

INCH-POUND

MIL-C-28859B

19 JANUARY 1990  
SUPERSEDING  
MIL-C-28859A(EC)  
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MILITARY SPECIFICATION  
CONNECTOR COMPONENT PARTS, 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 connector component parts using a compliant feature.

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-55Z3, 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 5935

DISTRIBUTION STATEMENT A

Approved for public release; distribution is unlimited.

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## 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

## FEDERAL

- QQ-P-35 - Passivation Treatments for Corrosion-Resistant Steel.
- QQ-N-290 Nickel Plating (Electrodeposited).
- QQ-P-730 Bronze Phosphor Bronze Plating, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections

## MILITARY

- MIL-P-13949 - Plastic Sheet, Laminated, Metal Clad (For Printed Wiring Boards), General Specification for
- MIL-M-24519 - Molding Plastics, Electrical, Thermoplastic.
- MIL-C-28754 - Connectors, Electrical, Modular, and Component Parts, General Specification For.
- MIL-C-28859/1 - Connector Component Parts, Electrical Backplane, Printed Wiring Compliant Pin
- MIL C-28859/5 - Connector Component Parts, Electrical Backplane, Printed Wiring, Low Insertion Force (LIF), Compliant Contact
- MIL-I-43553 - Ink, Marking, Epoxy Base
- MIL-G-45204 - Gold Plating, Electrodeposited.
- MIL-I-46058 - Insulating Compound, Electrical (For Coating Printed Circuit Assemblies)
- MIL-P-55110 - Printed wiring Boards, General Specification for.
- MIL-C-55330 - Connectors, Electrical and Fiber Optic, Packaging of.
- MIL-P-81728 - Plating, Tin-Lead (Electrodeposited).

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## STANDARDS

## MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
- MIL-STD-1285 - Marking of Electrical and Electronic Parts.
- MIL-STD-1344 - Test Methods for Electrical Connectors.
- MIL-STD-45662 - Calibration Systems Requirements.

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

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are 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)

- B 46.1 - Surface Texture (Surface Roughness, Waviness, and Lay).

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

## AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

- A 681 - Standard Specification for Tool Steels Alloy
- B 122 - Standard Specification for Copper-Nickel-Tin Alloy Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar.
- B 194 - Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

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(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

### THE 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 N. Lincoln Avenue, 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 informational 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.

## 3. REQUIREMENTS

3.1 Specification sheets The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Connector component parts furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.5 and 6.3).

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3.3 Materials. The material for each part shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the connector component part to conform to the performance requirements. Acceptance of approval of any constituent material shall not be construed as a guarantee of the acceptance of the furnished product.

3.3.1 Compliant component material. The compliant components shall be made from the following material:

- (a) Compliant contact: Beryllium copper sheet in accordance with ASTM B194, UNS number C17200, with a minimum hardness of 50 on the Rockwell 30N scale. The compliant contact shall have a minimum Knoop microhardness of 310.
- (b) Feed-to and Feed-through: Either copper alloy sheet, UNS number C72500, temper H08, in accordance with ASTM B122, or beryllium copper in accordance with ASTM B194, UNS number C17200, minimum Knoop hardness of 310, or phosphor bronze alloy per QQ-B-750, composition A, half hard minimum.

3.3.1.1 Compliant component finish. The compliant components shall be finished with gold plate in accordance with MIL-G-45204, type II, grade C, class 1, to a thickness of 50 microinch minimum over nickel plating in accordance with QQ-N-290, class 1, to a thickness of 50 microinch minimum. Exposed base material is permitted in noncritical break off or plating carrier areas of the connector parts, providing all performance requirements are maintained with no degradation of critical areas (see 3.1).

3.3.1.2 Localized compliant component finish. To reduce the quantity of gold required for protection, when specified (see 6.2), the compliant component shall be provided a localized finish which consists of 50 microinch minimum nickel finish per QQ-N-290, class 1, all over, 50 microinch minimum gold per MIL-G-45204, type II, grade C, class 1 on the tines contact area, and 0.0001 to 0.0003 inch tin-lead finish per MIL-P-81728, 50-95 percent tin composition on the wrappost tail.

3.3.2 Housing material. The housing material shall be polyester thermoplastic in accordance with MIL-M-24519, type GPT-30F, color black.

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### 3.4 Design requirements.

3.4.1 Compliant components. The compliant components shall be designed in accordance with the applicable specification sheet and other requirements herein.

3.4.1.1 Compliant feature. The design of the compliant feature shall be the responsibility of the individual manufacturer. No portion of the compliant feature shall protrude above the top surface of the backplane.

3.4.1.2 Removal. The compliant tuning fork component shall be capable of being individually removed from the backplane without removing the housing.

3.4.2 Housing. The housing shall be designed in accordance with the applicable specification sheet. The housing shall be designed to be removed and replaced without removing the compliant contact from the printed-wiring backplane.

### 3.5 Performance requirements.

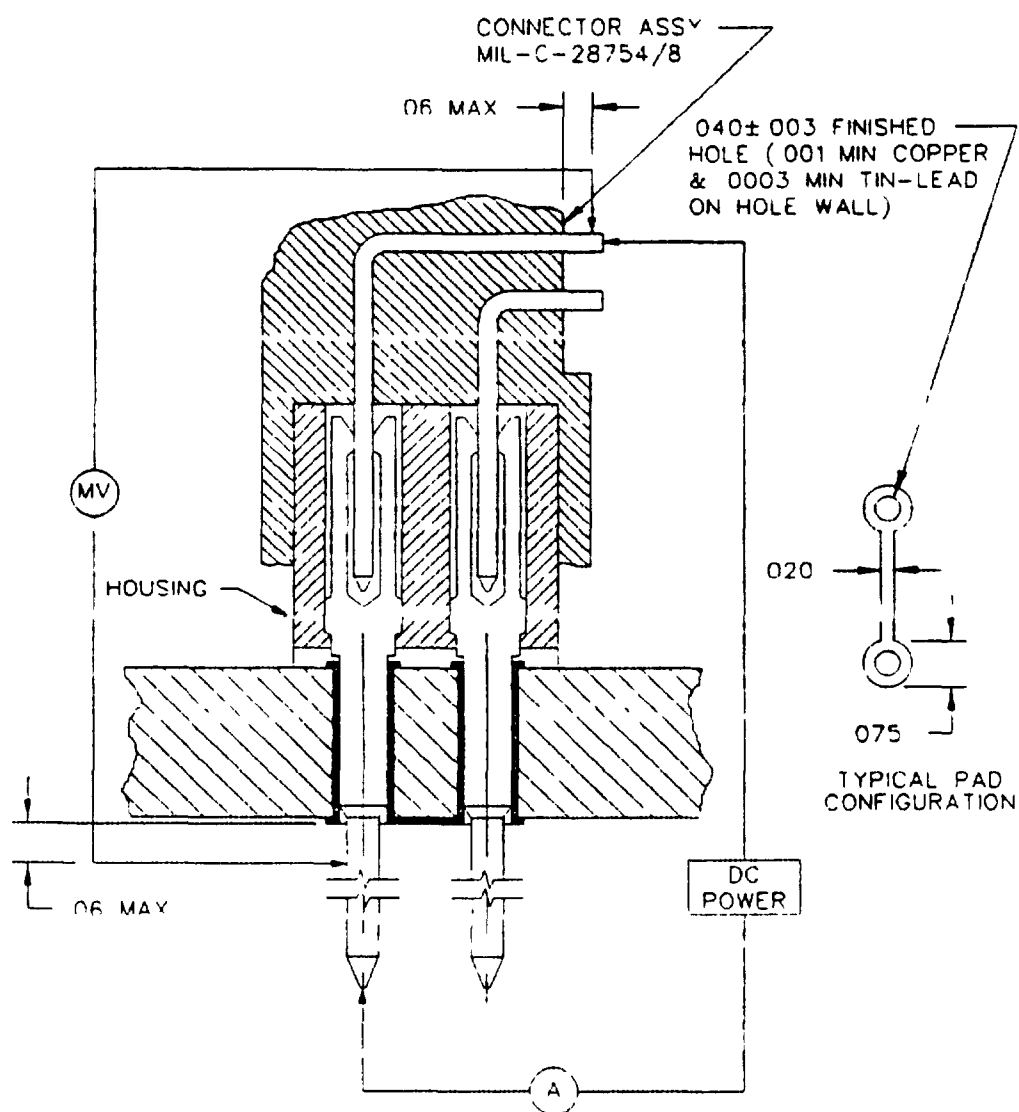
#### 3.5.1 Electrical requirements.

3.5.1.1 Contact resistance When the contacts are tested as specified in 4.7.2.1 and figure 1, the voltage drop shall not exceed 20 millivolts (mV).

3.5.1.2 Contact to printed-wiring backplane resistance. When the contacts are tested as specified in 4.7.2.2 and the applicable figure, the voltage drop shall not exceed 6 mV for double sided boards (see figure 2), and 20 mV for multilayer boards (see figure 3).

3.5.1.3 Insulation resistance When connectors are tested as specified in 4.7.2.3, the insulation resistance shall be as specified in table 1.

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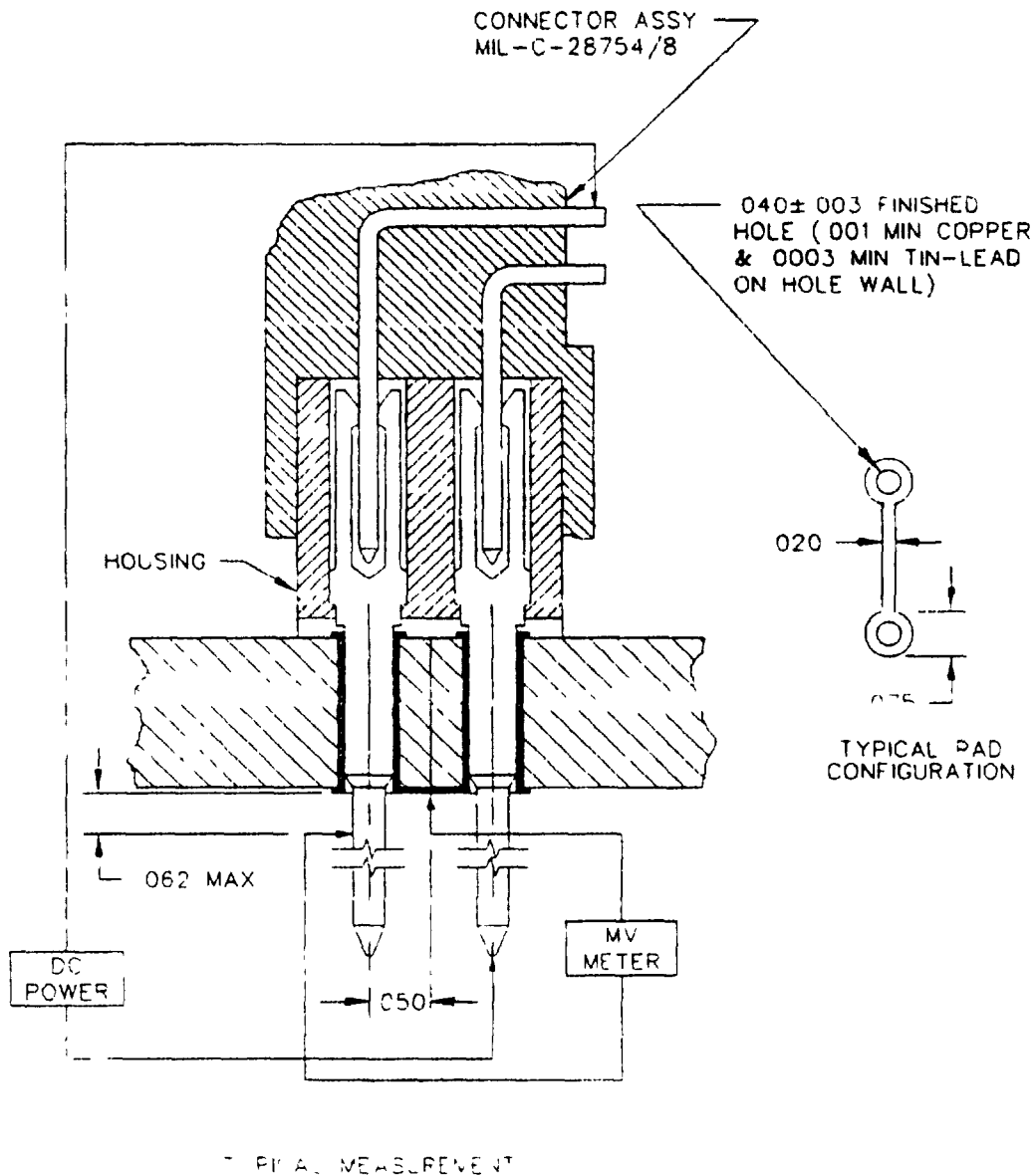


