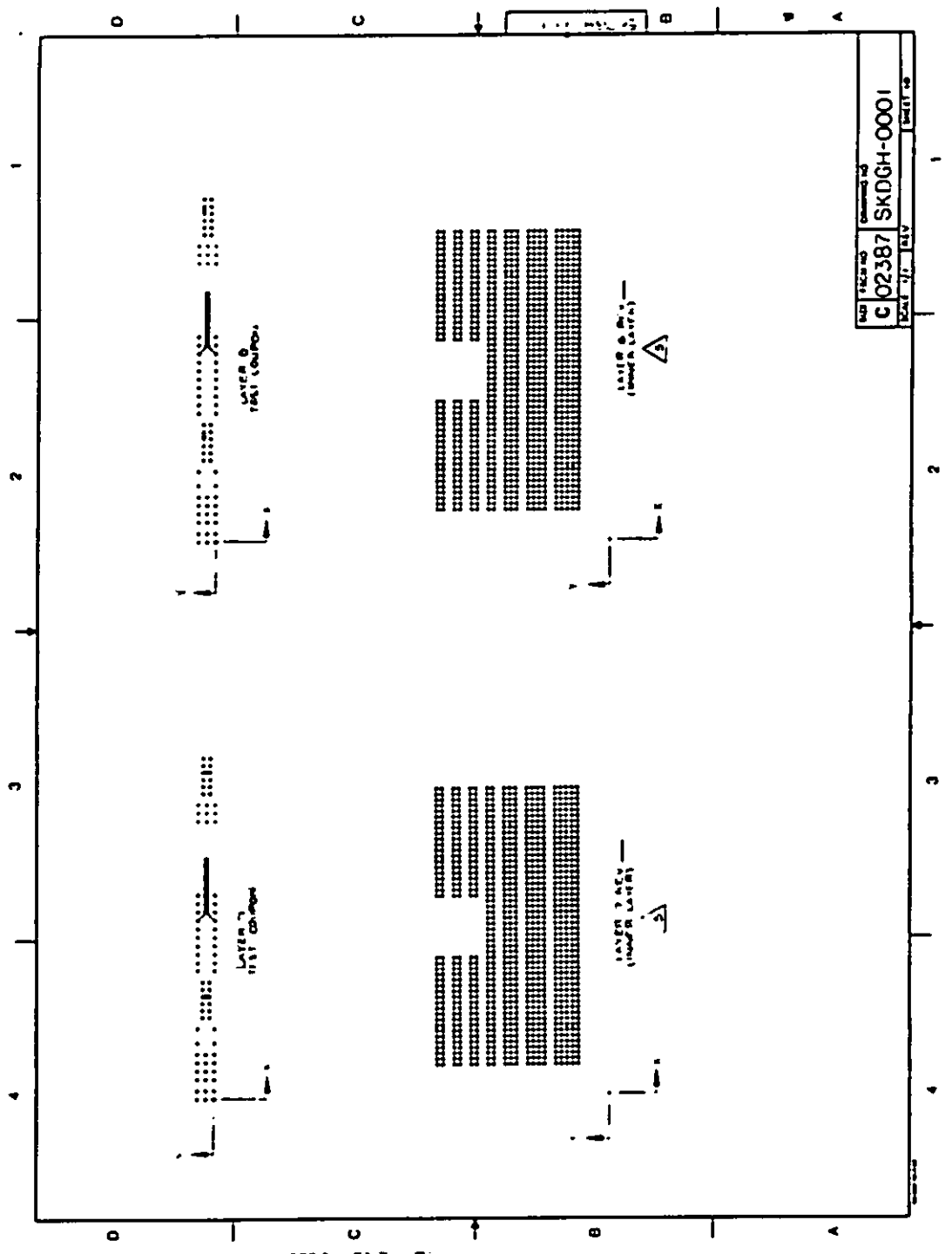


FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

