## 1.0 GENERAL

This specification covers the gold plated contact DU BOX™ Printed Wiring Board Connectors designed for parallel (vertical) interconnection of printed wiring boards in low power applications. The connectors provide only the female half of the interconnection and are designed for mating with single or double rows of 0.025 inch square pins, free-standing on 0.100 inch centers. This product is Lead Free and meets the requirements of the European Union Directive of Restrictions for Hazardous Substances (Directive 2002/95/EC).The specification is composed of the following sections:



## 2.0 APPLICABLE DOCUMENTS

The following documents, of the issue in effect on the date of the latest revision of this specification, shall form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

| | |
|---|---|
| QQ-N-290 | Nickel Plating (Electrodeposited) |
| QQ-S-571 | Solder: Lead Alloy, Tin-Lead Alloy, and Tin Alloy; Flux Cored Ribbon and Wire, and Solid Form |
| QQ-B-750 | Phosphor Bronze |

MILITARY

MIL-F-14256 Flux, Soldering, Liquid (Rosin Base), Activated
MIL-M-24519 Molding Plastics, Polyester, Thermoplastic
MIL-G-45204 Gold Plating, Electrodeposited
MIL-C-45662 Calibration System Requirement
MIL-F-55110 Printed Wiring Boards

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-275 Printing Wiring for Electronic Equipment
MIL-STD-1344 Test Methods for Electrical Connectors

INDUSTRY SPECIFICATION/STANDARDS

ASTM B-103 Phosphor Bronze Plate, Sheet, Strip and Rolled Bar, Spec for DOD ADOPTED
UL-94 Tests for Flammability of Plastic Materials

FCI Labs Reports- Supporting Data

ZA5-2625 Lead Free Plating investigation.
EL-2006-06-025 GXT test report.

## 3.0 REQUIREMENTS

3.1 Qualification - Connectors furnished under this specification shall be products capable of meeting the qualification test requirements specified herein.

3.2 Material - The material for each part shall be as specified herein, or equivalent. Substitute material shall meet the performance requirements of this specification.

3.2.1 Terminal - The body shall be ex-hard phosphor bronze strip C51000 in accordance with QQ-B-750 and CA-510 specifications.

3.2.2 Insulator Housing - All housing material shall be rated flame retardant 94V-0, or better, in accordance with UL-94.

3.2.3 The housing shall be 30% glass filled polyester, Polycyclohexylenedimethylene terephthalate (PCT) in accordance with 16-508-159

3.3 Finish

3.3.1 Terminal - The terminal shall be plated in the contact area with 15 microinches (minimum) gold per MIL-G-45204, Type II, Grade C or GXT plating over 50 microinches (minimum) nickel per QQ-N-290, Class 2.

3.3.2 The terminal shall be plated in the contact area with 30 microinches (minimum) gold per MIL-G-45204, Type II, Grade C or GXT plating over 50 microinches (minimum) nickel per QQ-N-290, Class 2.

3.3.3 The terminal solder tail shall be plated with 100 microinches (minimum) tin lead 93-7 alloy per QQ-5-571 over 20 microinches (minimum) nickel per QQ-N-290, Class 2.Or pure tin plating 100 microinches (minimum) over 20 microinches (minimum) Nickel.

3.3.4 The terminal, other than contact and solder tail, shall be plated with 3 microinches (minimum) gold per MIL-G-45204, Type I, Grade B over 20 microinches (minimum) nickel per QQ-N-290, Class 2.

3.4 Design and Construction - The connector shall be a multi-piece assembly having one or two rows of contacts with solder tail terminations for installation in 0.030 or 0.070 inch diameter holes in a 1/16 inch thick printed wiring board. The connector legs can be bent to provide surface mount capability. The female end of the contact shall interface with 0.025 inch square pins on 0.100-inch centers.

3.4.1 Mating - The connector shall be capable of mating and unmating by hand without the use of special tools within the specified temperature range (see 3.6.4 and 5.4).

3.4.2 Workmanship - Connectors shall be uniform in quality and shall be free from burrs, scratches, cracks, voids, chips, blisters, pin holes, sharp edges, and other defects that will adversely affect life or serviceability.