## NOTE:

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

FIGURE 1. Test setup for measuring mated contact resistance.

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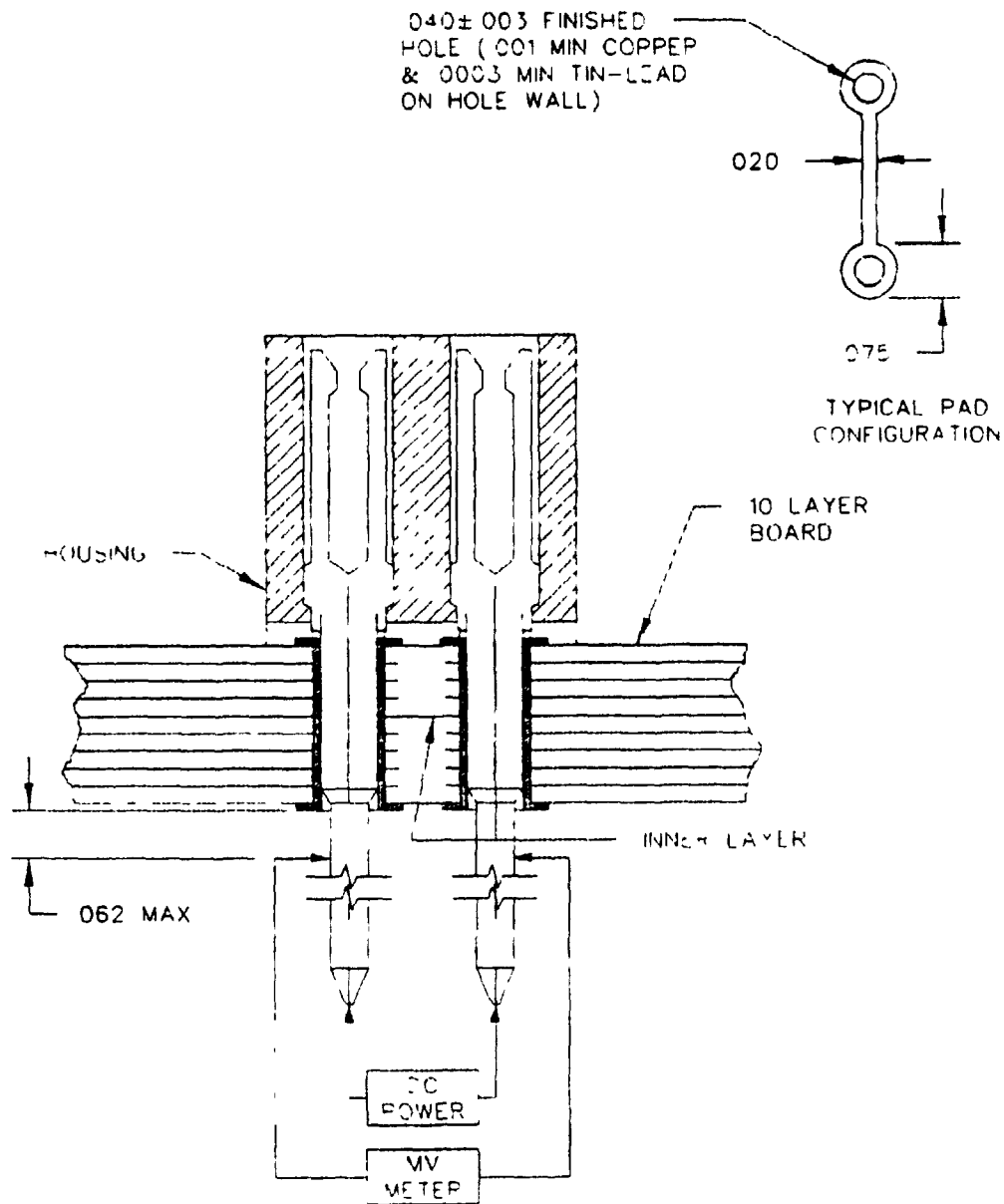
## NOTE.

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

FIGURE 2. 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 3. Contact to inner layer resistance (multilayer boards).

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3.5.1.4 Dielectric withstanding voltage. Unmated connector assemblies are tested as specified in 4.7.2.4. There shall be no evidence of arcing, breakdown, or damage.

3.5.1.5 Low signal level contact resistance. Connector assemblies tested as specified in 4.7.2.5 shall not exceed a voltage drop of 20 mV per mated contact pair. Contact positions monitored for low signal level contact resistance shall be deleted from any test circuit imposing a voltage in excess of 20 mV.

### 3.5.2 Mechanical requirements.

3.5.2.1 Standard insertion engaging and separating force. When tested as specified in 4.7.3.1, the force to engage the tuning fork shall be 6.0 ounces (1.66 newton) maximum, and the force to separate shall be 2.0 ounces (0.56 newtons) minimum.

3.5.2.2 Low insertion force (LIF) engaging and separating force. When tested as specified in 4.7.3.1, the average force to engage shall be 2.25 ounces (0.63 newton) maximum with random readings at 4.00 ounces (1.12 newtons) maximum. Separation force shall be 4.0 ounces (1.11 newtons) maximum.

3.5.2.3 LIF normal force. When tested as specified in 4.7.3.2, the average normal force on each tine shall be greater than 3.53 ounces (0.98 newtons) with random readings of not less than 3.00 ounces (0.84 newtons) allowed.

TABLE I Insulation resistance (megohms)

| Before humidity | Measured within 1 hour after removal from chamber | After 2 hours drying |
|-----------------|---|----------------------|
| 10,000          | 10  | 500                  |

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3.5.2.4 Compliant component retention.

3.5.2.4.1 Initial installation. After initial installation of the compliant component into the printed-wiring backplane, the maximum pushout force allowed shall be 45 pounds (200 newtons), when tested in accordance with 4.7.3.3. Upon insertion or extraction from the backplane, the compliant component shall not displace conductive debris outside the plated through hole.

3.5.2.4.2 Conditioning. After conditioning in accordance with 4.7.3.3.1, the pushout force shall be a minimum of 7.5 pounds (33.4 newtons).

3.5.2.5 Compliant component torque. When tested as specified in 4.7.3.4, the component shall withstand a minimum torque of 3 ounce-inches (0.021 newton-meter). Following removal of the applied torque, no displacement or deformation of the compliant component shall be visible.

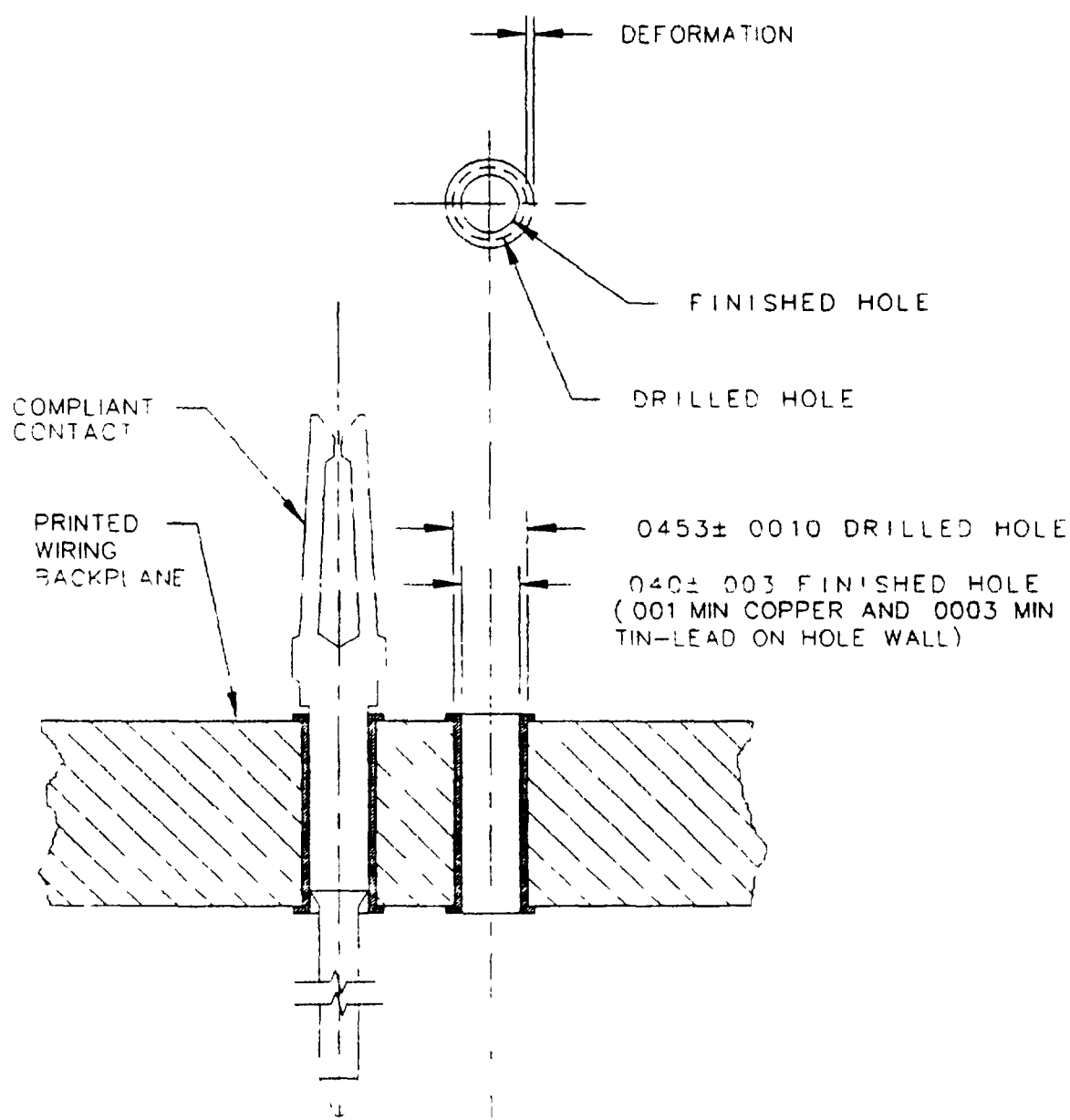
3.5.2.6 Housing retention. The housing retention force shall be as specified when tested in accordance with 4.7.3.5 (see 3.1).