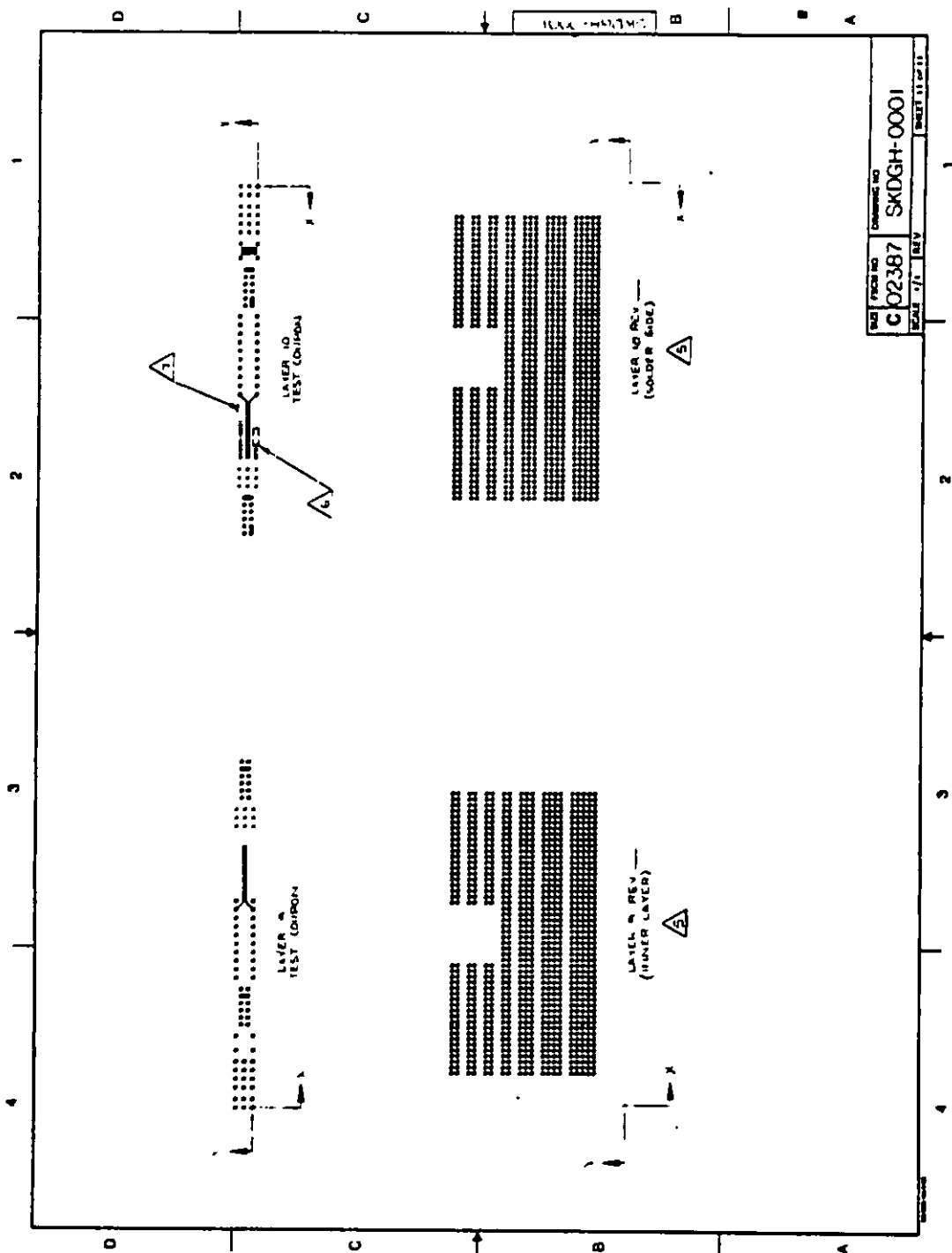


FIGURE 7. Multilayer board, qualification inspection sample - Continued.

