MILITARY SPECIFICATION

ASSEMBLIES, ELECTRICAL BACKPLANE,

PRINTED-WIRING, GENERAL SPECIFICATION FOR

This specification is approved for use by the Naval Electronic Systems Command, Department of the Navy, and is available 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.

1.2 Types. Printed-wiring electrical backplane assemblies shall be of the types shown in Table I, as specified (see 6.3).

TABLE I. Types.

Type Designator	Board Type
2	Double-sided
3	Multilayer

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-P-116	- Preservation, Methods of.
MIL-C-28754	- Connector, Electrical, Modular and Component Parts, General Specification for.
MIL-C-28859	- Connector Component Parts, Electrical Backplane, Printed-Wiring, General Specification for.
MIL-I-43553	- Ink, Marking, Epoxy Base.
MIL-I-46058	- Insulating Compound, Electrical (For Coating Printed Circuit Assemblies).
MIL-P-55110	- Printed-Wiring Boards.
MIL-C-55330	- Connector, Preparation for Delivery of.

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, Department of the Navy, Washington, D.C. 20360, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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-810	- Environmental Test Methods.
MIL-STD-1344	- Test Methods for Electrical Connectors.
MIL-STD-2119	- Printed-Wiring Electrical Backplane Assemblies.
MIL-STD-45662	- Calibration Systems Requirements.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring agency 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. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

ANSI-Y32.16	- Reference Designation for Electrical and Electronics Parts and Equipment.

(Application for copies should be addressed to the American National Standards Institute, 10 East 40th Street, New York, NY 10016.)

IPC-T-50	- Terms and Definitions.
IPC-SM-840	- Qualification and Performance of Permanent Polymer Coating (Solder Mask) for Printed Boards.

(Application for copies should be addressed to the Institute of Printed Circuits, 3451 Church Street, Evanston, IL 60203.)

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 approved backplane assembly drawing (see 6.3). 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 approved backplane assembly drawing, the latter shall govern.

3.2 Supplier certification. Printed-wiring electrical backplane assemblies furnished under this specification shall have been fabricated by a supplier who has been certified by inspection in accordance with 4.5 and 6.5.

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

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

3.3.2 Printed-wiring electrical backplane. The printed-wiring electrical backplane 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.

3.4 Material. The type of material shall be as specified in MIL-STD-2119 and the approved backplane assembly drawing. Acceptance or approval of any constitutent material shall not be construed as a guarantee of the acceptance of the finished product.

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

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

3.4.3 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 approved backplane assembly drawing.

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

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

3.5 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 electrical backplane assemblies shall meet the requirements of the approved assembly drawing and the following requirements of 3.5.1 through 3.5.5.

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

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

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

3.5.4 Wrappost tail tip position. Unless otherwise specified on the approved backplane assembly drawing (see 6.2), all wrappost tail tip positions shall be within true position of 0.020 inch (0.508 mm) diameter to specified datums on the approved backplane assembly drawing.

3.5.5 Bow and twist. When tested in accordance with 4.7.3.6, the maximum allowable bow and twist shall be 1.5 percent, unless otherwise specified on the approved assembly drawing.

3.6 Mechanical requirements.

3.6.1 Compliant component retention. The compliant components installed in the rigid printed-wiring board shall meet the following requirements.

3.6.1.1 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 (33.36 Newton) and a maximum of 45 pounds (200.17 Newton), when tested in accordance with 4.7.3.1.

3.6.1.2 Conditioned. After conditioning in accordance with 4.7.3.1.1, the pushout force shall be a minimum of 7.5 pounds (33.36 Newton).

3.6.1.3 Compliant component torque. When tested as specified in 4.7.3.2, the compliant component shall withstand a minimum torque of 3 ounce-inches (0.02119 Newton-Meter). Following removal of the applied torque, no displacement or deformation of the compliant component shall be visible.

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

3.6.2.1 Hole deformation radius. The average plated-through hole deformation radius shall be nc greater than 0.0015 inch (0.0038 cm), when measured from the drilled hole. The absolute maximum deformation radius shall be 0.002 inch (0.0051 cm) (see figure 3).

3.6.2.2 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 (0.00076 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 occured.

3.6.3 Housing retention. The housing retention shall be as specified on the applicable specification sheet of MIL-C-28859. When housings are removed, they shall be replaced with an unused housing and the removed housing discarded.

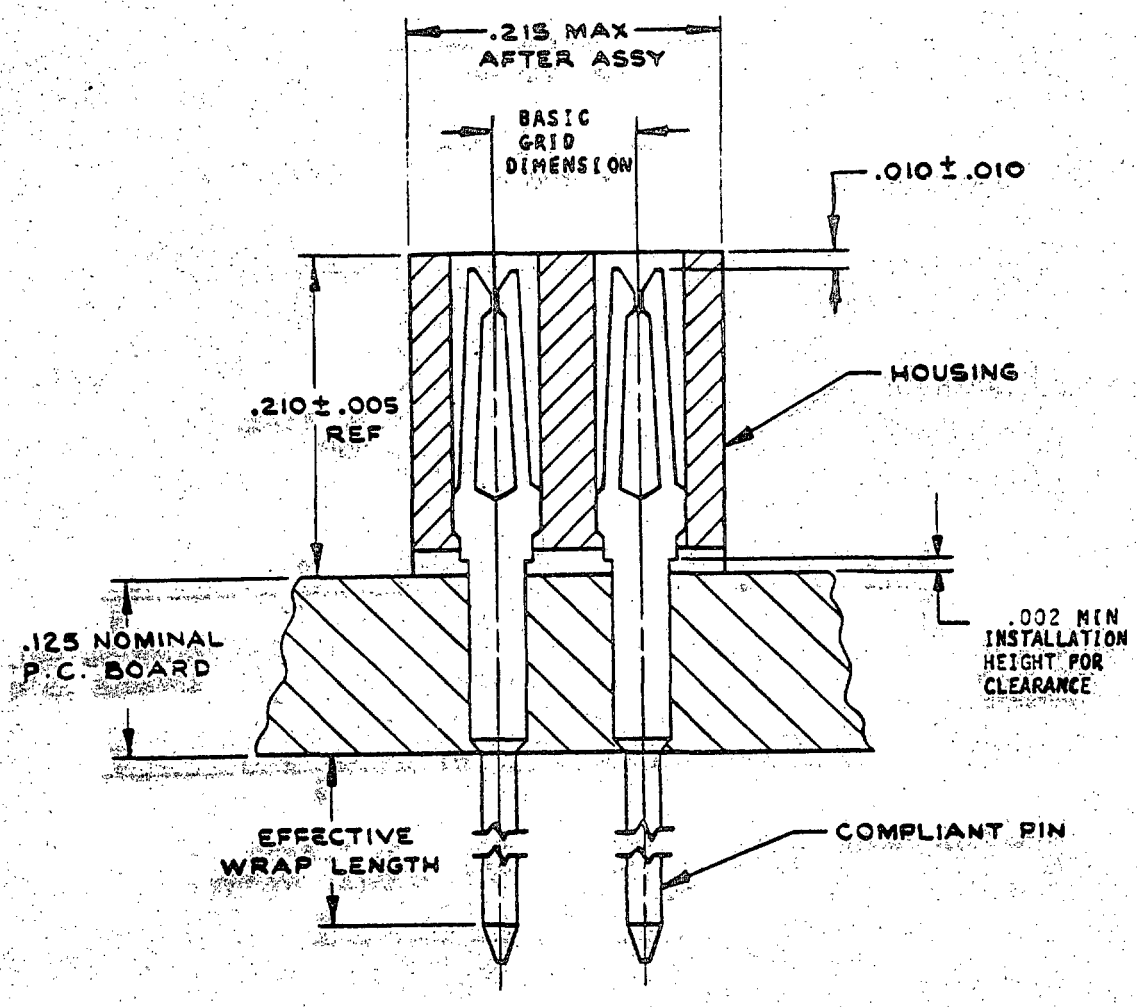

FIGURE 1. Cross-sectional view of printed-wiring electrical backplane assembly.

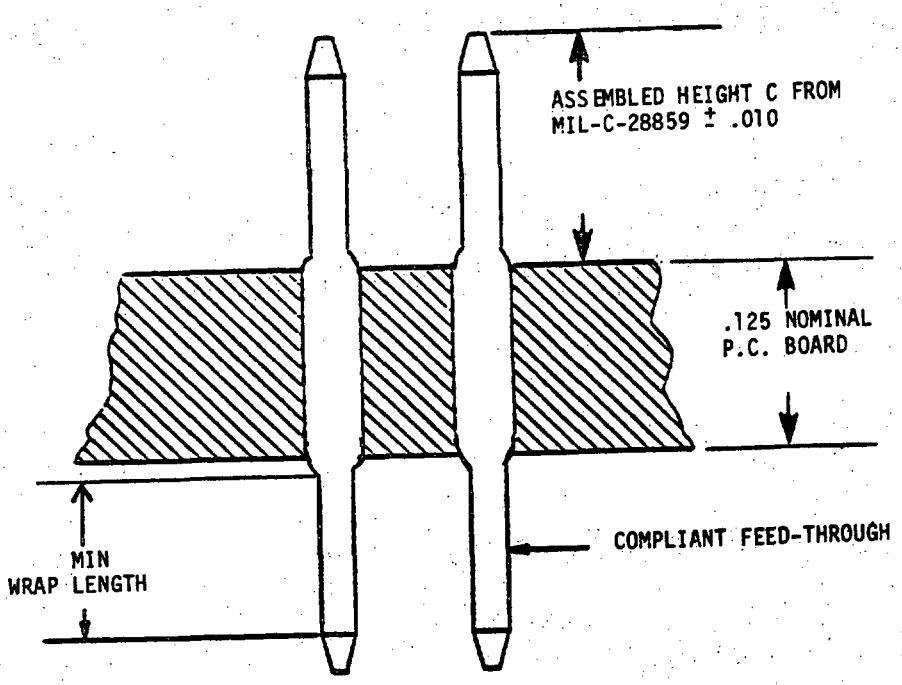

FIGURE 1. Cross-sectional view of printed-wiring electrical backplane assembly. - Continued.