3.5.2.7 Plated-through hole integrity. When microsectioned in accordance with 4.7.3.7, plated-through holes containing compliant components shall conform to the requirements specified in 3.5.2.7.1 through 3.5.2.7.3.

3.5.2.7.1 Hole deformation. The average plated-through hole deformation shall be no greater than 0.0015 inches (0.0038 centimeters (cm)), when measured from the drilled hole, based on a 10-hole microsection sample. The absolute maximum deformation shall be 0.002 inches (0.005 cm) (see figure 4).

3.5.2.7.2 Hole wall damage. The minimum copper thickness remaining between the compliant component and the printed-wiring laminate, averaged over a 10-hole microsection sample, shall not be less than 0.0003 inch (0.0008 cm) (see 4.7.3.7). 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.

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## NOTE.

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

FIGURE 4. Plated-through hole deformation.

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3.5.2.7.3 Vertical plane. The sample shall be viewed to ensure that no copper cracks, separations between conductor interfaces, or laminate-to-copper separations have occurred.

3.5.2.8 Durability. When connector component parts assembled onto the qualification test sample (see figure 5) and mated with connector assemblies qualified to MIL-C-28754 and with an appropriate supporting structure, are tested as specified in 4.7.3.6, there shall be no evidence of mechanical degradation that would adversely affect the contact's ability to function. In addition, after the test, the connector assembly shall conform to the requirements of 3.5.1.1 and 3.5.2.1 or 3.5.2.2.

3.5.3 Environmental requirements.

3.5.3.1 Temperature cycling. When the connector assembly is tested as specified in 4.7.4.1, the connector assembly shall show no evidence of cracking, fracturing, or other damage detrimental to the operation of the connector assembly.

3.5.3.2 Humidity. When tested as specified in 4.7.4.2, the connector assembly shall conform to the requirements of 3.5.1.5, 3.5.2.4.1, 3.5.1.2, 3.5.1.3, and 3.5.1.4.

3.5.3.3 Temperature-altitude. When tested as specified in 4.7.4.3, there shall be no evidence of cracks, burns, or other visible or dimensional damage which could cause electrical or mechanical breakdown of the connector assembly. In addition, at the completion of the temperature-altitude test, the connector assembly shall conform to the requirements of 3.5.1.3 and table I (before humidity) and 3.5.1.4.

3.5.3.4 Vibration. When connector component parts assembled onto the qualification test sample (see figure 5) and mated with connector assemblies qualified to MIL-C-28754 and with an appropriate supporting structure, are tested as specified in 4.7.4.4, 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 continuity of any of the contact circuits of more than 100 nS during test. Connectors shall conform to the requirements of 3.5.1.5, 3.5.1.2, and 3.5.2.1 or 3.5.2.2.

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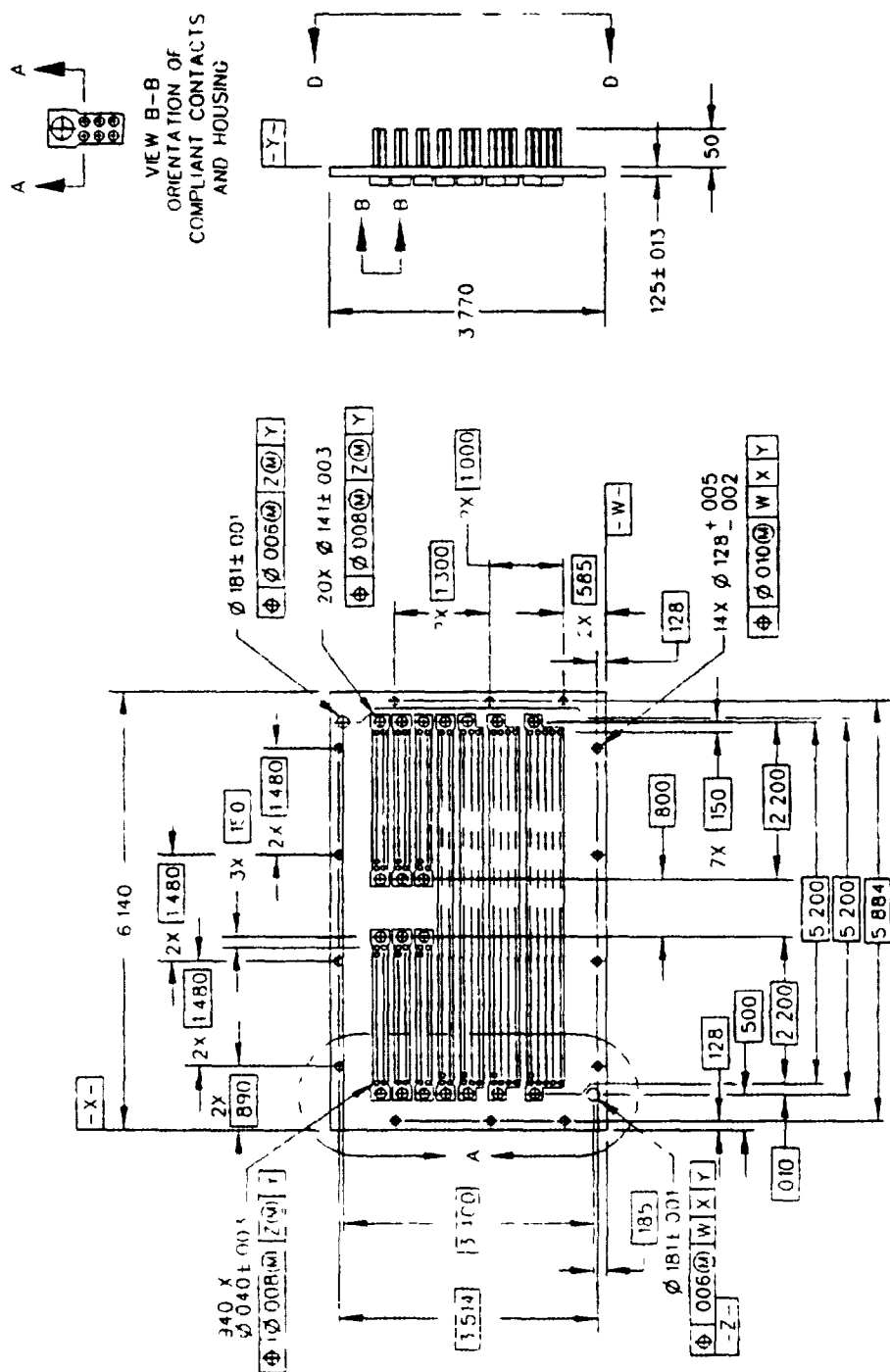
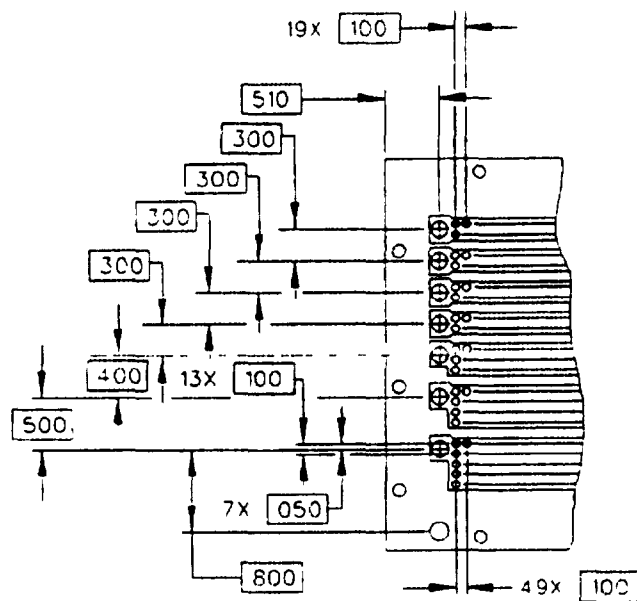
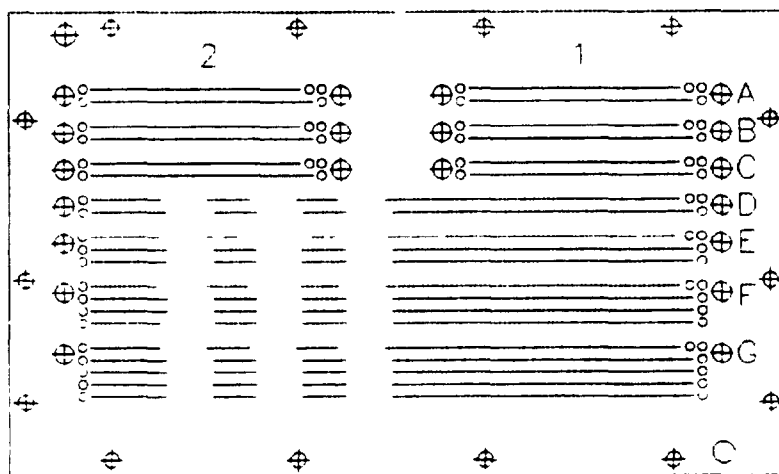


FIGURE 5. Qualification test sample configuration.