MIL-A-28870A

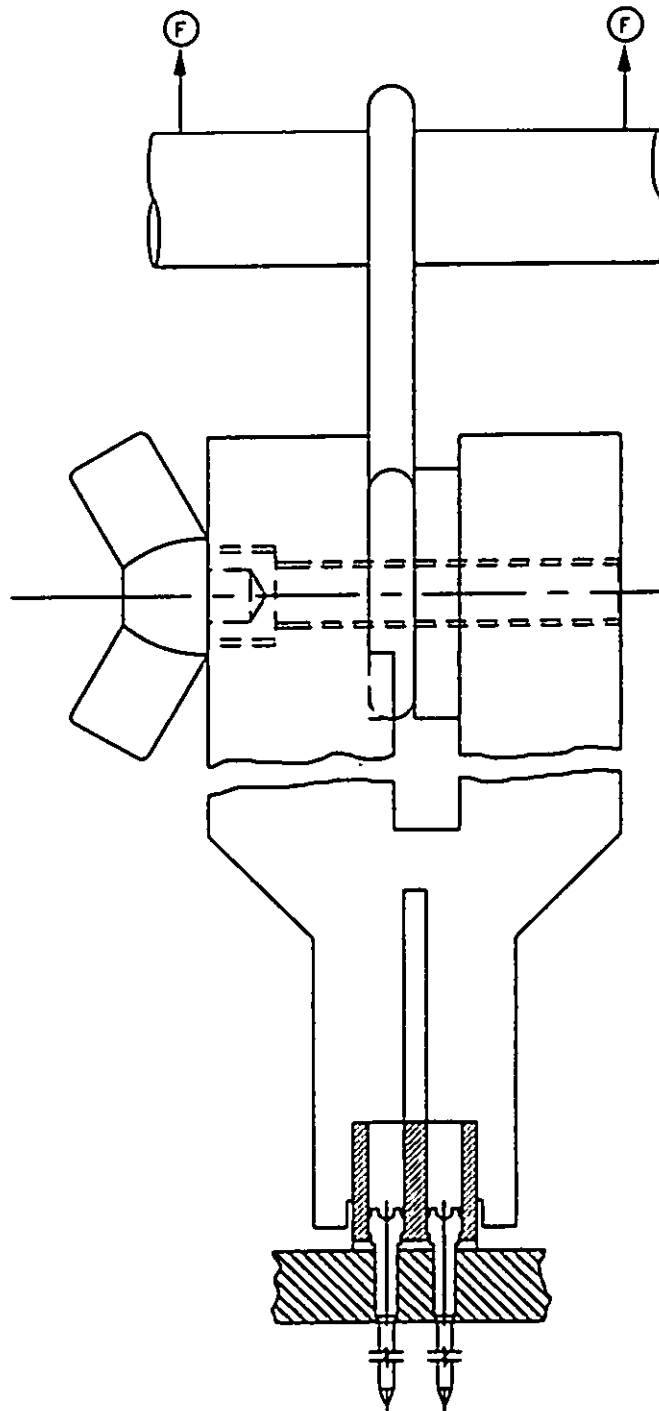


FIGURE 8. Test set-up for housing retention force.

MIL-A-28870A

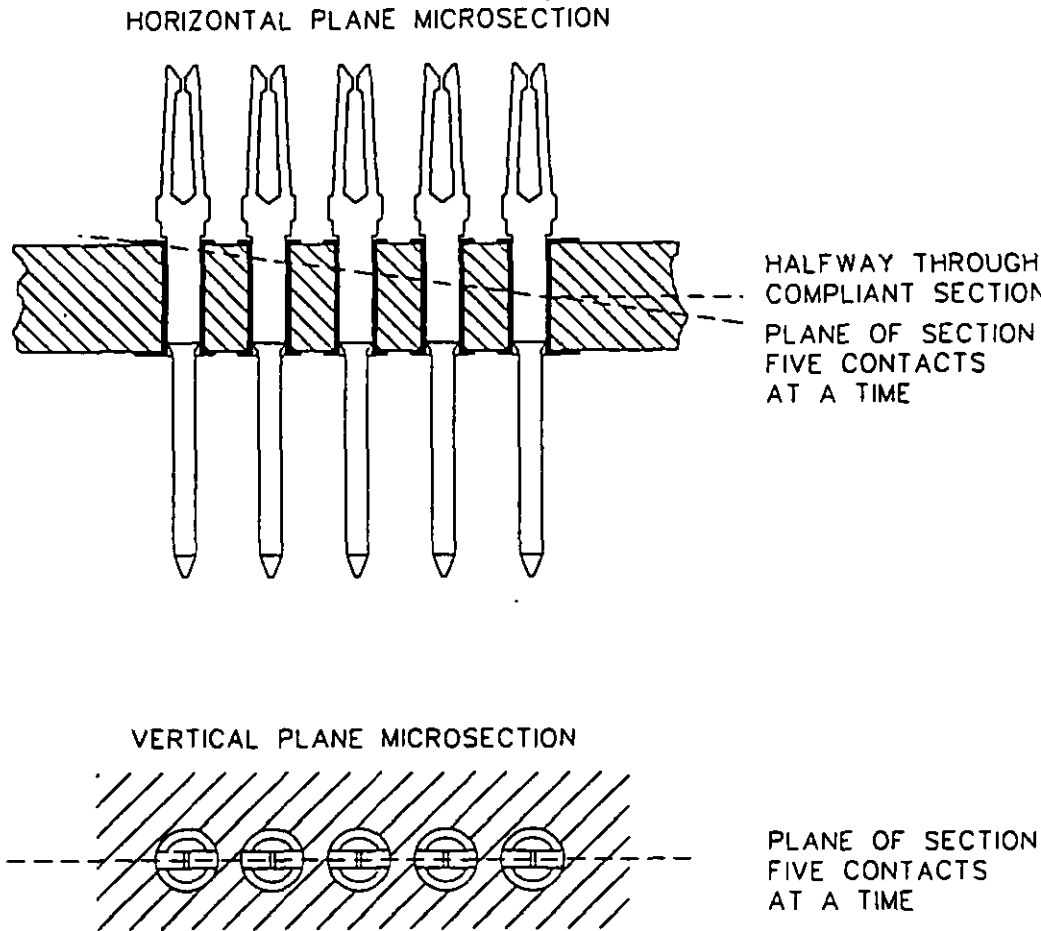


FIGURE 9. Horizontal and vertical plane microsection.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

| | | | |
|---|--|---|--|
| 1. DOCUMENT NUMBER MIL-A-28870A | | 2. DOCUMENT TITLE Backplane Assembly, Electrical, Printed-Wiring, General Specification for | |
| 3a. NAME OF SUBMITTING ORGANIZATION | | 4. TYPE OF ORGANIZATION (Mark one) | |
| b. ADDRESS (Street, City, State, ZIP Code) | | <input type="checkbox"/> VENDOR | |
| | | <input type="checkbox"/> USER | |
| | | <input type="checkbox"/> MANUFACTURER | |
| | | <input type="checkbox"/> OTHER (Specify): _____ | |
| 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.)