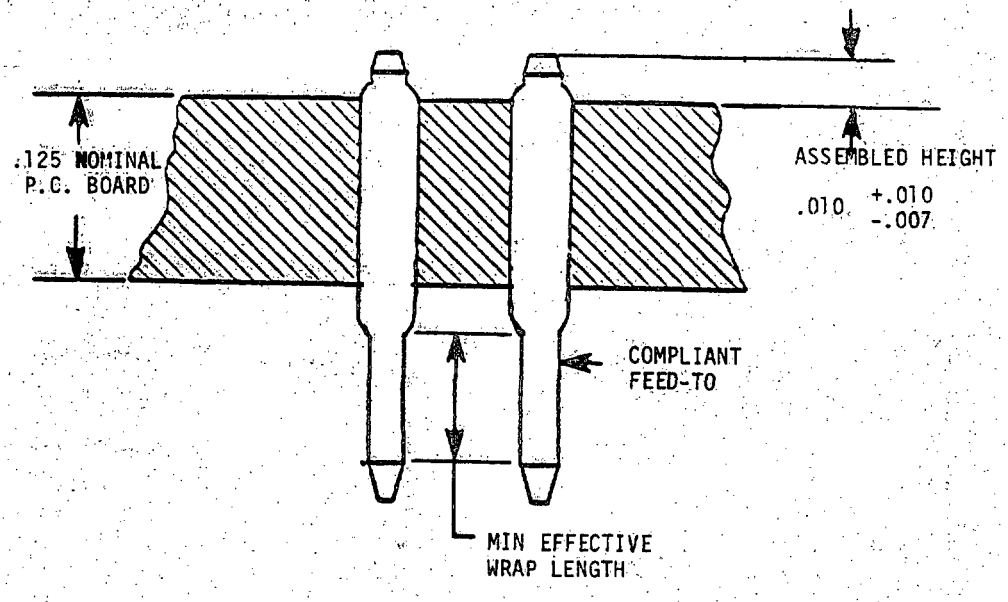

FIGURE 1. Cross-sectional view of printed-wiring electrical backplane assembly. - Continued

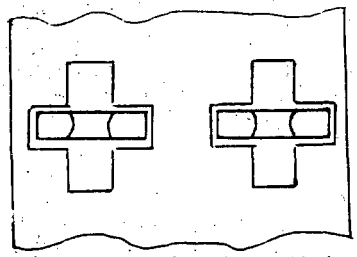

FIGURE 2A. Idealized condition.
(NO SCALE)

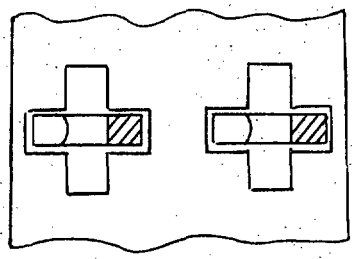

FIGURE 2B. Either tine broken.
(NO SCALE)
UNACCEPTABLE

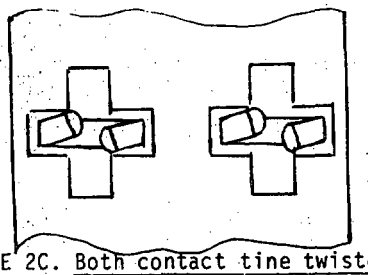

FIGURE 2C. Both contact tine twisted.
(NO SCALE)
UNACCEPTABLE

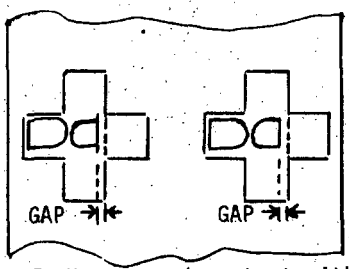

FIGURE 2E. Uncentered contact with gap.
(NO SCALE)
UNACCEPTABLE

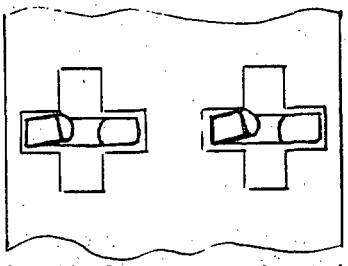

FIGURE 2D. Single contact tine twisted.
(NO SCALE) (5%)

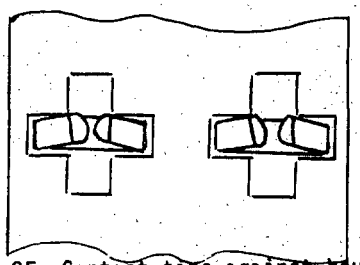

FIGURE 2F. Contact tine against housing.
(NO SCALE) (5%)

FIGURE 2. Compliant pin and housing workmanship standards.

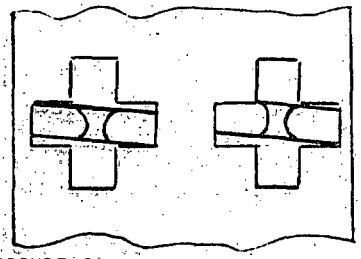

FIGURE 2G. Contact Orientation not Central to cruciform. (NO SCALE) (5%)

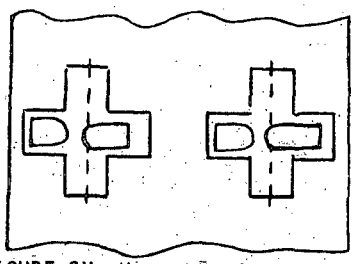

FIGURE 2H. Uncentered contact. (NO SCALE) (5%)

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

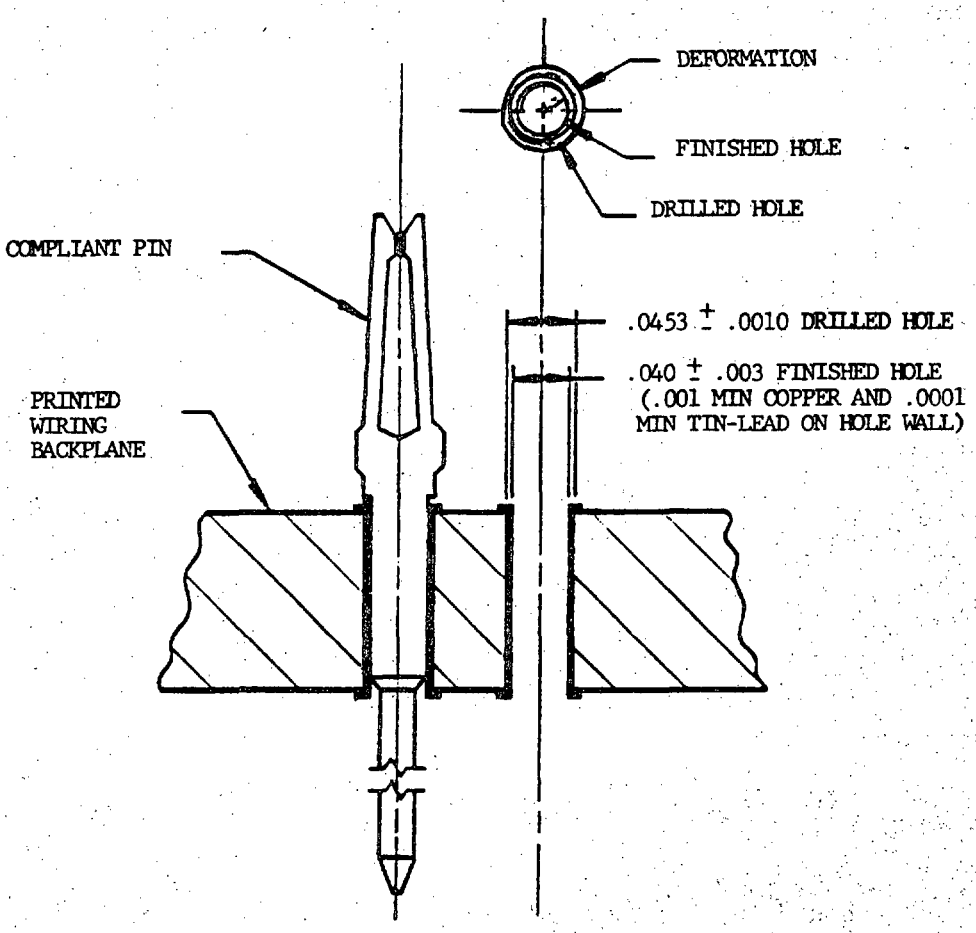

FIGURE 3. Plated - through hole deformation radius.

3.6.4 Keying peg retention. The keying pegs installed in the housing shall withstand a removal force of 5 pounds (22.24 Newton) minimum.

3.6.5 Engaging and separating force. When tested as specified in 4.7.3.7, the force to engage shall be 10 ounces (2.78 Newton) maximum, and the force to separate shall be 2 ounces (0.56 Newton) minimum. The tests shall be performed with the housing assembled.

3.7 Electrical requirements.

3.7.1 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 for type 2 assemblies (Figure 6), and 20 millivolts for type 3 assemblies (Figure 7).

3.7.2 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

3.7.3 Dielectric withstanding voltage. When tested as specified in 4.7.2.3, there shall be no evidence of arcing, breakdown or damage.

3.7.4 Circuitry.

3.7.4.1 Circuit continuity. When tested as specified in 4.7.2.4.1, there shall be no open circuits in the specimen.

3.7.4.2 Circuit shorts. When tested as specified in 4.7.2.4.2, there shall be no short circuits in the specimen.

3.8 Environmental requirements.

3.8.1 Thermal shock. When tested as specified in 4.7.4.1, the printed-wiring electrical backplane assembly shall show no evidence of cracking, fracturing or other damage detrimental to the operation of the assembly.

3.8.2 Life. When tested as specified in 4.7.4.5, the printed-wiring electrical backplane assembly shall exhibit no evidence of cracks, burns, or other visual or mechanical damage.

3.8.3 Temperature-altitude. When tested as specified in 4.7.4.2, 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. In addition, at the completion of the temperature-altitude test the assembly shall meet the requirements of 3.7.2 (before humidity) and 3.7.3.

3.8.4 Vibration. When printed-wiring electrical backplane assemblies are tested as specified in 4.7.4.3, there shall be no cracking or breaking, nor shall there be any loosening of parts, or other visible damage. There shall be no loss of electrical continuity of any of the contact circuits of more than 1 microsecond during test. Connectors shall meet the requirements of 3.6.1 and 3.7.1.

3.8.5 Shock (specified pulse). When printed-wiring electrical backplane assemblies are tested as specified in 4.7.4.4, 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. There shall be no loss of electrical continuity of any of the contact circuits of more than 1 microsecond during test. Connectors shall meet the requirements of 3.6.1 and 3.7.1.

3.9 Conformal coating/solder mask.

3.9.1 Coverage. Printed-wiring electrical backplanes shall be coated. The coating shall be applied to all areas specified in the assembly master drawing. Conformal coating shall be in accordance with MIL-I-46058 and 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.

3.9.2 Thickness. Unless otherwise specified on the assembly drawing, the conformal coating thickness for Type ER, UR, and AR shall be .003 ± .002 inch (.080 ± .050 mm); SR shall be .005 ± .003 inch (.13 ± .08 mm); and XY shall be .0005 to .002 inch (.01 ± .05 mm) when measured on a flat unencumbered surface.