3.4.3 Interchangeability - The connector shall be capable of mating with any appropriately constituted male connector of the same population without degradation in performance.

3.5 Electrical Characteristics

3.5.1 Current Rating - The maximum current rating of the connector shall be 3.0 amperes DC for individual terminals at ambient temperature <_ $20^{O}$ C and 2.0 amperes DC for the total connector.

3.5.2 Contact Resistance - The contact resistance shall not exceed the values specified in Table I.

## TABLE I - CONTACT RESISTANCE

| Maximum Resistance - Milliohms | |
|---|---|
| Initial | After Test |
| <_ 15 | <_ 20 |

When measured in accordance with MIL-STD-202, Method 307 (see 5.2) the following details shall apply:

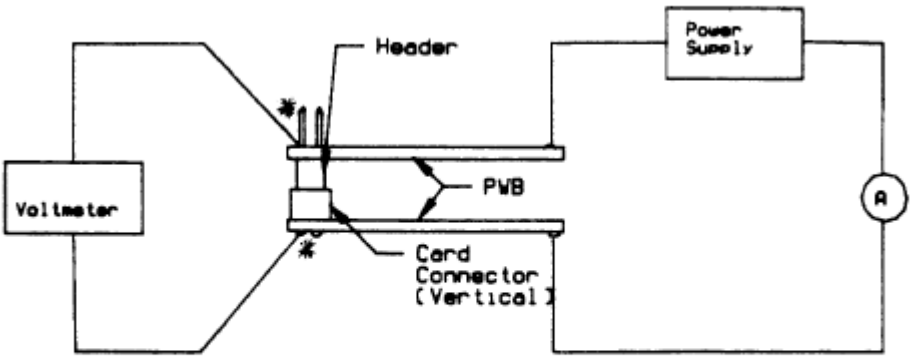
(a) Method of Connection: Attach current and voltage leads as shown in Figure 1.
(b) Test Current: 1 ampere DC, maximum
(c) Sample Size: 20 percent of connector population

3.5.3 Low Level Circuit Resistance - The low level circuit resistance shall not exceed the value specified in Table I when measured in accordance with MIL-STD-1344, Method 3002 (see 5.2). The following details shall apply:

(a) Method of Connection: see Figure 1
(b) Test Current: 10 milliampere DC
(c) Minimum Open Circuit Voltage: 20 millivolts DC
(d) Sample Size: 20 percent of connector population

3.5.4 Insulation Resistance - The insulation resistance of unmated connectors shall be not less than 100,000 megaohms (1,000 megaohms after exposure of the humidity environment described in 3.7.1) when measured in accordance with MIL-STD-202, Method 302. The following details shall apply:

(a) Test Condition: B (500 volts DC)
(b) Special Preparation: The connector shall not be terminated (see 5.3)
(c) Points of measurement: Between adjacent and opposing contact positions for 20 percent of connector population.

