1.0 Objective

This specification defines the performance, test, quality and reliability requirements of the Gold Plated Contact Bergcon PV Vertical and Horizontal Connector product. This product can be Lead Free and meets the requirements of the European Union Directive of Restrictions for Hazardous Substances (Directive 2002/95/EC).

2.0 Scope

This specification is applicable to the termination characteristics of the PV Connector family of products which provides interconnection of printed wiring boards in low power applications. The connectors only provide the female half of the interconnection and are designed for mating with single or double rows of .025 inch square pins, free standing or in headers on .100 or .150 inch centers.

3.0 General

This document is composed of the following sections:

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4.0 Applicable Documents

4.1 Specifications- N/A

4.2 Military Standards

MIL-STD-202 Test methods for electronic and electrical component parts.
MIL-STD-275 Printed Wiring for Electronic Equipment
MIL-M-14- Molding Plastic and Molded Plastic Parts, Thermosettings
MIL-F-14256 Flux, Soldering , Liquid (Rosin Base), Activated
MIL-M-20693 Plastic Molding Material, Polyamide (Nylon)
MIL-M-24519 Molding Plastics, Polyester , Thermoplastic
MIL-G-45204 Gold Plating, Electro deposited
MIL-C-45662 Calibration System Requirements
MIL-F-55110 Printed Wiring Boards

4.3 Federal Specifications

QQ-N-290 Nickel Plating (Electro deposited)
QQ-S-571 Solder: Lead Alloy, and Tin Lead Alloy and Tin Alloy; Flux Cored Ribbon and Wire and Solid Form.
QQ-B-613 Brass, Leaded and Non Leaded

4.4 Other Standards and Specifications

4.4.1 UL94- Test for Flammability of Plastic Materials.

4.4.2 EIA 364 Electrical Connector/Socket Test Procedures Including Environmental Classifications.

4.4.3 ASTM B –122 Copper - Nickel –Tin Alloy, Copper-Nickel –Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip and Rolled Bar.
ASTM B-194 Copper-Beryllium Alloy Plate, Sheet, Strip and Rolled Bar

4.4.4 ANSI-J-002 Test condition A

4.5 FCI Specifications

4.5.1 BUS-02-055 Plastic Resin Selection
BUS-02-056 Metal Selection
BUS-02-057 Plating Selection Guidelines
BUS-03-302 Sulfide Vapor Test
BUS-03-405 Insertion / Withdrawal Force Measurement
BUS-03-601 Current Rating / 30 Deg. C Temperature Rise
BUS-19-122 Solder Joint Reliability Test procedure for Surface Mount Connectors

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4.6 FCI Lab Reports - Supporting Data

ZA5-2625 Lead Free Plating investigation

5.0 Requirements

5.1 Qualification

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

5.2 Material

The material for each component shall be as specified herein or equivalent. Reference BUS-02-055; BUS-02-056.

Metalic Parts:

5.2.1 Contact Body: The body shall be one-half hard (H01) brass alloy UNS C26000 in accordance with QQ-B-613, or quarter hard (H01 Temper) Copper-Nickel-Tin alloy UNS C72500 in accordance with ASTM B-122.

5.2.2 Contact Spring: The spring shall be (TH02 Temper) heat-treated beryllium copper alloy UNS 17200 in accordance with ASTM B-194.

Insulator Housing :

All housing material shall be rated flame retardant 94V-1 or better in accordance with UL-94.