3.9.3 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.

3.10 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.

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

3.11.1 Resistivity of solvent extract. When uncoated backplanes are tested as specified in 4.7.5, the resistivity shall not be less than 2,000,000 ohm-centimeters.

3.12 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 supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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 supplier. The establishment and maintenance of calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662.

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

a. Materials inspection (see 4.3).

b. Suppliers certification inspection (see 4.5).

c. Quality conformance inspection (see 4.6).

4.3 Materials inspection. Materials inspections shall consist of certification 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	3.4.3	MIL-P-55110
Compliant components	3.4.1	MIL-C-28859
Housings	3.4.2	MIL-C-28859
Keying pegs	3.4.2	MIL-C-28754/39
Coatings	3.4.4	
Solder mask		IPC-SM-840, Class 3
Conformal		MIL-I-46058
Marking ink	3.4.5	MIL-I-43553

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-1344.

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

4.5.1 Sample size. The supplier shall assemble five certification inspection samples for each type (see 1.2) and base material of printed-wiring electrical backplane assembly for which certification is desired. The certification inspection sample shall conform to the requirements of figure 4 for double sided backplanes (type 2) and figure 5 for multilayer backplanes (Type 3). Each sample shall contain the qualified component parts 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 supplier. One hundred (100) spare compliant component pins, MIL-C-28859/1, and six housings, MIL-C-28859/2, shall be supplied with the certification inspection sample. Three certification inspection samples shall be tested at a laboratory acceptable to the government, and two shall be filed and retained as reference samples by the supplier. The laboratory 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 examinations and tests specified in Table IV in the sequence shown. Certification 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 certification approval. Failure criteria for specimens shall be as specified in the applicable requirement paragraph.

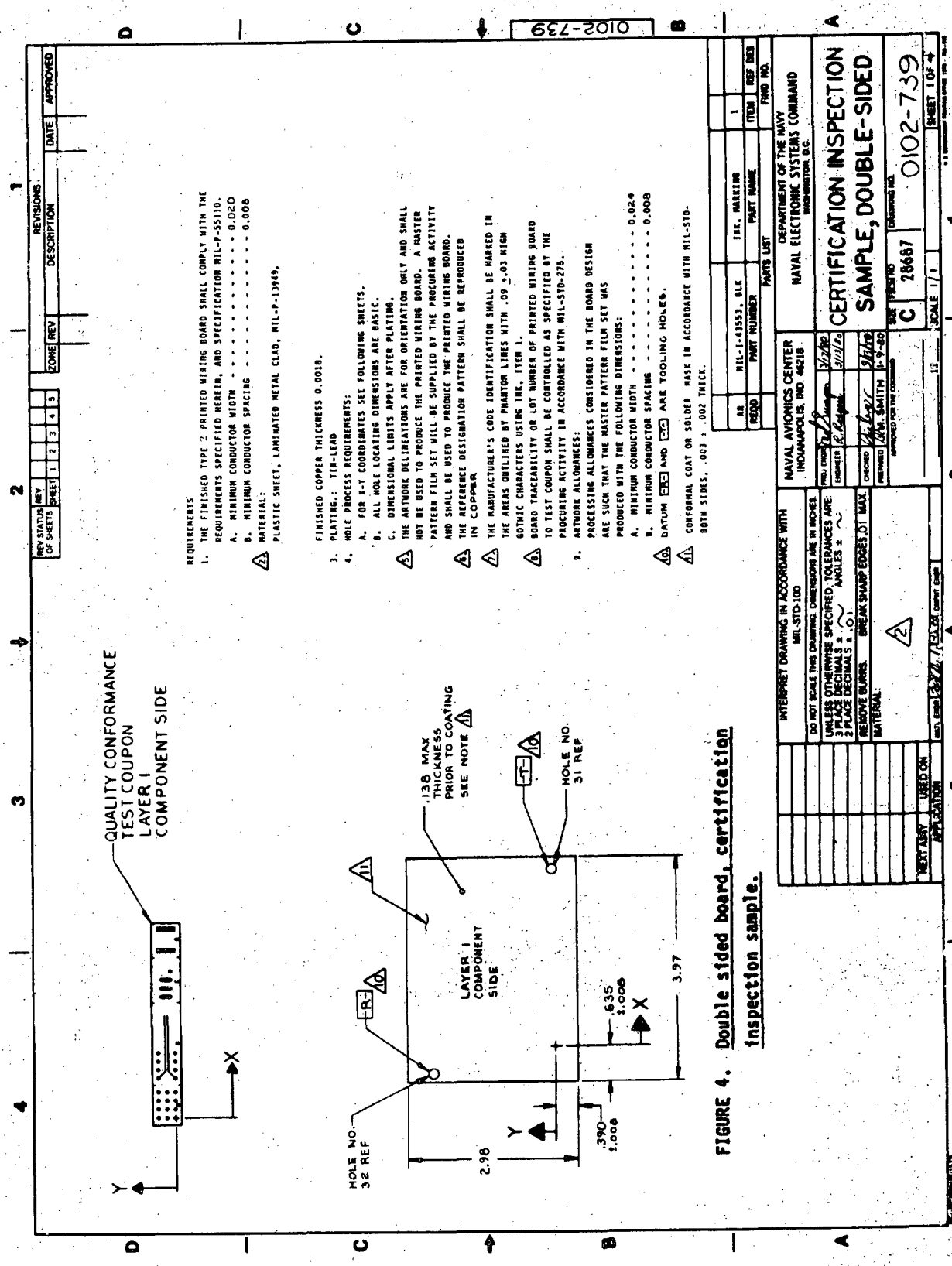

FIGURE 4. Double sided board, certification inspection sample.

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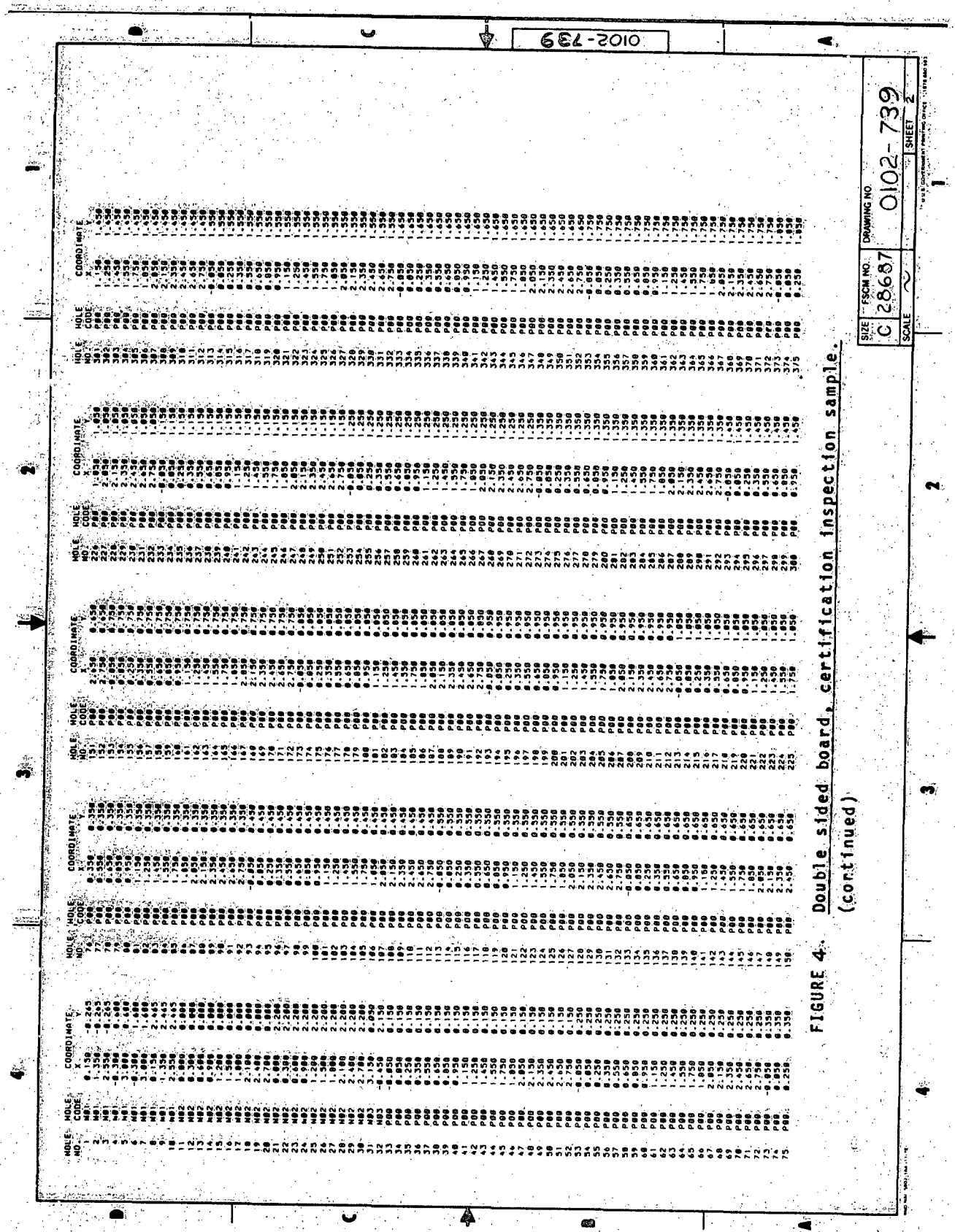

FIGURE 4. Double sided board, certification inspection sample. (continued)