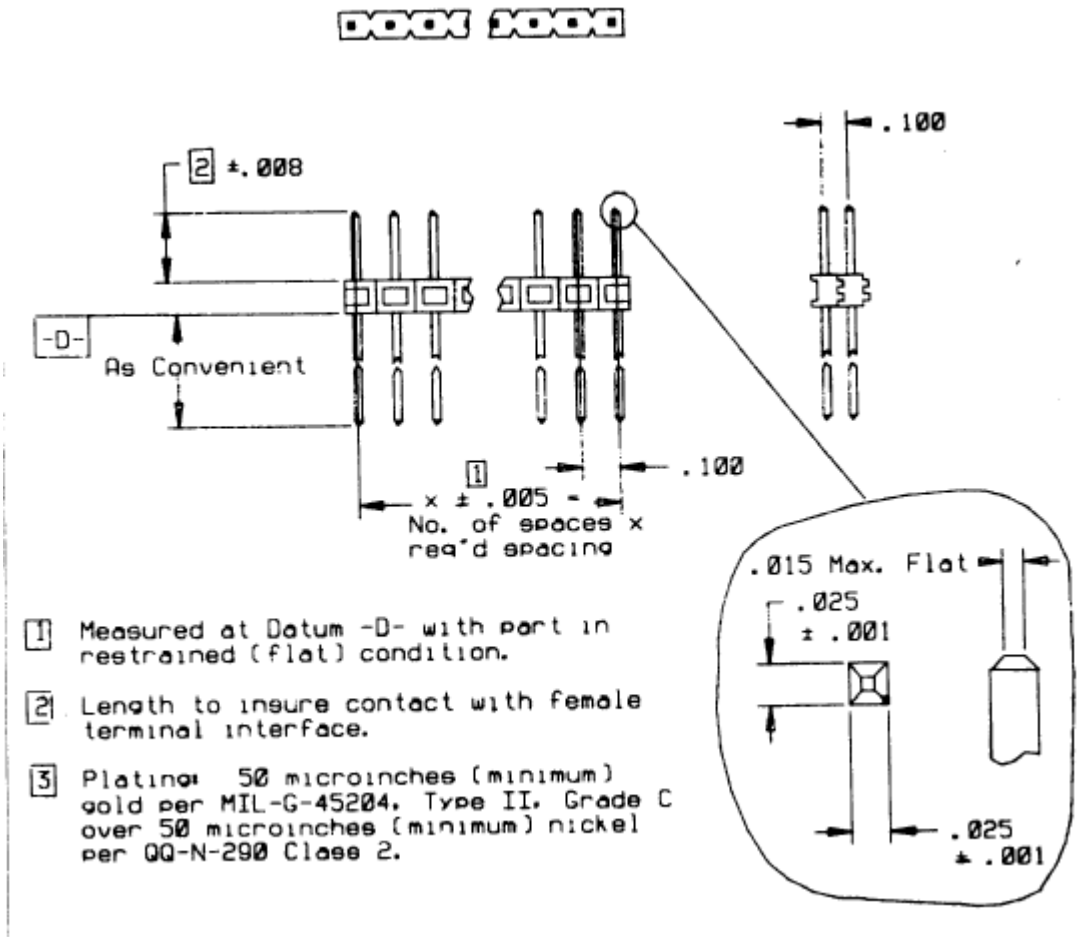



Vertical

FIGURE 1 - CONTACT RESISTANCE

*Probe Positioned at Pin-to-Board and Terminal-to-Board Solder Connection.

FIGURE 2- MATING HEADER



3.5.5 Dielectric Withstanding Voltage - There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (> 1 milliampere) when the unmated connectors are tested in accordance with MIL-STD-202, Method 301. The following details shall apply:

(a) Test Potential: See Table II
(b) Test Duration: 60 seconds
(c) Special Preparation: The connector shall not be terminated (see 5.3)
(d) Points of Measurement: Between adjacent and opposing contact positions for 20 percent of connector population

**TABLE II - DIELECTRIC WITHSTANDING VOLTAGE**

| Contact Spacing (inch) | Withstanding Voltage (volts, rms at 60 hz) |
|---|---|
| 0.100 | 1,000 |

3.5.6 Capacitance - The capacitance between pairs of adjacent or opposing contacts in an unmated connector shall not exceed 1.5 picofarads when measured in accordance with MIL-STD-202, Method 305. The following details shall apply:

(a) Test Frequency: 100 kilohertz
(b) Special Preparation: the connector shall not be terminated
(c) Sample Size: 20 percent of connector population

3.6 Mechanical Characteristics

3.6.1 Contact Retention - Individual contacts in the unterminated vertical connector shall withstand an axial load of 1 pound in the direction of normal pin insertion without dislodgement.

3.6.2 Terminal Strength - Individual contact tails in the unterminated connector shall withstand without fracture a bend of $45^{o}$ when tested in accordance with MIL-STD-202, Method 211. The following details shall apply:

(a) Direction of Bend: Normal to the width of the tail
(b) Number of cycles: 2
(c) Sample Size: 10 percent of connector population

3.6.3 Total Mating Force - The total force to mate the terminated connector with an appropriately populated header consisting of properly configured (see Figure 2) 0.025 inch square pins shall not exceed the individual contact insertion force times the number of terminals.

* Best estimate based on cumulative test time of hours of a continuing program; failure defined as a change in contact resistance greater than 25% from initial value.

3.6.4 Individual Contact Insertion Force - When measured using a maximum gage configured as shown in Figure 3, the individual contact insertion force shall not exceed the values shown in Table III.