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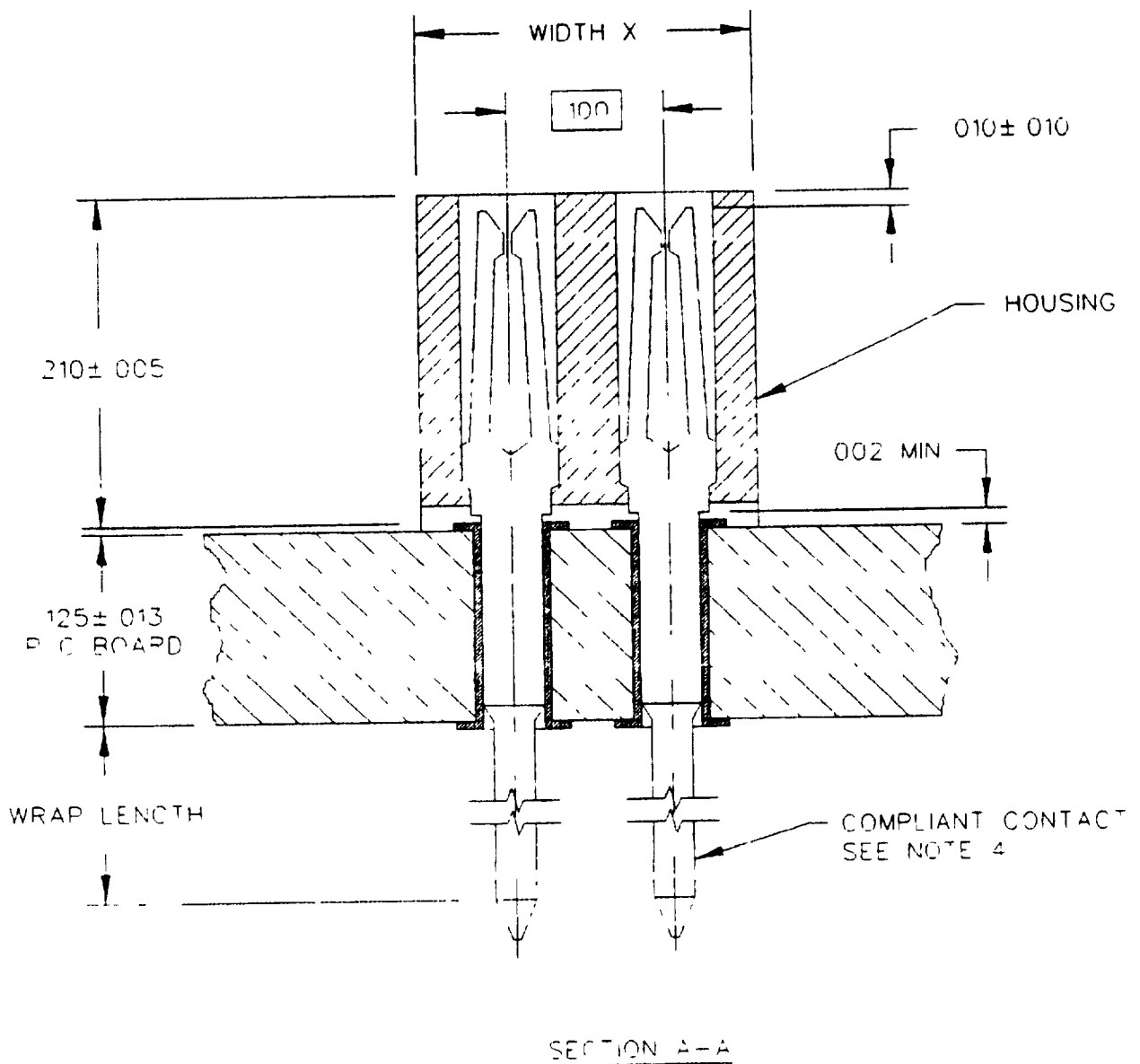
DETAIL A  
APPLICABLE TO BACKPLANE



VIEW D-D

FIGURE 5. Qualification test sample configuration - Continued.

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FIGURE 5. Qualification test sample configuration - Continued.



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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 |

| INCHES | MM    | INCHES | MM     | INCHES | MM     | INCHES | MM      |
|--------|-------|--------|--------|--------|--------|--------|---------|
| 0.001  | 0.025 | 0.100  | 2.540  | 0.50   | 12.70  | 3.400  | 86.360  |
| 0.002  | 0.051 | 0.125  | 3.175  | 0.500  | 12.700 | 3.514  | 89.256  |
| 0.003  | 0.076 | 0.128  | 3.251  | 0.510  | 12.954 | 3.770  | 95.758  |
| 0.005  | 0.127 | 0.141  | 3.581  | 0.585  | 14.859 | 5.200  | 132.080 |
| 0.006  | 0.152 | 0.150  | 3.810  | 0.800  | 20.320 | 5.884  | 149.454 |
| 0.008  | 0.203 | 0.181  | 4.597  | 0.890  | 22.606 | 6.140  | 155.956 |
| 0.010  | 0.254 | 0.185  | 4.699  | 1.000  | 25.400 |        |         |
| 0.013  | 0.330 | 0.210  | 5.334  | 1.300  | 33.020 |        |         |
| 0.040  | 1.016 | 0.300  | 7.620  | 1.480  | 37.592 |        |         |
| 0.050  | 1.270 | 0.400  | 10.160 | 2.200  | 55.880 |        |         |

FIGURE 5. Qualification test sample configuration - Continued.

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## NOTES:

1. Test sample shall be IPC-SM-840, class 3 solder masked or conformal coated using MIL-I-46058, type UR coating material prior to contact installation. Coating thickness shall be 0.001 inch to 0.003 inch when measured on a flat unencumbered surface.
2. Copper clad laminate for the test samples shall conform to MIL-P-13949, type GF for double-sided boards and to MIL-P-13949, type GF for multilayer boards. Inner layer copper thickness for multilayer boards shall be 2.0 ounces per square foot.
3. Double-sided and multilayer printed-wiring boards will be provided by the qualifying activity upon request from the contact/housing manufacturer. These boards shall then be pinned and housings shall be assembled by the compliant contact manufacturer. Test samples shall then be forwarded to the qualifying activity for qualification testing. Assembly of contacts and housings shall conform to figure 4. Printed-wiring boards shall conform to the requirements of MIL-P-55110.
4. Test samples shall incorporate compliant contacts conforming to MIL-C-28859/1-05 (0.500 inch wrappost length) or to MIL-C-28859/5-05 (0.500 inch wrappost length).
5. Dimensions are in inches. Metric equivalents are given for information only.

FIGURE 5. Qualification test sample configuration - Continued.

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3.5.3.5 Shock (specified pulse). When connector component parts assembled onto the qualification test sample (see figure 5) and mated with connector assemblies qualified to MIL-C-28754 and with an appropriate supporting structure, are tested as specified in 4.7.4.5, there shall be no breakage or loosening of contacts, breaking or cracking of housings, or other visible or dimensional damage which could cause electrical or mechanical breakdown. There shall be no loss of continuity of any of the contact circuits of more than 100 nS during test.

3.5.3.6 Salt spray (corrosion). When connector assemblies are tested as specified in 4.7.4.6, there shall be no visual signs of corrosion or corrosive salts on the basis metal that may degrade the mechanical or electrical performance. After testing, the component parts shall conform to the requirement of 3.5.1.5.

3.5.3.7 Temperature life. When tested as specified in 4.7.4.7, the connector component parts shall exhibit no evidence of cracks, burns, or other visual or mechanical damage.

3.5.3.8 Gas-tight-joint. When tested as specified in 4.7.4.8, the connector component parts shall conform to the requirement of 3.5.1.2.

3.6 Marking. Unless otherwise specified (see 3.1), component packaging (see 5.1) shall be permanently and legibly marked with the military part number (see 6.9), date code and manufacturer's source code in accordance with MIL-STD-1285. Other markings which in any way interfere with, obscure, or confuse those specified herein are prohibited. Markings shall be made using epoxy base ink in accordance with MIL-I-43553.

3.7. Workmanship. The workmanship on connector component parts supplied under this specification shall be suitable to assure conformance with the requirements contained herein. The compliant components shall be free of burrs or sharp corners which would otherwise damage the plating or mating connectors. The housing shall be free of cracks, voids, irregularities, sharp edges, or flash.

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## 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 this 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.

4.1.2 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.

4.1.3 Suppliers certification

4.1.3.1 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.

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4.1.3.2 Processes requiring certification. The following processes (if used in the manufacturing of components) shall be certified to their applicable specifications in accordance with 4.1.3.1 and this paragraph:

- (a) Nickel plating: QQ-N-290.
- (b) Gold plating: MIL-G-45204.
- (c) Tin-lead: MIL-P-81728

4.1.3.3 Certification approval Process certification shall be approved by the qualification activity.

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

- (a) Materials inspection (see 4.3)
- (b) Qualification inspection (includes table III tests, see 4.5)
- (c) Quality conformance inspection (Group A, B and C tests, see 4.6)

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table II, used in fabrication, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

4.4 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the GENERAL REQUIREMENTS of MIL-STD-202 and MIL-STD-1344.

4.5 Qualification inspection. Qualification inspection shall be performed at the qualifying activity (a Government laboratory or other laboratory acceptable to the Government) (see 6.3) on sample units produced with material, equipment and procedures normally used in production. The qualification inspection is the initial inspection of the manufacturer's product. It should not be confused with the quality conformance inspection (4.6) which is used to retain qualification.

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4.5.1 Sample.

4.5.1.1 Sample size. The qualification sample shall consist of three fully pinned printed-wiring electrical backplane assemblies in accordance with figure 5, plus individual piece parts (that is, compliant components and housings), that are representative of production hardware. See table III for backplane population requirements. When LIF compliant components (/5) are to be qualified in place of the standard force components (/1), the (/1) in table III will be replaced by the (/5). Twenty of each compliant component to be qualified and 10 housings shall be supplied in addition to the fully pinned backplane assemblies.

4.5.2 Inspection routine. The untested sample units shall be sent to the qualifying activity where they will be subjected to the qualification inspection specified in table IV, in the order shown

4.5.3 Failures. Failures in excess of those allowed in table IV shall result in refusal to grant qualification approval.

TABLE II Materials inspection.

| Material       | Requirement paragraph | Applicable specification          |
|----------------|-----------------------|-----------------------------------|
| Copper alloy   | 3.3 1                 | ASTM B194, QQ-B-750 and ASTM B122 |
| Plastic        | 3.3.2                 | MIL-M-24519                       |
| Nickel-plating | 3.3 1 1               | QQ-N-290                          |
| Gold-plating   | 3.3 1 1               | MIL-G-45204                       |
| Marking ink    | 3.6                   | MIL-I-43553                       |

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TABLE III. Backplane population requirements.

| Slash sheet(s)<br>to be qualified | Row or position     | Contains  |
|-----------------------------------|---------------------|-----------|
| /3 only                           | all                 | /3        |
| /4 only                           | all                 | /4        |
| /3 and /4                         | A, B, C, D,         | /4        |
|                                   | E, F, G             | /3        |
| /3, /4, and<br>/1 and /2          | A1                  | /3        |
|                                   | A2                  | /4        |
|                                   | remaining positions | /1 and /2 |
| /1 and /2                         | all                 | /1 and /2 |
| /1, /2 and /4                     | A2                  | /4        |
|                                   | remaining positions | /1 and /2 |
| /1, /2 and /3                     | A1                  | /3        |
|                                   | remaining positions | /1 and /2 |
| /1, /2, /3, /4<br>and /5          | A1                  | /3        |
|                                   | A2                  | /4        |
|                                   | B, C, D             | /1 and /2 |
|                                   | E, F, G             | /5 and /2 |

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TABLE III. Backplane population requirements - Continued.

| Slash sheet(s)<br>to be qualified | Row or position | Contains  |
|-----------------------------------|-----------------|-----------|
| /1, /2 and /5                     | A, B, C, D      | /1 and /2 |
|                                   | E, F, G         | /5 and /2 |

NOTE: If /5 is to be qualified and /1 is not to be qualified, /5 may replace /1 locations above and mark the test sample board "LIF". If /1 is to be qualified and /5 is not to be qualified, mark the test sample board "STD".