5.2.3 The housing shall be glass filled Nylon (Type 6-6) in accordance with MIL-M-20693, or,

5.2.4 The housing shall be filled diayll phthalate in accordance with MIL-M-14, Type SDGF or

5.2.5 The housing shall be glass filled polyester (Type GPT-15F or GPT-30 F) in accordance with MIL-M-24519, or

5.2.6 The housing shall be filled phenolic in accordance with MIL-M-14, Type MFH, or

5.2.7 The housing shall be glass filled PPS Type GST-40 F in accordance with MIL-M-24519B9 (EC), or

5.2.8 The housing shall be 45% glass filled High Temperature Nylon (PPA).

Other Plastic:

5.2.9 Insulator Bar (Optional): The bar shall be unfilled Nylon in accordance with MIL-M-20693, Composition A, Type 1

5.3 Finish : The finish for applicable components shall be as specified herein or equivalent. Reference BUS- 02-057.

5.3.1 Contact Body : The body shall be plated in the contact area with 15 micro-inches (minimum) (150-200 Knoop Hardness) gold per MIL-G-45204, Type II, Grade C over 50 micro-inches (minimum) nickel per QQ-N-290, Class 3, or

5.3.2 The body shall be plated in the contact area with 30 micro-inches (minimum) gold per MIL-G-45204, Type II, Grade C over 50 micro-inches (minimum) nickel per QQ-N-290, Class 2, or

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5.3.3 The body shall be plated in the contact area with 40 micro-inches (minimum) (150-200 Knoop Hardness) gold per MIL-G-45204, Type II, Grade C over 50 micro-inches (minimum) nickel per QQ-N-290, Class 2. or

5.3.4 The body shall be plated in the contact area with 50 micro-inches (minimum) gold per MIL-G-45204, Type II, Grade C over 50 micro-inches (minimum) nickel per QQ-N-290, Class 2.

5.3.5 Contact Spring:

The spring shall be plated with gold flash per MIL-G-45204.

5.3.6 Solder-tail:

The solder-tail will be plated with 3 micro-inches (minimum) gold flash over 50 micro-inches (minimum) nickel, except for the vertical card connector with 30 micro-inches gold in the contact area. The 30 micro-inch gold vertical card connector will have 100 micro-inches (minimum) Tin Lead (93%) over 50 micro-inches nickel on the solder-tail. Or will have 100-160 microinches pure tin.

5.4 Design And Construction

Connectors shall be of the design, construction, and physical dimensions specified on the applicable product drawing. The connector shall be a multi-piece assembly having one or two rows of contacts with solder-tail terminations for installation in 0.035 inch diameter holes in a 1/16 thick printed wiring board. The female end of the contact shall interface with 0.025 inch square pins on 0.100 or 0.150 inch centers, as appropriate

5.4.1 Mating: The connector shall be capable of mating and unmating by hand without the use of special tools within the specified temperature range.

5.4.2 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.

5.4.3 Inter-change ability: The connector shall be capable of mating with any appropriately constituted male connector of the same population without degradation in performance.

6.0 **Electrical Characteristics:**

6.1 Contact Resistance, Low Level (LLCR) - The low level contact resistance shall not exceed the following when measured in accordance with EIA 364-23.

The following details shall apply:

a. Method of Connection - Attach current and voltage leads as shown in Figure _1__.
b. Test Voltage - 20 milli-volts DC max open circuit.
c. Test Current – 1.0 milli-amperes DC (Not to exceed 100 milli-amperes)
d. Sample Size – 20 % of connector population.

6.2 Contact Resistance, Specified Current - The contact resistance at a specified current shall not exceed _(See Table 2) milli-ohms and milli-ohms after environmental exposure when measured in accordance with EIA 364-06. The following details shall apply:

a. Method of Connection - Attach current and voltage leads as shown in FIGURE __1__.

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b. Test Current __1__ amperes DC.
c. Sample size – 20 % of connector population

TABLE 2 – CONTACT RESISTANCE

Horizontal – 10 maximum milli-ohms initial
Horizontal – 15 maximum milli-ohms after environmental exposure
Vertical ------10 maximum milli-ohms initial
Vertical ------15 maximum milli-ohms after environmental exposure

6.3 Insulation Resistance - The insulation resistance of the unmated connector shall not be less than 50,000 meg-ohms after environmental exposure (5,000 meg-ohms after humidity) when measured in accordance with EIA 364-21. The following details shall apply:

a. Test Voltage - _500 __ volts DC.
b. Electrification Time - 2 minutes, unless otherwise specified.
c. Points of Measurement - Between adjacent contacts and opposing contact positions for 20 percent of connector population.