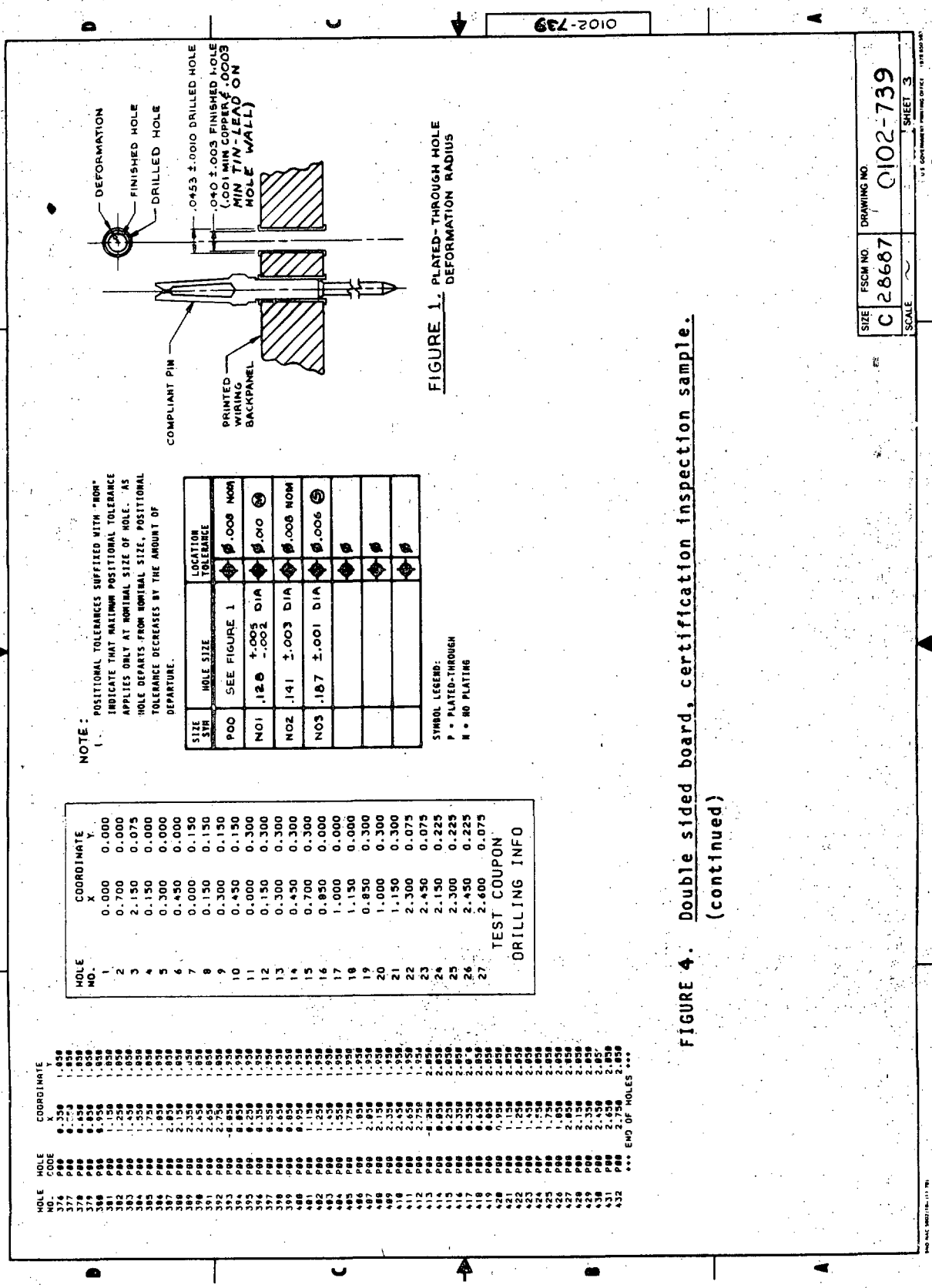

FIGURE 4. Double sided board, certification inspection sample. (continued)

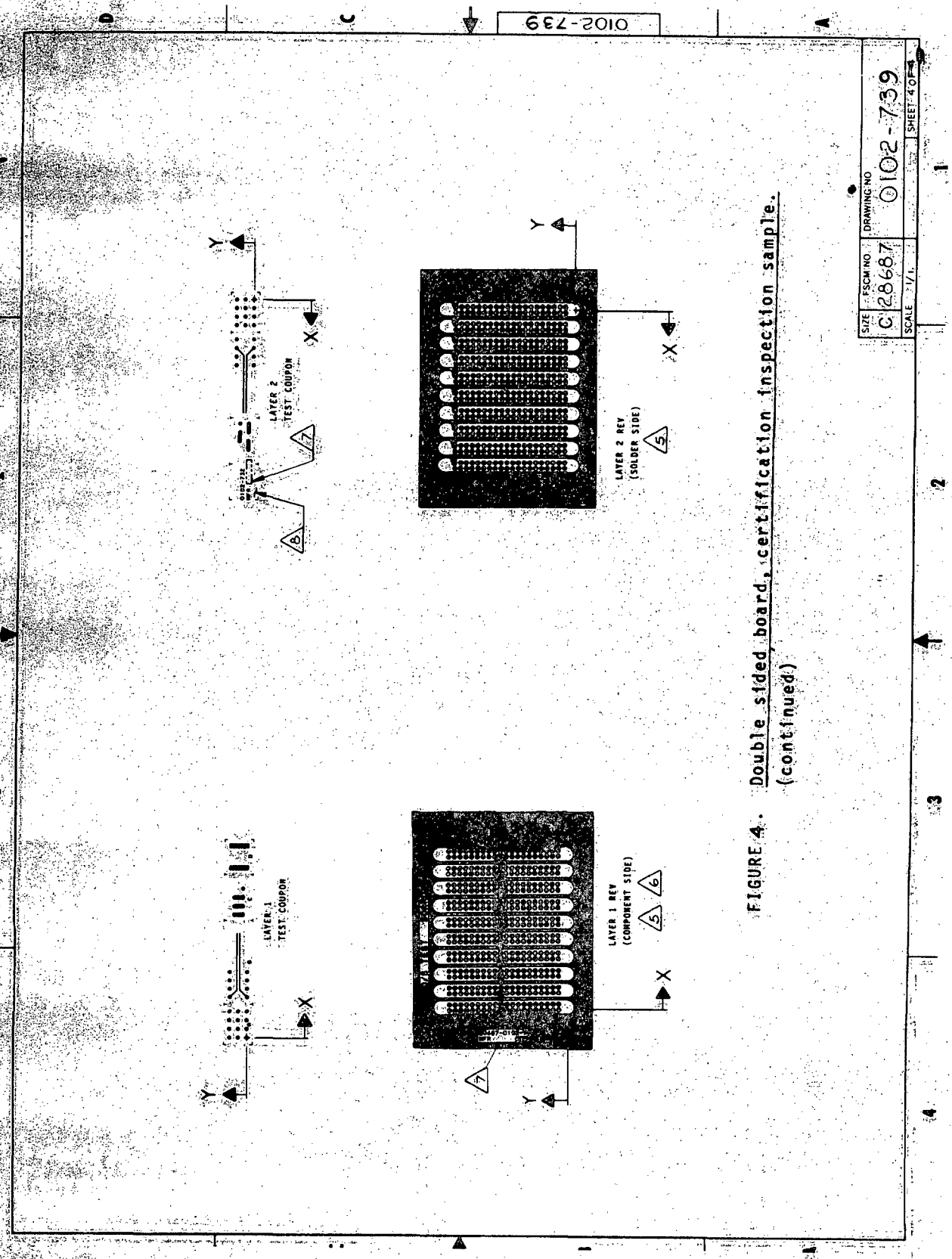

FIGURE 4. Double sided board, certification inspection sample. (continued)

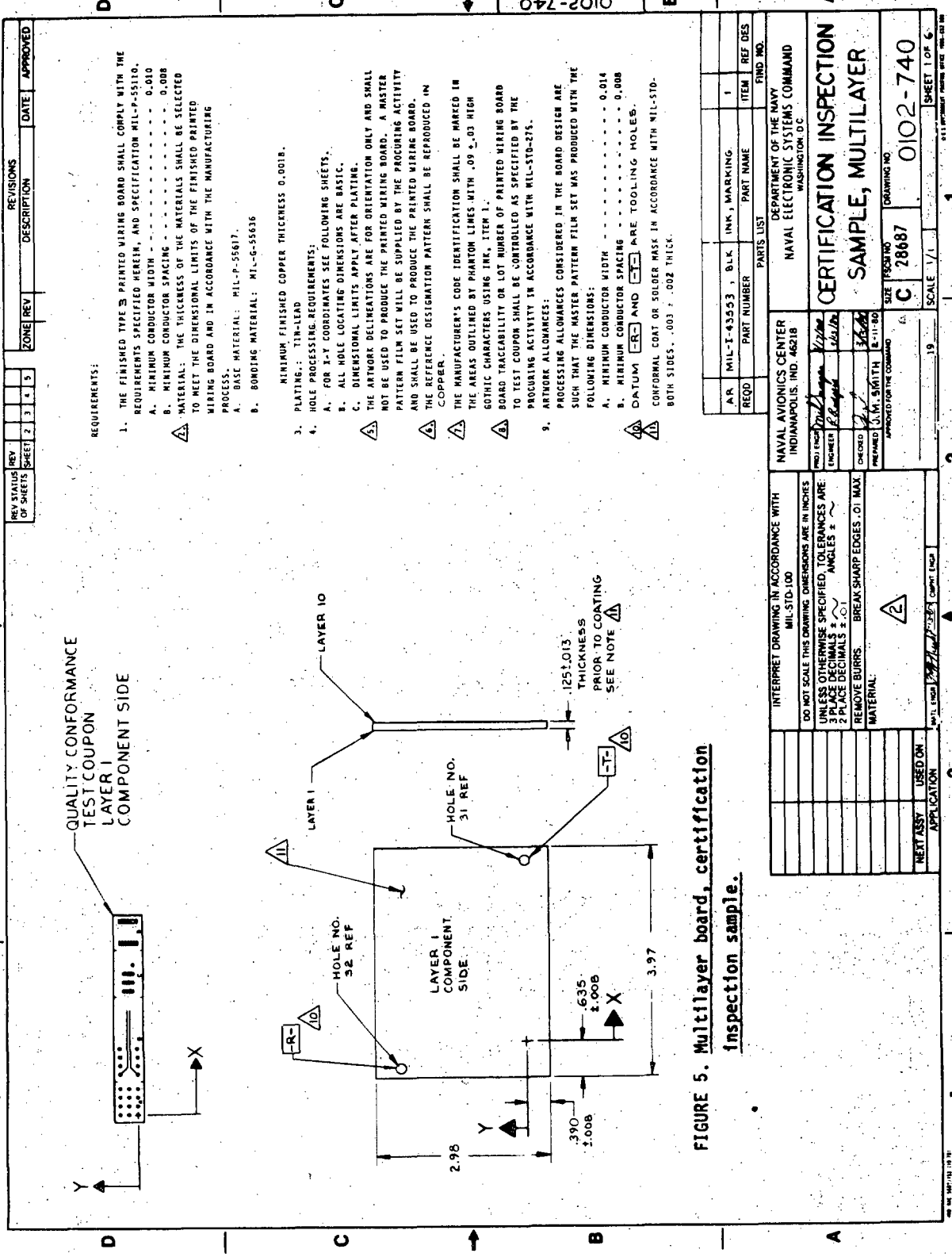

FIGURE 5. Multilayer board, certification inspection sample.