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TABLE IV. Qualification inspection.

| Examination or test            | Requirement paragraph   | Test paragraph | Number to be inspected | Number of defects allowed |
|--------------------------------|-------------------------|----------------|------------------------|---------------------------|
| <u>Subgroup I</u>              |                         |                | 1                      | 0                         |
| Visual examination             | 3.1, 3.3, 3.4, 3.6, 3.7 | 4.7.1          |                        |                           |
| Engaging and separating forces |                         |                |                        |                           |
| Standard                       | 3.5.2.1                 | 4.7.3.1        |                        |                           |
| LIF                            | 3.5.2.2                 | 4.7.3.1        |                        |                           |
| Normal force                   | 3.5.2.3                 | 4.7.3.2        |                        |                           |
| Temperature life               | 3.5.3.7                 | 4.7.4.7        |                        |                           |
| Temperature cycling            | 3.5.3.1                 | 4.7.4.1        |                        |                           |
| Low signal level CR            | 3.5.1.5                 | 4.7.2.5        |                        |                           |
| Humidity                       | 3.5.3.2                 | 4.7.4.2        |                        |                           |
| Low signal level CR            | 3.5.1.5                 | 4.7.2.5        |                        |                           |
| Contact retention (initial)    | 3.5.2.4.1               | 4.7.3.3        |                        |                           |
| Contact to PWB resistance      | 3.5.1.2                 | 4.7.2.2        |                        |                           |
| Insulation resistance          | 3.5.1.3                 | 4.7.2.3        |                        |                           |

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TABLE IV. Qualification inspection - Continued.

| Examination or test              | Requirement paragraph | Test paragraph | Number to be inspected | Number of defects allowed |
|----------------------------------|-----------------------|----------------|------------------------|---------------------------|
| <u>Subgroup I</u> - Cont.        |                       |                |                        |                           |
| Dielectric with-standing voltage | 3.5.1.4               | 4.7.2.4        |                        |                           |
| Housing retention                | 3.5.2.6               | 4.7.3.5        |                        |                           |
| <u>Subgroup II</u>               |                       |                | 1                      | 0                         |
| Visual examination               | 3.1.3.3.<br>3.4, 3.6  | 4.7.1          |                        |                           |
| Contact retention (initial)      | 3.5.2.4.1             | 4.7.3.3        |                        |                           |
| Hole conditioning                | 3.5.2.4.2             | 4.7.3.3.1      |                        |                           |
| Temperature life                 | 3.5.3.7               | 4.7.4.7        |                        |                           |
| Temperature cycling              | 3.5.3.1               | 4.7.4.1        |                        |                           |
| Low signal level CR              | 3.5.1.5               | 4.7.2.5        |                        |                           |
| Contact retention (final)        | 3.5.2.4               | 4.7.3.3        |                        |                           |
| Component torque                 | 3.5.2.5               | 4.7.3.4        |                        |                           |
| Contact to PWB resistance        | 3.5.1.2               | 4.7.2.2        |                        |                           |
| PTH-integrity (microsection)     | 3.5.2.7               | 4.7.3.7        |                        |                           |

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TABLE IV. Qualification inspection - Continued.

| Examination or test              | Requirement paragraph | Test paragraph | Number to be inspected | Number of defects allowed |
|----------------------------------|-----------------------|----------------|------------------------|---------------------------|
| <u>Subgroup II</u> - Cont.       |                       |                |                        |                           |
| Gas-tight-joint                  | 3.5.3.8               | 4.7.4.8        |                        |                           |
| Contact to PWB resistance        | 3.5.1.2               | 4.7.2.2        |                        |                           |
| <u>Subgroup III</u>              |                       |                | 1                      | 0                         |
| Visual examination               | 3.1, 3.3, 3.4, 3.6    | 4.7.1          |                        |                           |
| Dielectric with-standing voltage | 3.5.1.4               | 4.7.2.4        |                        |                           |
| Mated contact resistance         | 3.5.1.1               | 4.7.2.1        |                        |                           |
| Durability                       | 3.5.2.8               | 4.7.3.6        |                        |                           |
| Contact resistance               | 3.5.1.1               | 4.7.2.1        |                        |                           |
| Engage/separate                  | 3.5.2.1 or 3.5.2.2    | 4.7.3.1        |                        |                           |
| Temp/altitude                    | 3.5.3.3               | 4.7.4.3        |                        |                           |
| Insulation resistance            | 3.5.1.3               | 4.7.2.3        |                        |                           |
| Dielectric with-standing voltage | 3.5.1.4               | 4.7.2.4        |                        |                           |

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TABLE IV. Qualification Inspection - Continued.

| Examination or test         | Requirement paragraph | Test paragraph | Number to be inspected     | Number of defects allowed |
|-----------------------------|-----------------------|----------------|----------------------------|---------------------------|
| <u>Subgroup III</u> - Cont. |                       |                |                            |                           |
| Shock                       | 3.5.3.5               | 4.7.4.5        |                            |                           |
| Vibration                   | 3.5.3.4               | 4.7.4.4        |                            |                           |
| Low signal level CR         | 3.5.1.5               | 4.7.2.5        |                            |                           |
| Humidity                    | 3.5.3.2               | 4.7.4.2        |                            |                           |
| Low signal level CR         | 3.5.1.5               | 4.7.2.5        |                            |                           |
| Contact retention (initial) | 3.5.2.4.1             | 4.7.3.3        |                            |                           |
| Salt spray                  | 3.5.3.6               | 4.7.4.6        |                            |                           |
| Low signal level CR         | 3.5.1.5               | 4.7.2.5        |                            |                           |
| Contact to PWB resistance   | 3.5.1.2               | 4.7.2.2        |                            |                           |
| <u>Subgroup IV</u>          |                       |                | 20 contacts<br>10 housings | 0                         |
| Visual examination          | 3.1, 3.3,<br>3.4, 3.6 | 4.7.1          |                            |                           |
| Dimensional                 | 3.1                   | 4.7.1          |                            |                           |

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TABLE IV. Qualification inspection - Continued.

| Examination or test            | Requirement paragraph | Test paragraph | Number to be inspected | Number of defects allowed |
|--------------------------------|-----------------------|----------------|------------------------|---------------------------|
| <u>Subgroup IV</u> - Cont.     |                       |                |                        |                           |
| Material                       | 3.3.1, 3.3.2          |                |                        |                           |
| Contact hardness               | 3.3.1                 |                |                        |                           |
| Housing, retention (gage)      | 3.5.2.6               | 4.7.3.5        |                        |                           |
| Engaging and separating forces |                       |                |                        |                           |
| LIF                            | 3.5.2.2               | 4.7.3.1        |                        |                           |
| Standard                       | 3.5.2.1               | 4.7.3.1        |                        |                           |
| Normal force                   | 3.5.2.3               | 4.7.3.2        |                        |                           |

4.5.4 Retention of qualification. To retain qualification, the quality conformance inspection must be performed every 12 months on the qualification sample (see 4.5.1.1). The quality conformance inspection differs from the qualification inspection and is described fully in 4.6.

4.5.4.1 Noncontinuous production In the event that no production has occurred on an item during the time between initial qualification and quality conformance inspection, a report must be submitted. This will certify that although the item is not in production currently, the company still has the capabilities and facilities necessary to produce the item, and that the company still wishes to retain qualification on the item. If this break in production is longer than two consecutive inspection periods, each part number involved must be submitted for quality conformance inspection (4.6) two years after initial qualification, even if the item is still not

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going back into production. Whenever production is resumed, regardless of when this falls in the inspection period, each part number involved must be submitted for quality conformance inspection (4.6).

#### 4.6 Quality conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspection. Inspections using destructive tests may be conducted on those items taken from the same production group as those to be delivered. Delivery of products which have passed the groups A and B inspection shall not be delayed pending the results of the qualification inspection.

4.6.1.1 Inspection lot. An inspection lot shall consist of all components of the same type, produced under essentially the same conditions, and offered for inspection at one time.

4.6.1.2 Group A inspection. Group A inspection shall be conducted by the manufacturer and shall consist of the inspections specified in table V. The qualifying activity reserves the right to inspect the facilities and instrumentation used in the group A inspection.

TABLE V. Group A inspection

| Examination           | Requirement paragraph | Test paragraph |
|-----------------------|-----------------------|----------------|
| Visual and mechanical | 3.1, 3.3.1, 3.7       | 4.7.1          |
| Marking               | 3.6                   | 4.6.3          |

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 no greater than 2.5 percent defective.

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4.6.1.2.2 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. Such lots shall be kept separate from new lots, and shall be clearly identified as reinspected lots.

4.6.1.3 Group B inspection. Group B inspection shall be conducted by the manufacturer and shall consist of the inspection specified in table VI, in the order shown. The qualifying activity reserves the right to inspect the facilities and instrumentation used in the group B inspection. In lieu of inserting the compliant contact into a printed-wiring backplane to perform the housing retention inspections, the manufacturer may elect to build a permanent test fixture which would capture the compliant feature of the compliant contact and simulate the resting surface for the housing.

TABLE VI. Group B inspection.

| Examination                    | Requirement paragraph    | Test paragraph |
|--------------------------------|--------------------------|----------------|
| Engaging and separating forces | 3.5.2.1<br>or<br>3.5 2.2 | 4.7.3.1        |
| Normal force                   | 3.5.2.3                  | 4.7.3.2        |
| Housing retention              | 3.5.2.6                  | 4.7.3.5        |

4.6.1.3.1 Sampling plan. The sampling plan shall be in accordance with MIL-STD-105 for special inspection level S-4, based on contacts and housings. Unless otherwise specified herein, normal inspection shall be used at the start of the contract. The AQL shall be no greater than 0.4 percent defective.

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4.6.1.3.2 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. Such lots shall be kept separate from new lots, and shall clearly be identified as reinspected lots.

4.6.1.3.3 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract.

4.6.2 Periodic inspection. Periodic inspection shall consist of:

- (a) Group A quality conformance inspection.
- (b) Group B quality conformance inspection.
- (c) The group C quality conformance inspection which shall be conducted on the inspection lot by the qualifying activity in the time period specified in 4.5.4

4.6.2.1 Group C inspection. Group C inspection shall consist of the inspections specified in table IV in the order shown. Group C inspection shall be made on sample units which have passed the groups A and B inspections.

4.6.2.1.1 Sampling plan. The group C samples shall be in accordance with 4.5.1.

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

4.6.2.2 Noncompliance If a sample fails to pass group C inspection, the qualifying activity shall notify the manufacturer of such failure. The manufacturer 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 with essentially the same materials and processes; these are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity, has been taken. After the corrective action has been taken, the group C inspection shall be repeated on additional sample units. All inspections, or the inspections which the original sample



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failed, may be repeated at the option of the qualifying activity. Groups A and B inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful.