6.4 Dielectric Withstanding Voltage - There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (> 1 milli-ampere) when (unmated) connectors are tested in accordance with EIA 364-20. The following details shall apply:

a. Test Voltage – (*See* Table *3*) volts (DC RMS or AC, 60Hz).
b. Test Duration - 60 seconds.
c. Test Condition - 1 (760 Torr - sea level).
d. Points of Measurement - Between adjacent and opposing contact positions for 20 % of connector population.

TABLE 3 – DIELECTRIC WITHSTANDING VOLTAGE

Contact Spacing (inch)	Withstanding Voltage (volts, RMS at 60 Hz)
0.100	1,250
0.150	1,500

6.5 Current Rating - The temperature rise above ambient shall not exceed 30 deg C at any point in the system when all contacts are powered at _2.0_ ampere(s) or one contact is powered at _3.0__ amperes. The following details shall apply:

a. Ambient Conditions - Still air at 25 degrees C.
b. Reference - BUS-03-601.

6.6 Capacitance – The specification requirement shall be satisfied when evaluated in accordance with MIL-STD-202 Method 305. The following details shall apply:

a. Specification requirement __< 2.0_ pF (indicate < or >)
b. Sample documentation (Define application and provide drawings)
c. Sample test conditions
Frequency 100 khz (default 1 mhz)

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Amplitude ___volts (default 1 volt)

d. Sample size 20 % of connector population
e. Unmated Connector

7.0 Mechanical Characteristics

7.1 Mating / Unmating Force - The force to mate a receptacle connector and compatible header with .025 square pins shall not exceed (See Table 4) grams per contact times the number of contacts. (FIGURE 2) The following details shall apply:

a. Cross Head Speed - 1 inch per minute.
b. Lubrication - ____N/A_____.
c. Utilize free floating fixtures.
d. Reference - EIA 364-13.

7.2 Individual Contact Insertion/Withdrawal Force - The insertion force shall not exceed (See Table 4) grams when a maximum gauge is inserted. After three insertions with a maximum gauge, the withdrawal force shall not be less than (See Table 4) grams when measured using a minimum gauge. See FIGURE _3_ for gauge descriptions. Gauges should be cleaned after each test cycle with a soft eraser or equivalent non -abrasive material to remove any plating build-up. Gages should not be lubricated. Testing shall be in accordance with Berg Test Specification BUS-03-405.

TABLE 4 – FORCES VS SPRING THICKNESS

Spring Thickness (mils)	Individual Contact Force - - Grams Insertion (max)	Withdrawal (min)	Force / Contact In Composite Connector (grams Max)
3.0	200	30	200
3.5 & 4.0	300	40	300
4.8	450	50	450

7.3 Contact Retention – (Vertical Card Connector Only)
Individual contacts shall withstand an axial load of 2 pounds minimum applied at a rate of 0.2 inches/minute without dislodging from the housing cavity. Reference EIA 364-29.

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7.4 Terminal Strength – Individual contact tails in the un-terminated connector shall withstand without fracture a bend of 45 degrees 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 % of connector population

8.0 Environmental Conditions

After exposure to the following environmental conditions in accordance with the specified test procedure and/or details, the product shall show no physical damage and shall meet the electrical and mechanical requirements per paragraphs 6.0 and 7.0 as specified in the Table 1 test sequences. Unless specified otherwise, assemblies shall be mated during exposure.