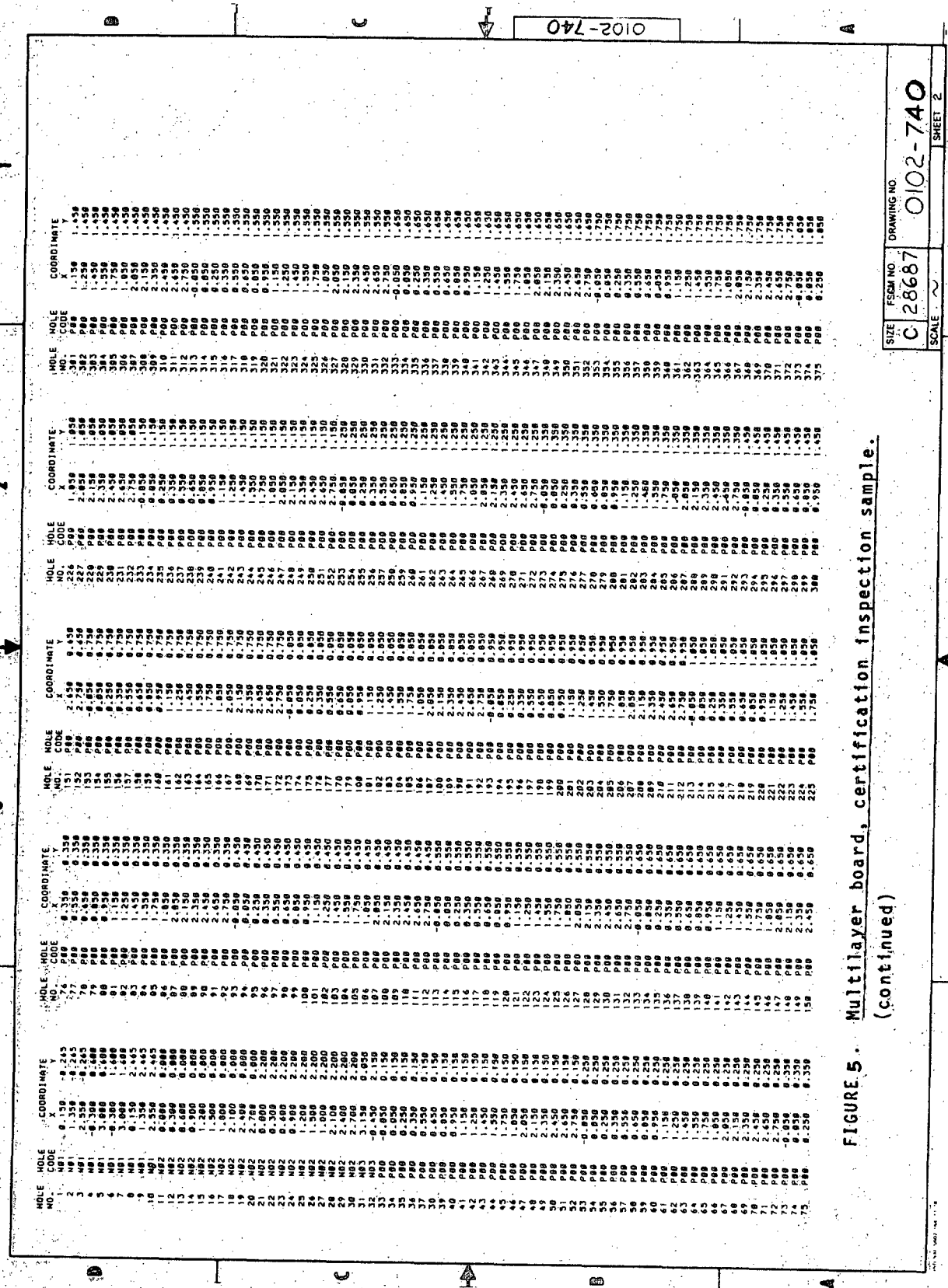

FIGURE 5. Multilayer board, certification inspection sample. (continued)

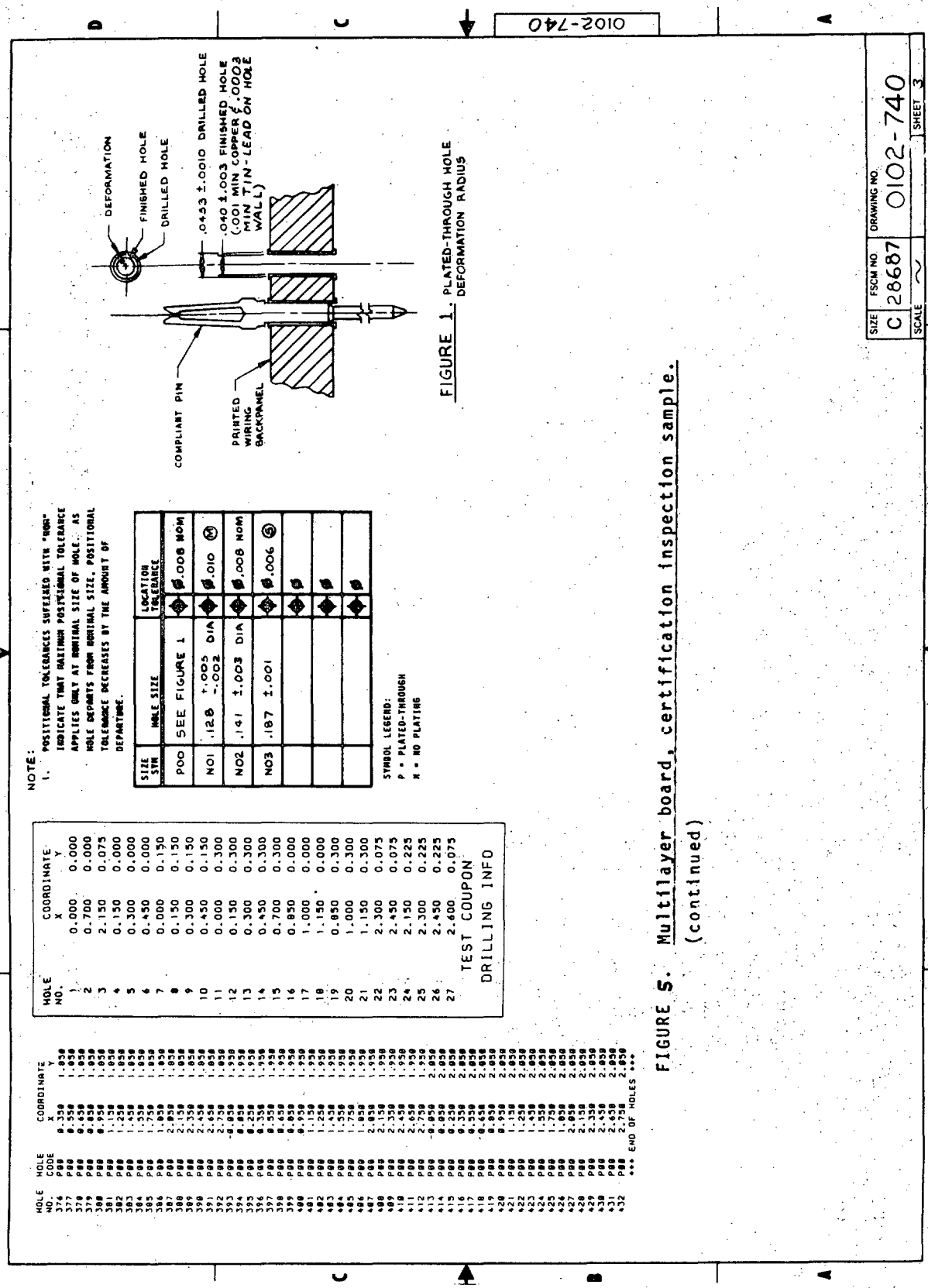

FIGURE 1. PLATED-THROUGH HOLE DEFORMATION RADIUS

FIGURE 5. Multilayer board, certification inspection sample. (continued)

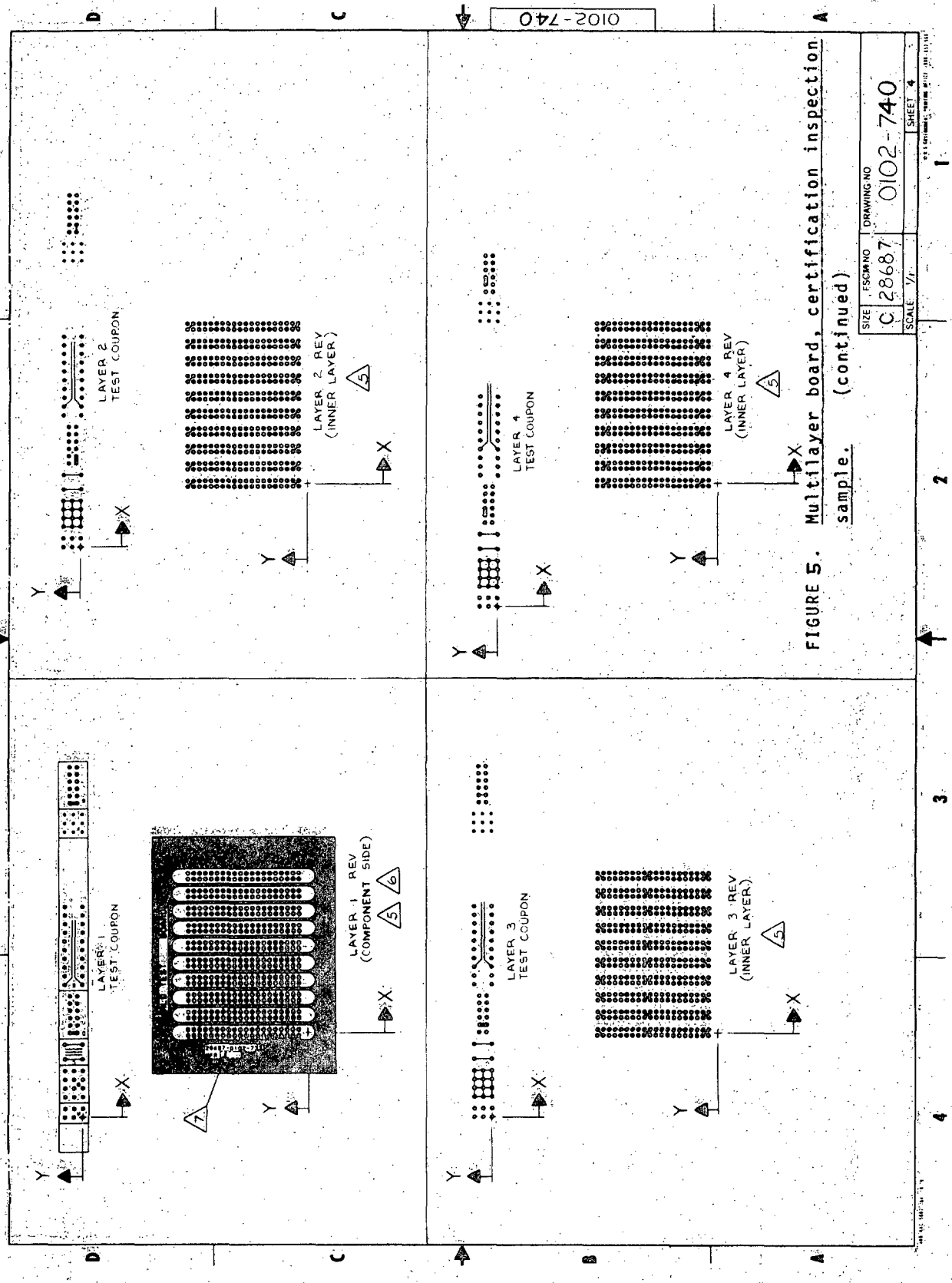

FIGURE 5. Multilayer board, certification inspection sample. (continued)