3.6.5 Individual Contact Withdrawal Force - After three insertions of a maximum gage, the force required to withdraw a minimum gage, configured as shown in Figure 3, shall be not less than the value shown in Table III.

**TABLE III - INSERTION/WITHDRAWAL FORCE**

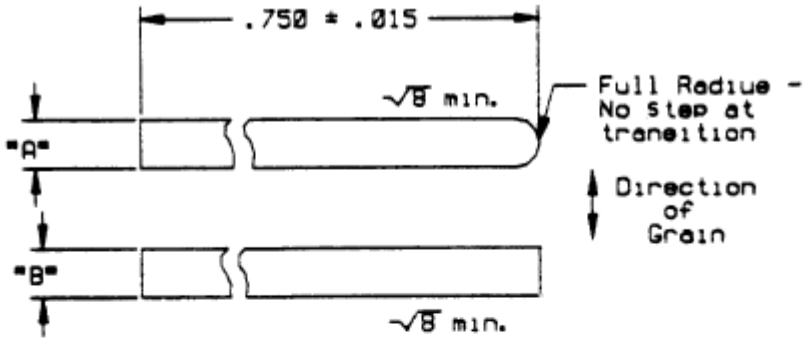
| Individual Contact Force-Grams | | Force/Contact in Composite Connectors |
|---|---|---|
| Insert (max) | Withdrawal (min) | (grams - max) |
| 250 | 30 | 250 |

3.6.6 Durability - After 225 mating cycles the contact resistance shall not exceed the value specified in Table I (see 3.5.2).

3.7 Environmental Conditions

3.7.1 Humidity - Within 1 hour after exposure of the unmated connector to a high humidity environment, the insulation resistance of an unterminated connector shall be not less than 1000 megohms (see 3.5.4) and the contact resistance of a terminated connector shall not exceed the value specified in Table I (see 3.5.2). The test shall be in accordance with MIL-STD-202, Method 103; the following details shall apply:

(a) Test Duration: 96 hours
(b) Relative Humidity: 90% minimum
(c) Temperature: $40^{o}$ C




Dimensions - Inch

| Gage | A | Tol. | B | Tol. |
|---|---|---|---|---|
| Min. | .0240 | + .0000 - .0002 | .025 | ±.001 |
| Max. | .0260 | + .0002 - .0000 | .025 | ±.001 |

Material: Shim Stock; grind to width and break edges; do not polish working surface.

Clean gage as follows before each use:

A. Scour surface with mildly abrasive material (rubber eraser, e.c.).

B. Wash surface with Freon and dry with clean cotton. DO NOT TOUCH SURFACE WITH FINGERS.

FIGURE 3 - INSERTION/WITHDRAWAL FORCE GAGE

3.7.2 Thermal Shock - After exposure of the unmated connector to alternate periods of extreme high and low temperature, there shall be no evidence of cracking or crazing of the insulator housing or other physical damage to the connector; after the test, the dielectric withstanding voltage of an unterminated connector shall be not less than the appropriate value specified in Table II (see 3.5.5) and the contact retention shall be not less than 2 pounds (see 3.6.1). The test shall be in accordance with MIL-STD-202, Method 107; the following details shall apply:

(a) Test Condition: B-1 (25 1-hour cycles)
(b) Temperature Range: -65 to +125$^{o}$ C

3.7.3 High Temperature Life - After exposure of the connector to a high temperature operating environment, the contact resistance shall not exceed the value specified in Table 1 (see paragraph 3.5.2). The test shall be in accordance with MIL-STD-202, Method 108; the following details shall apply:

(a) Test Chamber Temperature: 100$^{o}$ C
(b) Test Condition (Duration): B (250 hours)
(c) Operating Conditions: Rated current (see 3.5.1) through all contacts of terminated connector; duty cycle: 45 minutes ON and 15 minutes OFF

3.7.4 Shock - There shall be no evidence of physical or mechanical damage when the mated connector is subjected to transient accelerations. During and after each shock, the contacts shall evidence no discontinuity greater than 1 microsecond. The test shall be in accordance with MIL-STD-202, Method 213; the following details shall apply:

(a) Test Condition: A (50G, 11 ms half-sine)
(b) Number of Shocks: 3 shocks in each direction along three orthogonal axes (18 total)
(c) Mounting: see Figure 4

3.7.5 Vibration - There shall be no evidence of physical or mechanical damage when the mated connector is subjected to prolonged mechanical vibration; during the vibration along each axis, the contacts shall evidence no discontinuity greater than 1 microsecond. At the completion of the test, the contact resistance shall not exceed the value specified in Table I (see 3.5.2). The test shall be in accordance with MIL-STD-202, Method 204; the following details shall apply:

(a) Test Condition: B (+_ 15G, 10 to 2,000 Hz)
(b) Test Duration: 4 hours along each of three orthogonal axes (12 hours total)
(c) Mounting: see Figure 4

3.7.6 Hydrogen Sulfide ($H_2S$) Exposure - After exposure of the mated connector to a moist $H_2S$ atmosphere, the low level circuit resistance shall not exceed the value specified in Table I (see 3.5.3). The following details shall apply:

(a) Test Medium: 3 PPM $H_2S$ in air
(b) Test Temperature: $40^{o}$ C
(c) Test Duration: 48 hours

3.7.7 Salt Spray - After exposure of the mated connector to a salt fog atmosphere, the low level circuit resistance shall not exceed the value specified in Table I (see 3.5.3). The test shall be in accordance with MIL-STD-202, Method 101; the following details shall apply:

(a) Salt Solution: 5 percent by weight
(b) Test Condition: B (48 hours)

3.7.8 Solderability - The tails of individual contacts shall be solderable over a minimum length of 0.100 inch from the tip. The test shall be similar to MIL-STD-202, Method 208; the following details shall apply:

(a) Aging: suspended 2 inches above boiling distilled water for 60 minutes
(b) Acceptable Coverage: 95% minimum
(c) Solder: 60/40 Tin-Lead in accordance with QQ-S-571, Type S
(d) Flux: Type A, in accordance with MIL-F-14256
(e) Flux Immersion Time: terminal dipped and allowed to set 60 seconds
(f) Solder Dwell Time: terminal held immediately above solder for 10 seconds then immersed for 3 seconds
(g) Solder Temperature: 232 +_ $5^{o}$ C
(h) Number of Samples: 20

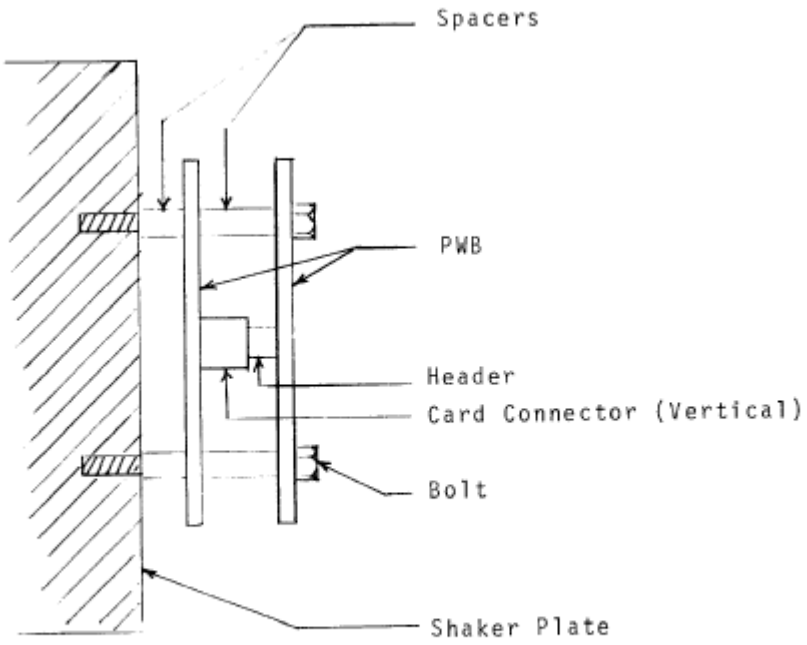



FIGURE 4 - SHOCK AND VIBRATION FIXTURING

3.7.9 Resistance to Soldering Heat - There shall be no evidence of physical damage to the insulator when the unterminated connector is subjected to the high temperature extreme imposed during soldering. the test shall be in accordance with MIL-STD-202, Method 210; the following details shall apply:

(a) Test Condition: B (260 +_ 5$^{O}$ C)
(b) Immersion Depth: To within 0.040 +_ 0.015 of insulator
(c) Dwell - 10 seconds

3.7.10 Resistance to Solvents - There shall be no evidence of physical damage to the insulator when the unterminated connector is exposed to a typical solvent/cleaner. The test shall be similar to MIL-STD-202, Method 215; the following details shall apply:

(a) Solvent: Agitated Trichloroethane
(b) Solvent Temperature: 55 +_ 5$^{O}$ C
(c) Immersion Time: 2 minutes
(d) Number of Immersions: 2

## 4.0 QUALITY ASSURANCE PROVISIONS

4.1 Equipment Calibration - All test equipment and inspection facilities used in the performance of any test shall be maintained in a calibration system in accordance with MIL-C-45662.

4.2 Inspection Conditions - Unless otherwise specified herein, all inspections shall be performed under the following ambient conditions:

(a) Temperature: 25 +_ 5$^{O}$ C
(b) Relative Humidity: 30 to 80%
(c) Barometric Pressure: Local ambient

4.3 Qualification Inspection - Qualification inspection shall be performed on sample units produced with equipment normally used in production.

4.3.1 Sample - Qualification inspection shall be performed on eight (8) of the largest population connectors of the type for which qualification under this specification is desired.

4.3.2 Preparation of Samples

4.3.2.1 Printed Wiring Test Boards - Four (4) test boards conforming to the applicable requirements of MIL-P-55110 and MIL-STD-275 shall be prepared.

4.3.2.2 Mating Headers - Four (4) mating headers of the appropriate population and configuration and conforming to the requirements of figure 2 shall be prepared.

4.3.2.3 Sample Mounting - Four (4) connectors (one per board) shall be installed in, and hand-soldered to, the test boards; a flux more active than that specified in 3.7.8 may be used to ensure that the solder joint does not contribute any degradation.

4.3.2.4 Sample Configuration - The various test samples shall be configured as shown in Table IV.

4.3.3 Test Sequence - The sample connectors shall be subjected to the inspections specified in Table V in the order shown.

**TABLE IV - SAMPLE CONFIGURATION**

| Sample No. | Terminated | Mating Header Required |
|---|---|---|
| 1-2 | No | No |
| 3-6 | Yes | Yes |
| 7-8 | No | No |

**TABLE V - CONNECTOR QUALIFICATION INSPECTION**

| Examination or Test | Paragraph | Sample Number 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Individual Contact Insertion Force | 3.6.4 | - | - | - | X | X | X | - | - |
| Individual Contact Withdrawal Force | 3.6.5 | - | - | - | X | X | X | - | - |
| Total Mating Force | 3.6.3 | - | - | - | X | X | X | - | - |
| Contact Resistance | 3.5.2 | - | - | X | X | X | X | - | - |
| Low Level Circuit Resistance | 3.5.3 | - | - | - | X | X | X | - | - |
| Insulation Resistance | 3.5.4 | X | X | - | - | - | - | - | - |
| Capacitance | 3.5.6 | X | - | - | - | - | - | - | - |
| Humidity | 3.7.1 | X | X | X | - | - | - | - | - |
| Thermal Shock | 3.7.2 | X | X | X | - | - | - | - | - |
| Dielectric Withstanding Voltage | 3.5.5 | X | X | - | - | - | - | - | - |
| Contact Retention | 3.6.1 | - | X | - | - | - | - | - | - |
| High Temperature Life | 3.7.3 | - | - | X | - | - | - | - | - |
| Shock | 3.7.4 | - | - | - | X | X | - | - | - |
| Vibration | 3.7.5 | - | - | - | X | X | - | - | - |
| Durability | 3.6.6 | - | - | - | X | - | X | - | - |
| Hydrogen Sulfide | 3.7.6 | - | - | - | X | X | X | - | - |
| Salt Spray | 3.7.7 | - | - | - | X | X | X | - | - |
| Terminal Strength | 3.6.2 | - | - | - | - | - | - | X | - |
| Solderability | 3.7.8 | - | - | - | - | - | - | X | - |
| Resistance to Soldering Heat | 3.7.9 | - | - | - | - | - | - | X | - |
| Resistance to Solvents | 3.7.10 | - | - | - | - | - | - | - | X |

4.4 Requalification Testing

If either of the following conditions occur, the product responsible engineer shall initiate requalification testing.