4.6.3 Inspection of preparation for delivery. Sample packaging and the inspection of the preservation, packaging, packing, and marking for shipment and storage shall be in accordance with section 5.

4.7 Methods of examination and test.

4.7.1 Visual and mechanical examination. Connector component parts ( housings and compliant components) shall be examined to determine that the material, design, construction, physical dimensions, markings, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.6, 3.7).

4.7.2 Electrical testing

4.7.2.1 Contact resistance (see 3.5.1.1). Compliant contacts shall be wired in accordance with Method 3004 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Method of connection: See figure 1.
- (b) Test current: Three amperes.
- (c) Twenty contacts per sample shall be tested.

4.7.2.2 Plated-through hole to contact resistance (see 3.5.1.2). Compliant contacts shall be tested in accordance with the test set-up depicted in figure 2. The following details shall apply:

- (a) Method of connection: See figures 2 and 3.
- (b) Test current: Three amperes
- (c) Twenty contacts per sample shall be tested.

4.7.2.3 Insulation resistance (see 3.5.1.3). Compliant contacts and housings shall be tested in accordance with Method 3003 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Test voltage: 100 volts direct current (VDC)  $\pm 5$  percent.
- (b) Test points: Between adjacent contacts.

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4.7.2.4 Dielectric withstanding (see 3.5.1.4). Compliant contacts and housings shall be tested in accordance with Method 3001, test condition I of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Test voltage: 350 volts alternating current (VAC) 60 hertz (Hz), or 500 VDC.
- (b) Test points: Between adjacent contacts.

4.7.2.5 Low signal level contact resistance. Compliant contacts and housings shall be tested in accordance with Method 3002 of MIL-STD-1344 and shall meet the requirements of 3.5.1.5. Test probes shall be no more than 0.06 inch (1.52 mm) from the surface of the connector housing.

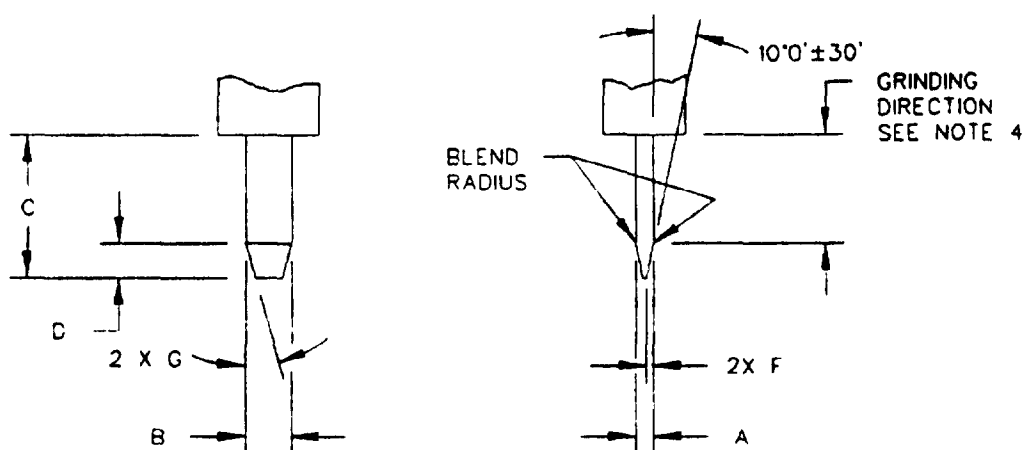
4.7.3 Mechanical testing.

4.7.3.1 Engaging and separating force (see 3.5.2.1 or 3.5.2.2). Compliant contacts shall be tested in accordance with Method 2014 of MIL-STD-1344. The test blade specified in figure 6 shall be inserted into 50 different contacts, and the engaging and separating forces recorded.

4.7.3.2 LIF normal force (see 3.5.2.3). LIF normal force shall be measured using equipment which directly indicates the force exerted by each tine or the average force exerted by both tines when the gap between the contact points is  $0.020 \pm 0.0002$  inch ( $0.508 \pm 0.005$  mm). Any equipment used for these measurements must be capable of direct correlation with normal force measurements using conventional force versus deflection techniques. LIF normal force measurements shall be made on 50 contacts not mounted in the qualification test sample. All measurements shall be performed on contacts which were tested under 4.7.3.1.

4.7.3.3 Compliant component retention (see 3.5.2.4). Compliant components shall be tested in accordance with Method 2007 of MIL-STD-1344. After initial insertion, a minimum of 7.5 pounds (33.4 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.

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| Grid Spacing | A<br>±0.0001 | B<br>+0.002<br>-0.003 | C<br>MIN | D<br>±0.010 | F<br>±0.0002 | G<br>±3 |
|--------------|--------------|-----------------------|----------|-------------|--------------|---------|
| 0.100        | 0.0200       | 0.050                 | 0.164    | 0.040       | 0.0080       | 15      |

| INCHES | MM    | INCHES | MM    | INCHES | MM   |
|--------|-------|--------|-------|--------|------|
| 0.0001 | 0.003 | 0.010  | 0.25  | 0.164  | 4.17 |
| 0.0002 | 0.005 | 0.0200 | 0.508 |        |      |
| 0.002  | 0.05  | 0.040  | 1.02  |        |      |
| 0.003  | 0.08  | 0.050  | 1.27  |        |      |
| 0.008  | 0.20  | 0.100  | 2.54  |        |      |

FIGURE 6. Engaging and separating force test blade.

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## NOTES:

1. Material: Hardened tool steel. Hardness: Knoop 542-630.
2. Alternate material: Tungsten Carbide (CD-650). Hardness: Rockwell "A" 89.5-93.0.
3. Surface finish: 4-8 micro-inch on working surfaces in accordance with ANSI-B46.1.
4. Grinding to be in the direction of blade movement during test.
5. Dimensions are in inches. Metric equivalents are given for information only.

FIGURE 6. Engaging and separating force test blade - Continued.

4.7.3.3.1 Conditioning. The manufacturer is responsible for submitting a sample or coupon with 10 adjacent contact holes conditioned. Conditioning is done by the vendor prior to submission. The compliant component mounting hole in the backplane shall be conditioned by using those contacts of the same design supplied by the manufacturer for qualification. The hole shall be conditioned by the insertion and removal of a virgin compliant contact followed by the insertion and removal of a second virgin compliant contact in the same hole. A third virgin compliant contact shall then be inserted in the hole, and the pushout force shall conform to the requirements of 3.5.2.4.

4.7.3.4 Compliant component torque (see 3.5.2.5). Compliant components shall be 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.

4.7.3.5 Housing retention force (see 3.5.2.6). The capability of the housing to be retained by the compliant contacts shall be measured in a test set-up similar to that shown in figure 7. The load required to remove the housing shall be as specified on the applicable specification sheet.

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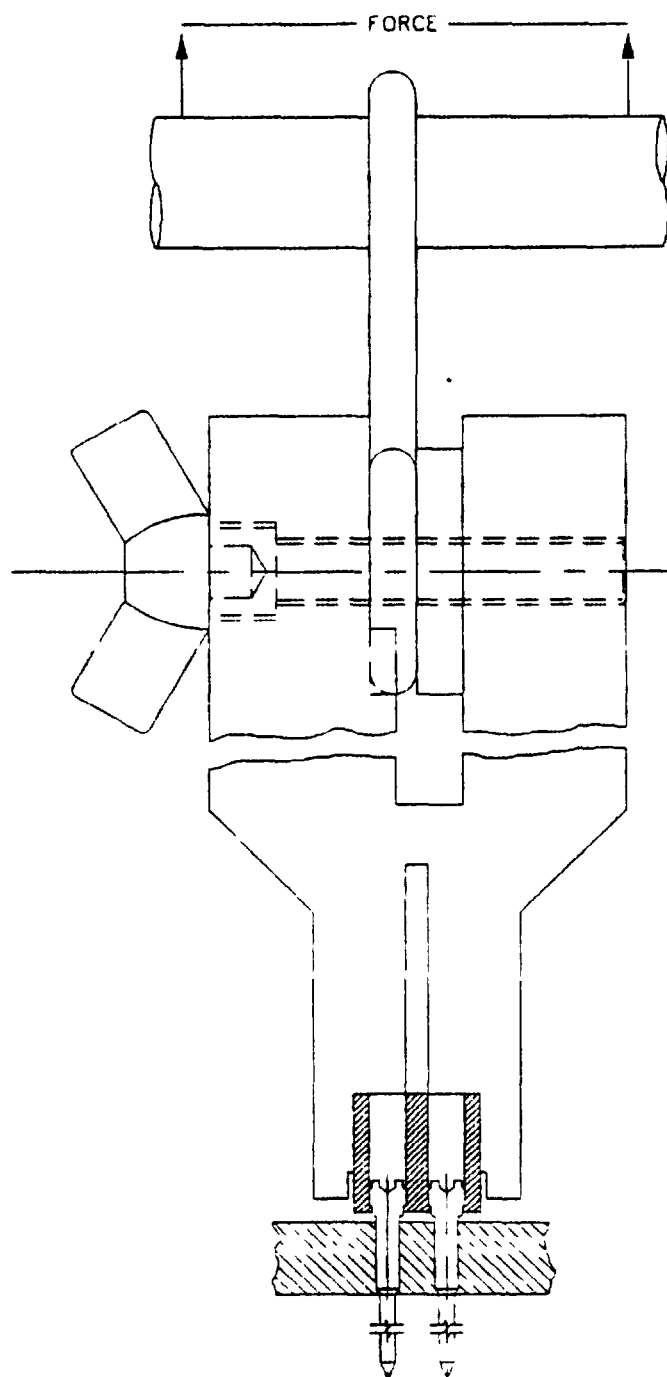


FIGURE 7. Test set-up for housing retention force.

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4.7.3.6 Durability testing (see 3.5.2.8). Compliant components shall be tested in accordance with Method 2016 of MIL-STD-1344. Compliant contacts shall be subjected to 500 cycles of mating and unmating.

4.7.3.7 Plated-through hole integrity. After hole conditioning as specified in 4.7.3.3.1, compliant components contained in plated-through holes shall be microsectioned as specified herein to determine conformance to 3.5.2.7:

- (a) Double-sided printed-wiring boards. Plated-through holes containing compliant components shall be microsectioned in the horizontal plane and examined for conformance to 3.5.2.7. 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. Plated-through holes containing compliant components shall be microsectioned (10 each in the vertical and horizontal planes). In both the horizontal and vertical planes, the microsectioned sample shall be examined for conformance to 3.5.2.7. 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 a magnification of 400X to resolve questionable copper thickness interfaces between the pin and printed-wiring laminate.

4.7.4 Environments.

4.7.4.1 Temperature cycling (see 3.5.3.1). Connector component parts mounted to the qualification test sample shall be tested in accordance with Method 1003 of MIL-STD-1344. The following details and exceptions shall apply:

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- (a) Test condition: A-3, except 400 cycles.
- (b) Following testing, connectors shall conform to the requirements of 3.5.1.1.