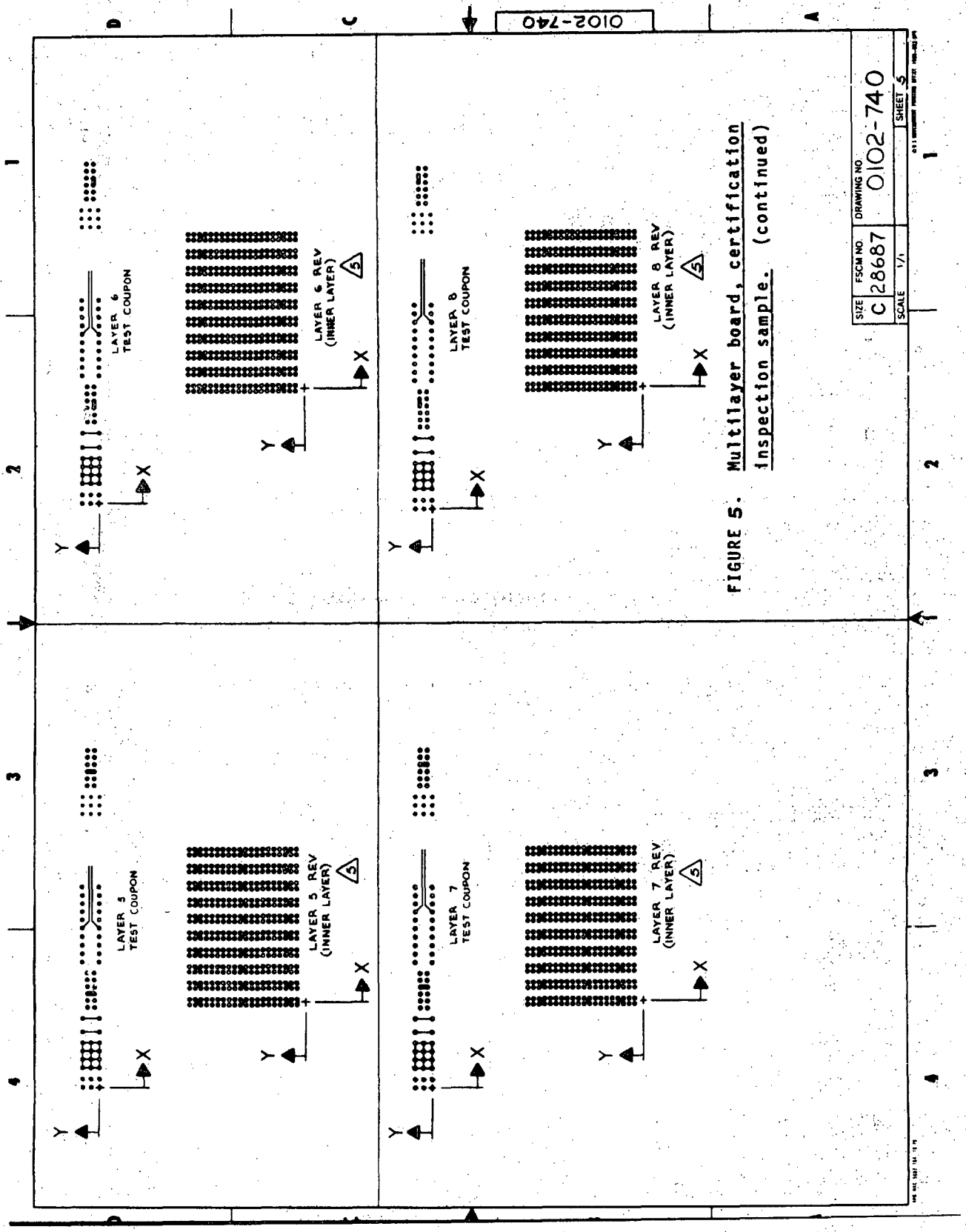

FIGURE 5. Multilayer board, certification inspection sample. (continued)

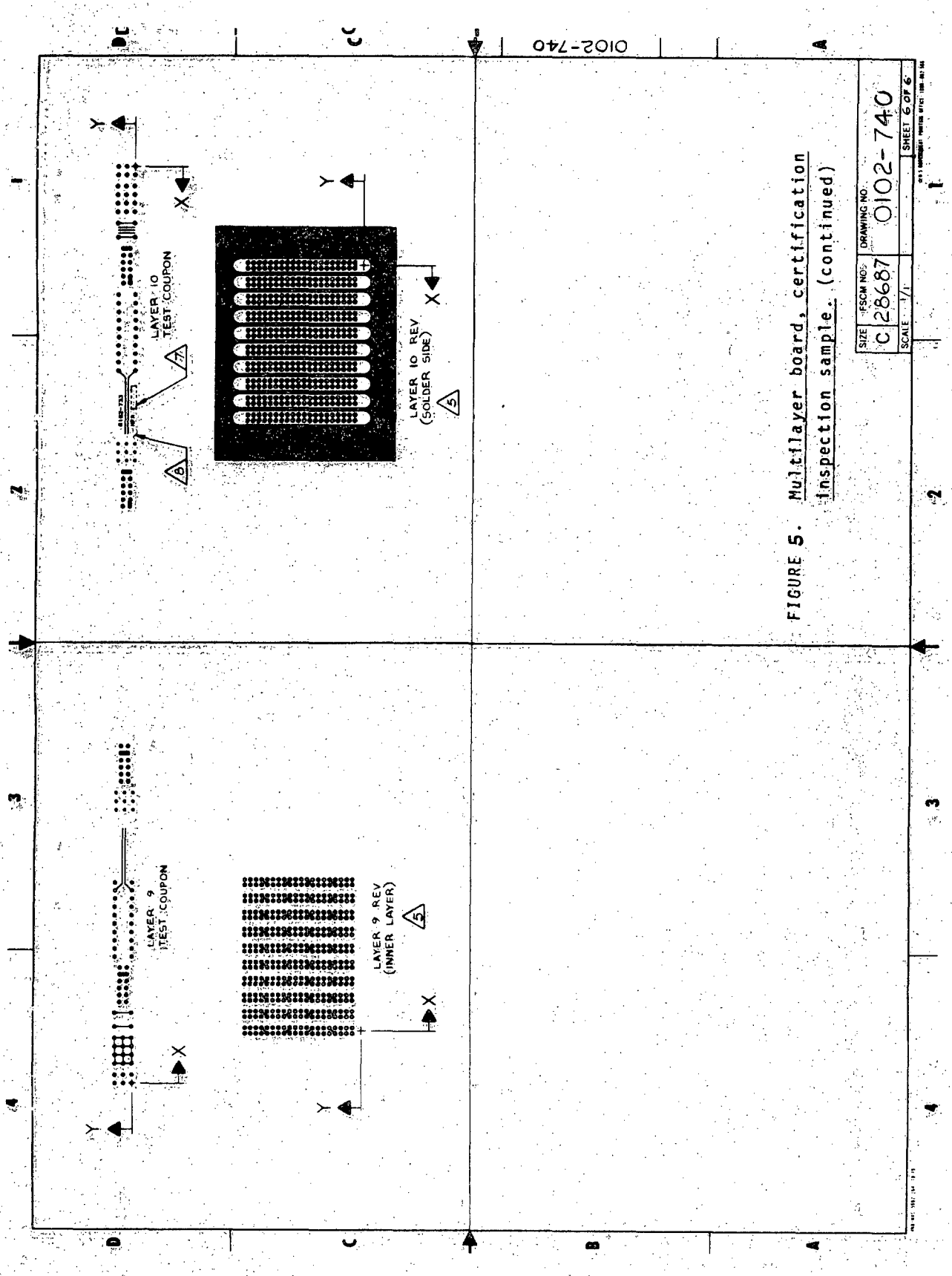

FIGURE 5. Multilayer board, certification inspection sample. (continued)

TABLE IV. Supplier Certification Inspection

Examination or test	Requirement paragraph	Method paragraph	Number of samples to be inspected	Number defects allowed	Measurements per Sample		
					Sample		
					1	2	3
Subgroup I							
Design and construction	3.1, 3.4, 3.5, 3.9, 3.10, 3.11	4.7.1 4.7.3.6			1/	1/	1/
Pwb to component resistance	3.7.1	4.7.2.1			20	20	20
Dielectric withstanding voltage	3.7.3	4.7.2.3			1/	1/	1/
Insulation resistance	3.7.2	4.7.2.2	3	0	1/	1/	1/
Engaging and separating forces	3.6.5	4.7.3.7			1/	1/	1/
Compliant component retention	3.6.1	4.7.3.1			10	10	10
Housing retention	3.6.3	4.7.3.3			2	2	2
Keying peg retention	3.6.4	4.7.3.4			2	2	2
Compliant component torque (wrappost)	3.6.1.3	4.7.3.2			5	5	5
Subgroup II							
Life	3.8.2	4.7.4.5			1/		
Pwb to component resistance	3.7.1	4.7.2.1	1	0	20		
Compliant component retention	3.6.1	4.7.3.1	1	0	10		
Subgroup III							
Thermal shock	3.8.1	4.7.4.1				1/	
Pwb to component resistance	3.7.1	4.7.2.1				20	
Temperature altitude	3.8.3	4.7.4.2				1/	
Insulation resistance	3.7.2	4.7.2.2	1	0		1/	
Dielectric withstanding voltage	3.7.3	4.7.2.3				1/	
Compliant component retention	3.6.1	4.7.3.1				2/	
Plated-through hole integrity	3.6.2	4.7.3.5				2/ 3/	

Table IV. Supplier Certification Inspection - (Continued)

Examination or test	Requirement paragraph	Method paragraph	Number of samples to be inspected	Number defects allowed	Measurements per Sample		
					Sample		
					1	2	3
Subgroup IV							
Vibration	3.8.4	4.7.4.3					1/
Compliant component retention	3.6.1	4.7.3.1					10
Pwb to component resistance	3.7.1	4.7.2.1					20
Shock (specified pulse)	3.8.5	4.7.4.4	1	0			1/
Compliant component retention	3.6.1	4.7.3.1					2/
Pwb to component resistance	3.7.1	4.7.2.1					20
Plated-through hole integrity	3.6.2	4.7.3.5					2/ 3/

1/ Per test method paragraph
2/ Type 2, 10 measurements; Type 3, 20 measurements
3/ 10 horizontal and 10 vertical microsections for Type 3

4.5.4 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 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.