4.4.1 A significant design change is made to an existing product previously qualified under this specification. A significant design change shall be defined to include, but not be limited to, changes in contact material composition, contact material thickness, contact force, contact surface geometry, underlying material composition, underlying material thickness, insulator design, contact base material, or contact lubrication requirements.

4.4.2 A product failure occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.

Requalification testing shall consist of all or applicable parts of the Qualification Test Matrix as determined by development/product, quality, test, and reliability engineering.

## 5.0 NOTES AND DEFINITIONS

5.1 Total Mating Force - The higher population connectors may, because of their size, prohibit manual mating (or unmating) of the connector with its header. This condition represents a human limitation and not necessarily a connector malfunction (see 3.4.1 and 3.6.3).

5.2 Contact Resistance - Differences in contact resistance between various terminal configurations represent changes in the bulk resistance due to longer lengths of current paths; correction for these differences in bulk resistance will permit comparison of results for different styles of terminal (see 3.5.2 and 3.5.3).

5.3 Termination - The type of printed wiring board and the geometry of its land areas will affect this parameter; for this reason, this sample has not been terminated (see 3.5.4 and 3.5.5).

5.4 Lubrication of Card Connectors - All gold plated contact systems have been found to be improved by suitable lubrication which can enhance durability and lower insertion forces. FCI DU BOX™ Card Connectors are not lubricated during manufacture. After the soldering and cleaning operation, it is advisable to lubricate the connector system if durability and low insertion forces are important to the applications. The recommended lubrication is Nye 176 as a 5% solution of 111 trichloroethane. This mixture may be applied by brushing, sponging, dipping, or spraying. It can be applied to either the card connector or the pin field with equal effectiveness.

The preferred method is to dip the pin field in the mixture and then allow the 111 trichloroethane to evaporate; this is the most economical method for using the lubricant. If this is not possible, then an absorbent brush or roller may be used to apply the liquid to the pins.

The roller can also be used to apply lubricant to the card connector itself. Another method is to dip a pin field in the solution and transfer it immediately to the card connector, inserting just enough to deposit a small droplet on each contact.

The connector can be dipped into a container but care must be taken not to transfer an excessive amount of lubricant. The lead-in windows of the connector should be touched to the surface and the mixture will wick up into the contact area. The excess liquid should be blown off.

It is vital that commercial "contact cleaner-lubricants" not be used, as these materials have virtually no lubricants in them and the cleaning action will cause immediate severe wear and increase the insertion force as much as three times normal.

## REVISION RECORD

| REV | PAGE | DESCRIPTION | EC # | DATE |
|---|---|---|---|---|
| A | All | Change 5.4 to reflect that connectors are not lubricated during manufacture and recommend lubrication after soldering and cleaning process Reformat specification | V01510 | 10/19/90 |
| B | 8 | Change Table III to Insertion/Withdrawal Force; Change 3.6.6 to 225 mating cycles; delete Table IV; | V10414 | 02/27/91 |
| | 14 | Change Table V to IV, and VI to V; | | |
| | 15 | Add 4.4 Requalification Testing; | | |
| | 16 | Change chlorethane in 5.4 to 111 trichloroethane | | |
| C | 2 | Add MIL-M-24519 to MILITARY specifications and add 3.2.4 | V20286 | 03/05/92 |
| D | All | Revised format to be consistent with GS-01-001, and change BERG, Dupont, etc. references to FCI. | V01904 | 07/31/00 |
| E | 2,7 | Changed 3.2.3. Deleted 3.2.4. Changed 3.6.1 from 2 pounds to 1 pound | V02513 | 03/13/01 |
| F | 1-3 | Add Lead free information | M06-189 | 06/12/06 |
| G | 2,3 | Add GXT information, and Lab test reference for GXT | M07-0227 | 05/17/07 |
| H | All | Update format | M07-0229 | 05/18/07 |

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