4.7.4.2 Humidity (see 3.5.3.2). Connector component parts mounted to the qualification test sample shall be tested in accordance with Method 1002 of MIL-STD-1344, type II. The following exception shall apply:

- (a) Steps 7A and 7B are not required.

4.7.4.3 Temperature-altitude testing (see 3.5.3.3). Connector component parts mounted to the printed circuit board shall be tested in accordance with MIL-STD-202, Method 105, condition D, "Barometric Pressure (reduced)". The following details and exceptions shall apply:

- (a) During the last half hour, 30 VDC shall be applied between adjacent contacts.
- (b) Temperature shall be 60°C.

4.7.4.4 Vibration testing (see 3.5.3.4). Connector component parts mounted to the qualification test sample with an appropriate connector and supporting structure shall be tested in accordance with Method 2005 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Discontinuity shall be monitored during testing (100 nS maximum) over two groups of 20 contacts each. Each group shall be connected in series.
- (b) Sinusoidal test condition: III.
- (c) Random test condition: V test letter E.
- (d) Duration of random test: 15 minutes each axis.

4.7.4.5 Shock (specified pulse) testing (see 3.5.3.5). Connector component parts mounted to the qualification test sample with an appropriate connector and supporting structure shall be tested in accordance with Method 2004 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Discontinuity shall be monitored during testing (100 nS maximum) over two groups of 20 contacts each. Each group shall be connected in series.
- (b) Test condition: G.

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4.7.4.6 Salt spray testing (see 3.5.3.6). Connector component parts mounted to the qualification test sample shall be tested in accordance with Method 1001 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Test condition letter. B.
- (b) Conditioning after exposure: All exposed surfaces of the connector component parts shall be thoroughly washed with warm tap water and air dried.
- (c) Subsequent to exposure: A visual inspection shall be conducted.
- (d) Magnification of 10X is required.

4.7.4.7 Temperature life (see 3.5.3.7). Connector component parts mounted to the qualification test sample shall be tested in accordance with Method 1005 of MIL-STD-1344. The following details and exceptions shall apply:

- (a) Test condition:  $+125 \pm 3^{\circ}\text{C}$ .
- (b) Test time condition: D.

4.7.4.8 Gas-tight-joint (see 3.5.3.8). Compliant contact to printed-wiring board interface gas-tight area shall be tested as follows:

- (a) The samples shall be suspended and sealed in a container with an appropriate volume of aqua regia solution (1:1 concentrated hydrochloric and nitric acids). The solution shall not touch the assemblies. The assemblies shall be exposed to the aqua regia fumes for 30 minutes.
- (b) Dry the samples and test in accordance with 4.7.2.2.

## 5. PACKAGING

5.1 Packaging. Preparation for delivery shall be in accordance with MIL-C-55330.



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## 6. NOTES

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

6.1 Intended use. Connector component parts covered by this specification are intended for use in printed-wiring backplanes applicable to ground support, airborne and shipboard electrical and electronic equipment.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number and date of this specification, and the title, number and date of the applicable specification sheet and complete part number.
- (b) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1).
- (c) Tools (as required).
  - 1. Insertion and withdrawal tools.
- (d) Marking, levels of preservation and packaging and packing required (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 28859 whether or not such products 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 Products List is the Naval Sea Systems Command, SEA-55Z3, Department of the Navy, Washington, DC 20362-5101; however, information pertaining to qualification of products may be obtained from the Naval Avionics Center,

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Indianapolis, IN 46219-2189. Application for qualification tests shall be made in accordance with SD-6, Provisions Governing Qualification (see 6.3.1). The printed-wiring backplane assemblies, compliant contacts, and housings shall be forwarded to the Naval Avionics Center, Code 442, 6000 East 21st Street, Indianapolis, IN 46219-2189.

6.3.1 Qualification application. Copies of SD-6, Provisions Governing Qualification, may be obtained from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

6.4 Definitions. The following definitions are applicable to terms used herein.

6.4.1 Qualifying activity. This activity is responsible for performing qualification testing on printed-wiring backplane assemblies, compliant contacts and housings. This function is performed by the Naval Avionics Center, Code 444, 6000 East 21st Street, Indianapolis, IN 46219-2189, or by any other laboratory approved and chosen by the Naval Avionics Center.

6.4.2 Pitch. The distance from the first row of contacts in a connector footprint to the first row of contacts in an immediately adjacent connector footprint. Pitch varies depending on the number of contact rows in a connector footprint.

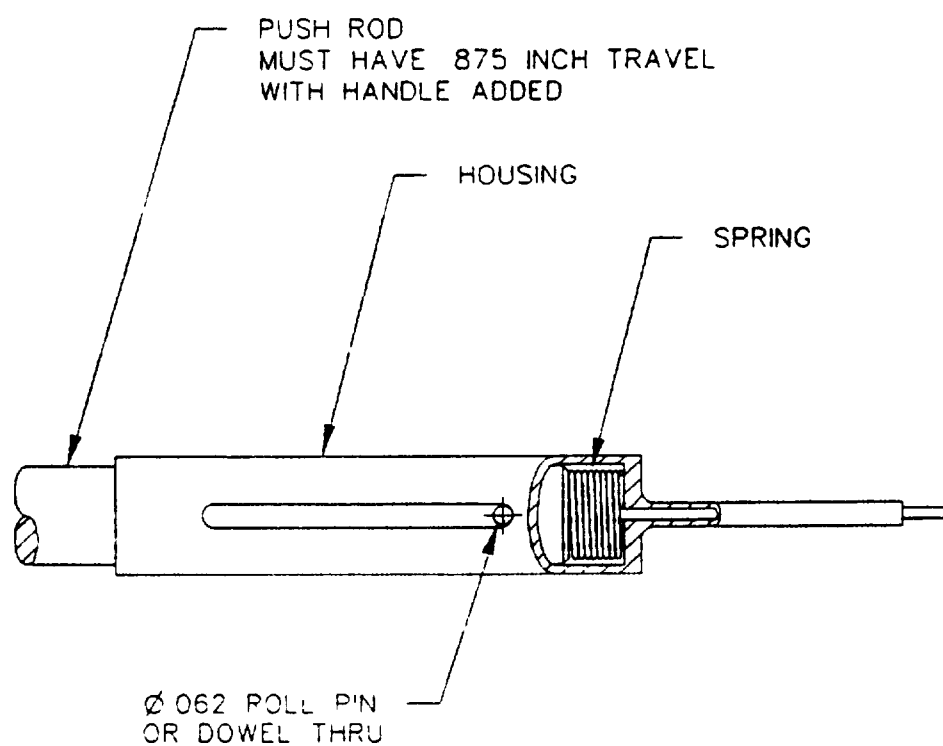
6.5 Shipment of contacts. At the option of the contracting officer, compliant contacts may be mounted on a carrier or delivered loose in bulk.

6.6 Supersession data. This specification supersedes MIL-C-28859A(EC) dated 15 October 1980.

6.7 Contact insertion and removal tool. When applicable, a suitable hand tool or tools will be provided with qualification samples to insert and remove the contacts (see figures 8 and 9).

6.8 Current-carrying-capacity. The current ratings given in the specification sheets are for single contacts. It may be necessary to derate the total current carrying capacity of a connector.

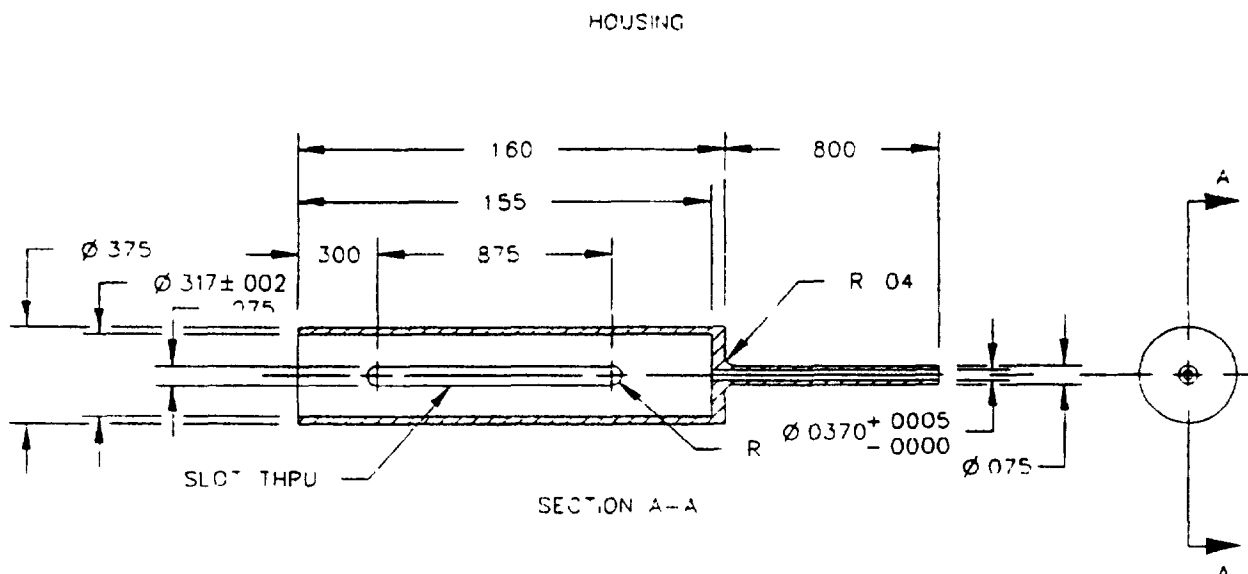
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FIGURE 8. Hand removal tool.