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 certification.

d. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the procuring activity and to the cognizant certification organization has not been taken, action shall be taken to remove certification. In addition to the periodic submission of inspection data, the supplier shall immediately notify the cognizant certifying 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 certification organization taken. In the event that no production occurred during the reporting interval, the supplier shall be required to recertify (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.

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 supplier 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 of Table V with the sampling increased to five production backplanes or quality conformance test coupons.

TABLE V. In-process inspection.

Test	Requirement paragraph	Method paragraph
Cleanliness and resistivity of solvent extract	3.11 and 3.11.1	4.7.5

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 of product for delivery. Inspection of product for delivery shall consist of groups A and B inspection.

4.6.1.1 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.

4.6.1.2 Group A inspection. Group A inspection shall consist of the examinations specified in Table VI.

4.6.1.2.1 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 and minor defects shall be as defined in MIL-STD-105.

4.6.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier 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.

TABLE VI. Group A Inspection.

Examination or Test	Requirement Paragraph	Method Paragraph	Inspection Level	AQL (percent defective)		Sample Deliverable Backplane	Coupon	Measurement Per Sample
				Major	Minor			
Design and construction	3.1, 3.4, 3.5, 3.9, 3.10, 3.11	4.7.1, 4.7.3.6	II	0.10	0.15	X		2/
Continuity and shorts (when specified)	3.7.4	4.7.2.4	100%					
Insulation resistance	3.7.2	4.7.2.2	II	0.10	0.15	X		2/
Engaging and separating			100%	5/	5/	X		10
Housing retention	3.6.2	4.7.3.3	2/	0.10	0.15		X	3
Keying peg retention	3.6.4	4.7.3.4	1/	0.10	0.15		X	6
Compliant component retention, Min	3.6.1	4.7.3.1	100%	1/	1/	X 4/		5 6/
Compliant component retention, Max	3.6.1	4.7.3.1	1/	1/	1/		X 4/	5
Plated-through hole integrity	3.6.2	4.7.3.5	1/	1/	1/		X	3/ 7/

1/ 1 Coupon per panel.
2/ Per test method paragraph.
3/ Minimum of 5 holes horizontal per microsection and 5 holes vertical.
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/ Microsection in any one direction 100 percent of the time and per pendicular to that direction using a sampling plan based on MIL-STD-105 general inspection level II with an AQL of 2.5 percent defective.

4.6.1.2.3 Disposition of backplanes. Backplanes which have passed group A inspection may be delivered on the contract or purchase order, and need not be delayed pending the results of group B inspection.

4.6.1.3 Group B inspection. Group B inspection shall consist of the examination and tests specified in Table VII, in the order shown.

4.6.1.3.1 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.

4.6.1.3.2 Rejected lots. If the coupons from an inspection lot fail 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 corrective action has been taken, group B inspection shall be repeated on additional coupons. Group A inspection may be reinstituted; 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.

4.6.2 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 6.3).

4.7 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, 3.4, 3.5, 3.9, 3.10 and 3.11).

4.7.2 Electrical testing.

4.7.2.1 Printed-wiring backplane to compliant component resistance (see 3.7.1). The test sample shall conform to the requirements of 3.7.1 when tested as shown in figure 6 or 7. The following details shall apply:

a. Method of connection: See figures 6 and 7.

b. Test current: Three amperes.

c. Twenty contacts per sample shall be tested.

4.7.2.2 Insulation resistance (see 3.7.2). Printed-wiring electrical backplane assemblies shall be tested in accordance with method 3003.1 of MIL-STD-1344. The following details and exceptions shall apply:

a. Test voltage: 100 v. HS direct current (dc) ± 5 percent.

b. Test points: Between adjacent electrically isolated circuit paths.

c. Insulation resistance: See Table II.

4.7.2.3 Dielectric withstanding voltage (see 3.7.3). Compliant components and housings shall be tested in accordance with method 3001.1 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.

TABLE VII. Group B inspection.

Examination or test	Requirement paragraph	Method paragraph	No. of samples to be inspected	Measurements per sample
Thermal shock	3.8.1	4.7.4.1	1	1/
Pwb to component resistance	3.7.1	4.7.2.1		20
Temperature altitude	3.8.3	4.7.4.2		1/
Insulation resistance	3.7.2	4.7.2.2		1/
Dielectric withstanding voltage	3.7.3	4.7.2.3		1/
Compliant component retention	3.6.1	4.7.3.1		2/
Plated-through hole integrity	3.6.2	4.7.3.5		2/ 3/
Vibration	3.8.4	4.7.4.3	1	1/
Compliant component retention	3.6.1.1	4.7.3.1		2/
Pwb to component resistance	3.7.1	4.7.2.1		20
Shock	3.8.5	4.7.4.4		1/
Compliant component retention	3.6.1.1	4.7.3.1		2/
Pwb to component resistance	3.7.1	4.7.2.1		20
Plated-through hole integrity	3.6.2	4.7.3.5		2/ 3/

1/ Per test paragraph
2/ Type 2, 10 measurements; type 3, 20 measurements
3/ 10 horizontal and 10 vertical microsections for type 3

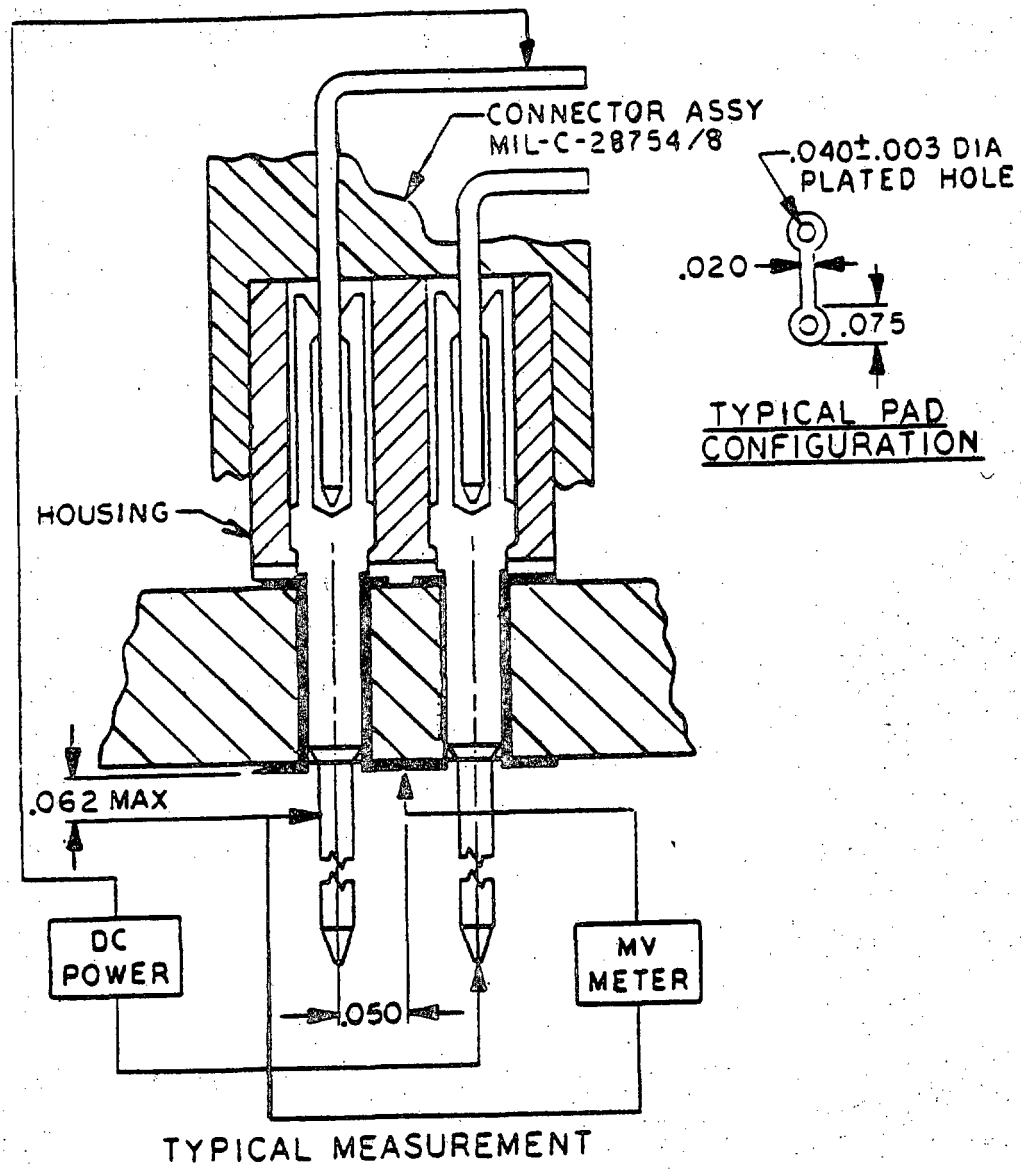

FIGURE 6. Contact to plated-through hole resistance (double sided boards).