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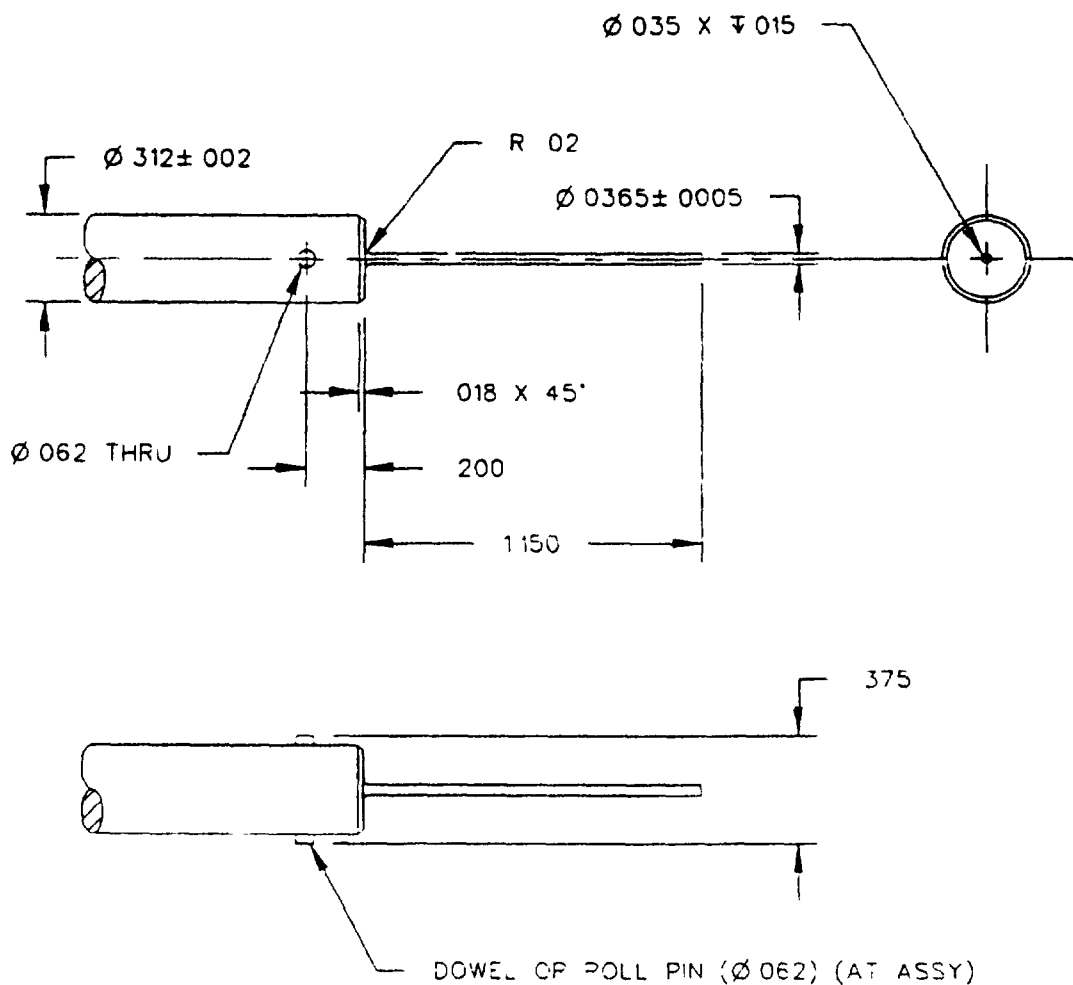
## NOTES:

1. Tolerance on 0.000  $\pm$  0.005, or 0.00  $\pm$  0.01 unless otherwise specified.
2. Material to be: tool steel alloy, ASTM A681, type D2.
3. Harden to Rockwell "C" 50 minimum after machining.
4. Passivation treatment, QQ-P-35.
5. Dimensions are in inches. Metric equivalents are given for information only.

FIGURE 8. Hand removal tool - Continued.

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## PUSH ROD



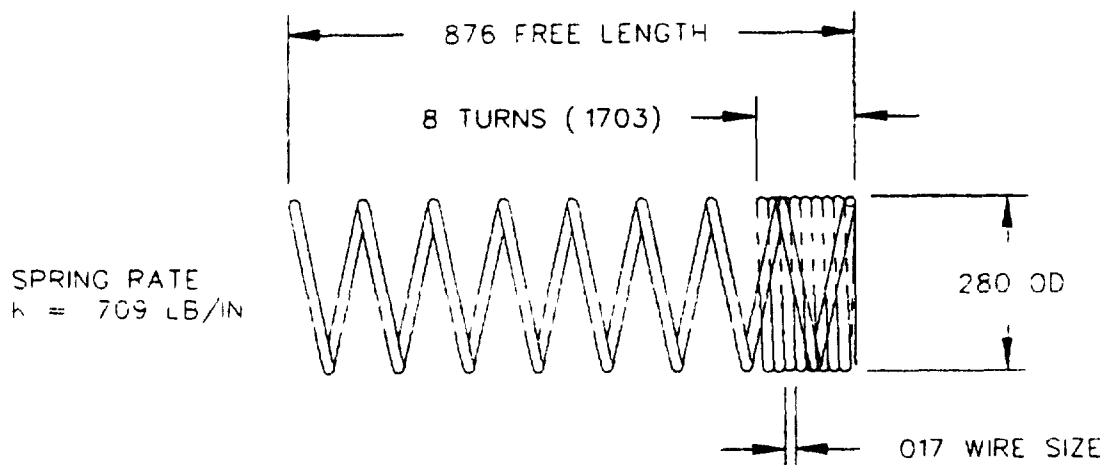
## NOTES:

1. Tolerance on  $0.000 \pm 0.005$ ; or  $0.00 \pm 0.01$ .
2. Material to be: tool steel alloy, ASTM A681, type D2, harden to Rockwell "C" 50 minimum after machining.
3. Finish: dry film lubricate sliding surfaces.
4. Add handle for ease of use. Complete overall length 5-6 inches.

FIGURE 8. Hand removal tool - Continued.

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SPRING

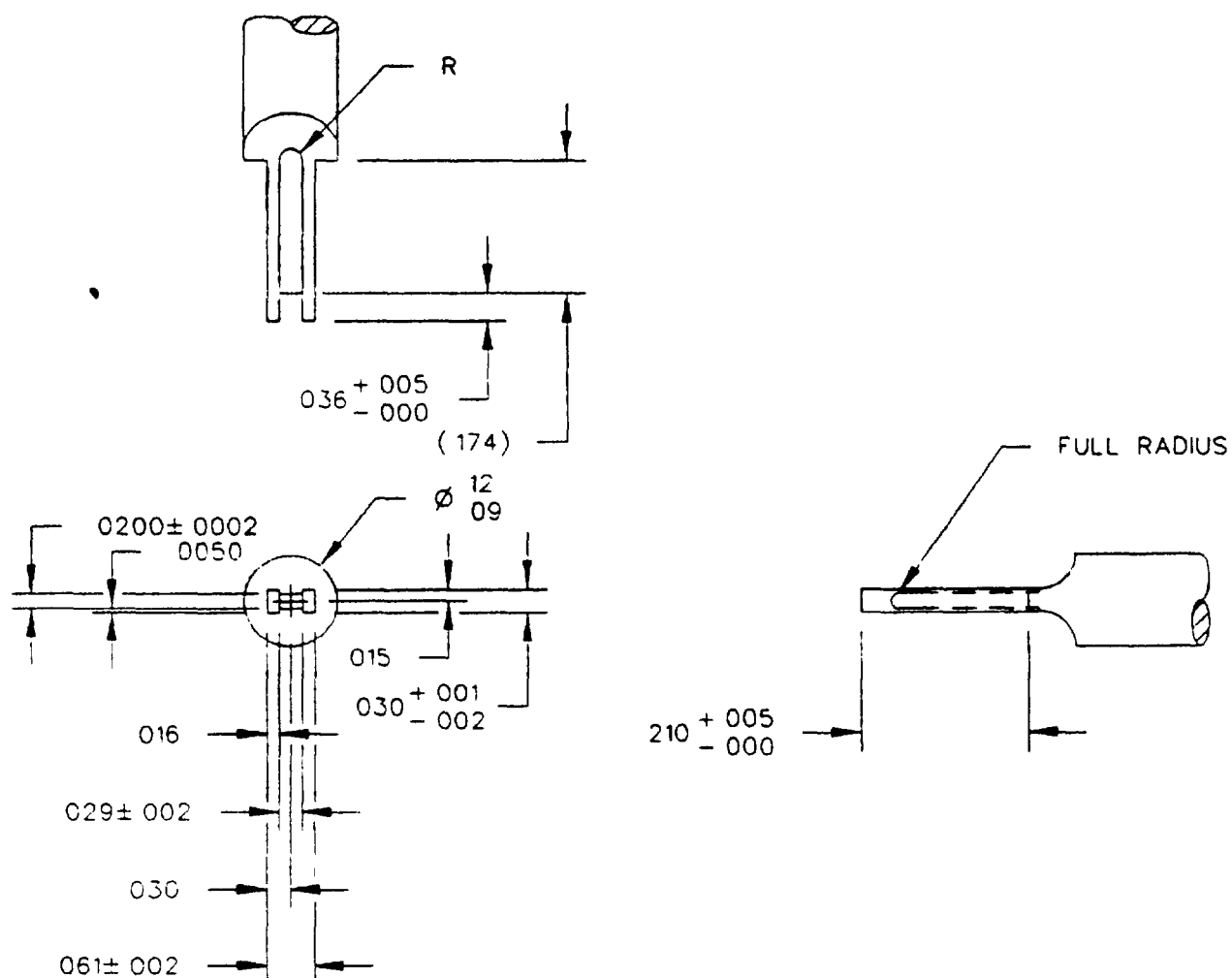


NOTES:

1. Material to be: stainless steel, AISI 301 or 302.
2. Heat treat as required to obtain spring rate.
3. Degrease.

FIGURE 8. Hand removal tool - Continued.

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FOR REFERENCE ONLY

FIGURE 9. Hand insertion tool.

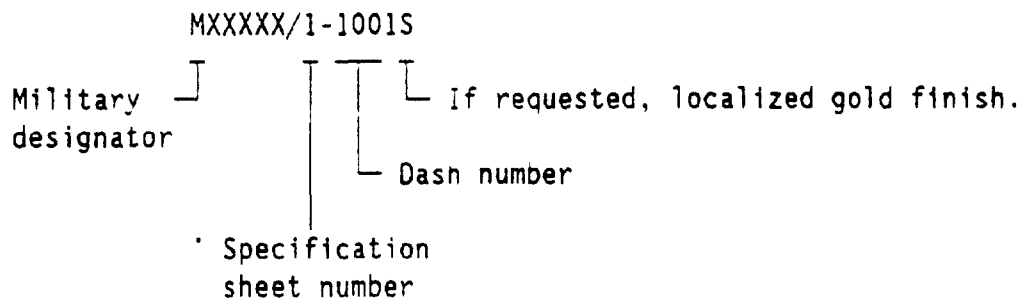
**MIL-C-28859B**

**NOTES:**

1. Material: tool steel alloy, ASTM A681, type D2.
2. Harden to Rockwell "C" 50 minimum after machining.
3. Add handle for ease of use. Completed overall length 5-6 inches.
4. Break all sharp corners and edges.
5. Dimensions are in inches. Metric equivalents are given for information only.

FIGURE 9. Hand insertion tool - Continued.

6.9 Part or identifying number (PIN). The PIN to be used for components acquired to this specification shall consist of the letter M, the basic number of the specification sheet, and an assigned dash number (see 6.2) as shown in the following:



#### 6.10 Subject term (keyword) listing.

Compliant contacts.  
Housings.

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



**MIL-C-28859B**

**Custodians:**

Navy - SH

Army - CR

Air Force - 85

**Review activity:**

DLA - ES

**User activity:**

Navy - MC

**Preparing activity:**

Navy - SH

**Agent: NW**

**(Project 5935-3751)**

## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

|  |  |  |  |
|--|--|--|--|
| 1 DOCUMENT NUMBER<br>MIL-C-28859B                            |  | 2 DOCUMENT TITLE Connector Component Parts, Electrical Backplane,<br>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)  |  |

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