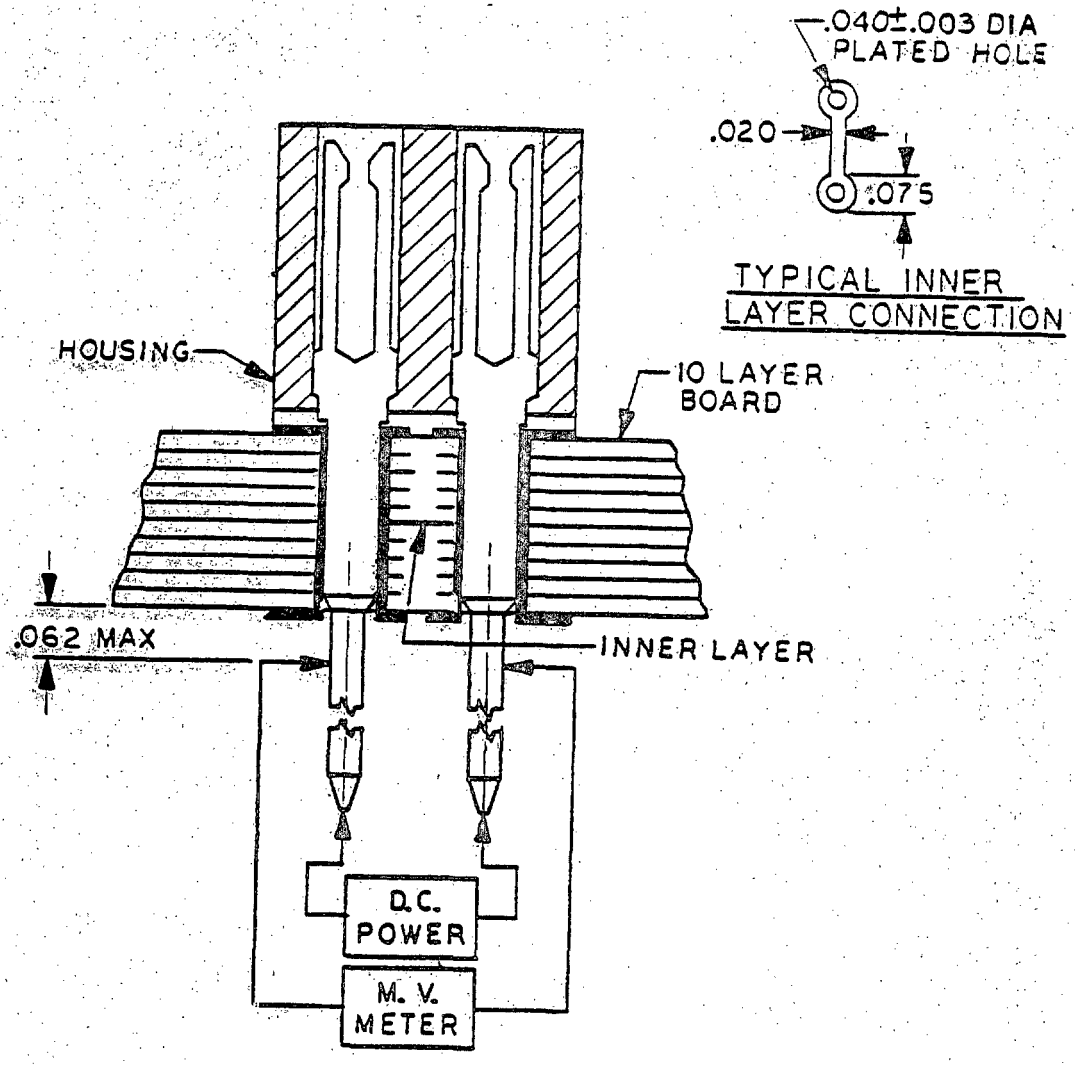

FIGURE 7. Contact to inner layer-resistance (multilayer boards).

4.7.2.4 Circuitry (see 3.7.4).

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 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 (see 3.6.1.1). Compliant components shall be tested in accordance with method 2007.1 of MIL-STD-1344. After initial insertion, a minimum of seven and one-half pounds (33.36 Newton) and a maximum of forty-five pounds (200.17 Newton) 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 3.6.1.2 following the insertion of the third virgin compliant component.

4.7.3.2 Compliant component torque (see 3.6.1.3). Compliant components shall be tested in accordance with method 211 of MIL-STD-202, test condition E. Three inch-ounces (0.02119 Newton-Meter) of torque shall be applied to the compliant component tail.

4.7.3.3 Housing retention force (see 3.6.3). The capability of the housing to be retained by the compliant pin components shall be measured in a test set-up similiar to that shown in figure 8. The load required to remove the housing shall be as specified on the applicable specification sheet.

4.7.3.4 Keying peg retention (see 3.6.4). Keying peg retention shall be established by applying a load of 5 pounds (22.24 Newton) 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.

4.7.3.5 Plated-through hole integrity (see 3.6.2). After hole conditioning as specified in 4.7.3.1.1, compliant pins contained in plated-through holes shall be microsectioned as specified herein to determine conformance to paragraph 3.6.2.

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 3.6.2. 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 boards. Ten plated-through holes containing compliant pins 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 3.6.2. 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 pin and printed-wiring laminate.

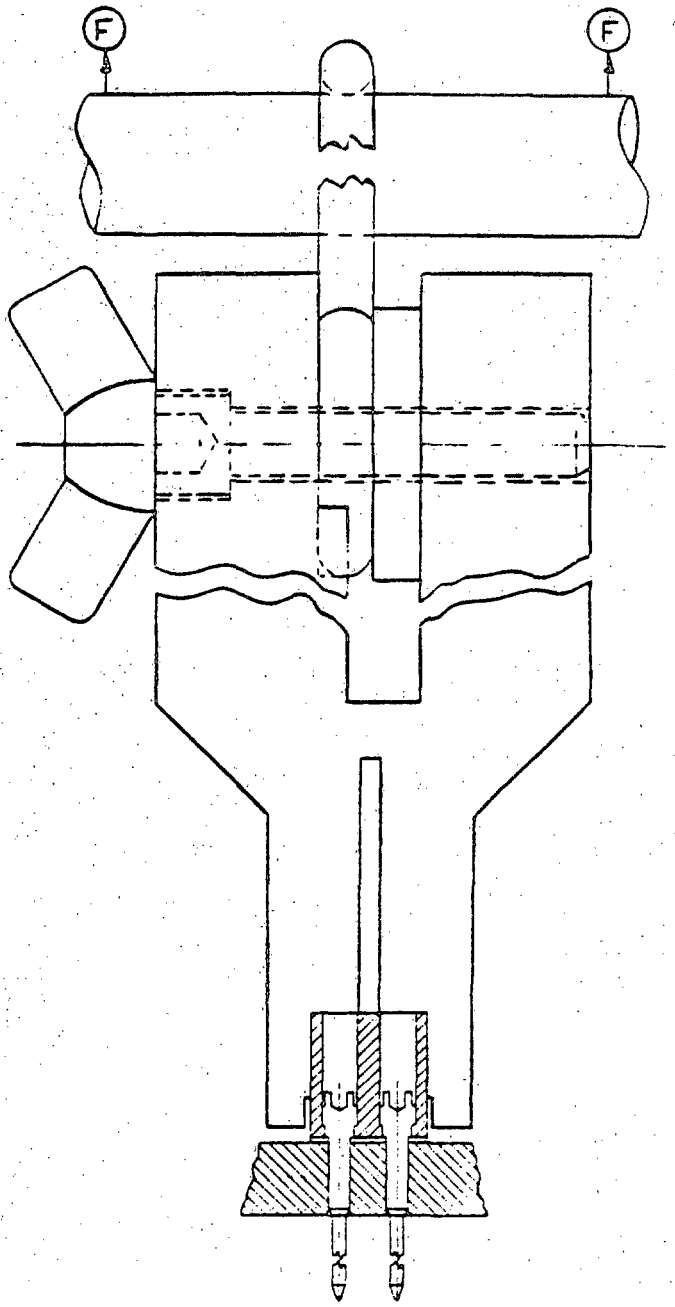

FIGURE 8. Test set-up for housing retention force.

4.7.3.6 Bow and twist. The printed-wiring backplane assembly shall be placed unrestrained on a flat horizontal surface with the convex surface of the assembly upward. The maximum vertical displacement (the vertical distance from the horizontal surface 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 horizontal surface and the highest corner and dividing this measurement by the length of the longest side.

4.7.3.7 Engaging and separation force. Compliant pins shall be tested in accordance with method 2014 of MIL-STD-1344. The engaging and separation forces shall be determined using the test blade specified in MIL-C-28859. The maximum engaging force shall be 10 ounces, the minimum separation force shall be 2 ounces.

4.7.4 Environments.

4.7.4.1 Thermal shock (see 3.8.1). Printed-wiring backplane electrical assemblies shall be tested in accordance with method 107 of MIL-STD-202, test condition B. The following details and exceptions shall apply:

a. Following testing, assemblies shall meet the requirements of 3.7.1.

4.7.4.2 Temperature-altitude testing (see 3.8.3). Printed-wiring electrical backplane assemblies shall be tested in accordance with method 504.1, category 6, steps 1B, 3, 6, and 13 of MIL-STD-810. The following details and exceptions shall apply:

a. Step 3: Thirty minutes. Test potential of ± 30 volts dc applied between all adjacent contacts.

b. Step 6: During the last 1/2 hour of step 6, a test potential of ± 30 volts dc shall be applied between all adjacent contacts.

c. Step 13: Temperature shall be 60° C.

d. Following testing, assemblies shall meet the requirements of 3.7.2 and 3.7.3.

4.7.4.3 Vibration testing (see 3.8.4). Printed-wiring backplane electrical assemblies shall be tested in accordance with methods 204 and 214 of MIL-STD-202. 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 (1.0 microsecond discontinuity maximum).

b. Random test condition: I (test condition letter E).

c. Duration of random vibration: 30 minutes each axis.

d. Sinusoidal test condition: Test condition G.

e. Duration of sinusoidal vibration: 3 cycles each axis.

f. Following testing, assemblies shall meet the requirements of 3.6.1 and 3.7.1.

4.7.4.4 Shock testing (see 3.8.5). Printed-wiring backplane electrical assemblies shall be tested in accordance with method 213 of MIL-STD-202. 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 (1.0 microsecond discontinuity maximum).

b. Test condition: I

c. Following testing, assemblies shall meet the requirements of 3.6.1, 3.6.2 and 3.7.1.

4.7.4.5 Life (see 3.8.2). Printed-wiring backplane electrical assemblies shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition: 125 ± 3° C.

b. Test time condition: D.

c. Following testing, assemblies shall meet the requirements of 3.6.1 and 3.7.1.

4.7.5 Cleanliness and resistivity of solvent extract (see 3.11 and 3.11.1). The cleanliness and resistivity of solvent extract test and the approved alternate testing 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. Also, see 6.4.

6. NOTES

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 Contact insertion and removal tool. When applicable, a tool or tools will be provided with qualification samples to insert and remove the contacts (see 3.1).

6.3 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification.

b. Title, revision letter, and drawing number of the applicable assembly drawing for the printed-wiring electrical backplane.

c. Tools (as required).

(1) Insertion and removal tools.

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

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

6.5 Supplier certification inspection. Contracts and awards will be made only for backplanes fabricated by a supplier who, prior to the time set for opening bids, has passed the certification inspection test (see Table IV), and has 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 of MIL-P-55110.

6.5.1 The cognizant certification organization is the Naval Electronic Systems Command, ATTN: ELEX 8111, Washington, D.C. 20360. Information pertaining to certification may be obtained from the above address.

Review activities:
Navy - OS, SH
DLA - ES

User activities:
Navy - AS, MC, CG

Preparing activity:
Navy - EC

(Project 5999-N070)

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a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

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