8.1 Thermal Shock - EIA 364-32.

a. Number of Cycles - __25__ 1 hour cycles
b. Temperature Range - Between _-55_ and _+130_ deg C (-55 to + 105 for nylon insulators)
c. Time at Each Temperature - 60 minutes
d. Transfer Time - 5 minutes, maximum
e. Unmated Connector

8.2 Humidity, Steady State - EIA 364-31, Method II.

a. Relative Humidity - 95%
b. Temperature - +40 deg C
c. Test Condition - A (96 hours)
d. Unmated Connector

8.3 High Temperature Life - EIA 364-17.

a. Test Temperature - 100 deg C (+ 75 deg C for Nylon insulators)
b. Test Duration – 250 hours
c. Operating conditions : Rated current through all contacts of terminated connector. Duty Cycle : 45 minutes ON and 15 minutes OFF.

8.4 Hydrogen Sulfide (H2S) - BUS-03-302

a. Duration - 48 hours
b. Temperature - 40 deg C
c. Test Vessel - 9000 milli-liter glass desiccator
d. Test Medium : 3 PPM H2S in air

8.5 Salt Spray - EIA 364-26

a. Salt Solution - 5% by weight
b. Test Condition – B (48 hours)

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8.6 Vibration Sinusoidal - EIA 364-28
- a. Test Condition – III
- b. Vibration Amplitude - 0.06" DA or +/-15G
- c. Frequency Range - 10 to 2000 hertz
- d. Sweep Time and Duration - 20 minutes per sweep, 4 hours along each of three orthogonal axes
  (12 hours total)
- e. Mounting - Rigidly mount assemblies. See Figure 4
- f. No discontinuities greater than 1 microsecond

8.7 Mechanical Shock - EIA 364-27
- a. Condition - A (50G, 11 millisecond half-sine)
- b. Shocks - 3 shocks in both directions along each of three orthogonal axes (18 total)
- c. Mounting - Rigidly mount assemblies (See Figure 4)
- d. No discontinuities greater than 1 microsecond.

8.8 Durability – After the number of mating cycles of Bergstik II, 30 micro-inch thick gold plated header on .100 centerline, the individual contact withdrawal force shall not be less than value in grams in Table 4 and the contact resistance shall not exceed the value specified in Table 2.

TABLE 5 - DURABILITY

Gold Plating (Thickness u-inch)	Spring Thickness (mils)	Mating Cycles
15	3.5	50
15	3.0	50
30	3.5	250
30	3.0	250
40	3.5	250
40	3.0	250
50	3.5	250
50	3.0	250

8.9 Solderability - ANSI-J-002, Test Condition A
- a. Steam aging –1—hours (suspended 2 inches above boiling distilled water for 60 minutes)
- b. Contact areas evaluated shall meet the ANSI-J-002 requirements.
- c. Number of samples: 20
- d. Acceptable coverage: 95% minimum of .100 length from the tip
- e. Solder : 60/40 Tin-Lead in accordance with QQ-S-571, Type S
- f. Flux: Type A in accordance with MIL-F-14256
- g. Flux Immersion Time: Terminal dipped and allowed to set 60 seconds
- h. Solder Dwell Time: Terminal held immediately above solder for 10 seconds then immersed for 3 seconds.
- i. Solder temperature: 232 +/- 5 deg. C

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8.10 Resistance to Solder Heat - EIA 364-56
- a. Test Condition – E
- b. Immersion depth: To within .040 +/- .015 of insulator
- c. There shall be no evidence of physical or mechanical damage

8.11 Resistance to Solvents - EIA 364-11
- a. Solvent - Alcohol
- b. Solvent Temperature - 25 deg C
- c. Immersion Time - 2 minutes
- d. Number of Immersions – 2

9.0 QUALITY ASSURANCE PROVISIONS

9.1 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 and ISO 9000.

9.2 Inspection Conditions

Unless otherwise specified herein, all inspections shall be performed under the following ambient conditions:
- a. Temperature: 25 +/- 5 deg C
- b. Relative Humidity: 30% to 60%
- c. Barometric Pressure: Local ambient

9.3 Sample Quantity And Description

9.4 Samples:
Qualification Inspection shall be performed on eight (8) of the largest population connectors of the type for which qualification under this specification is desired.

9.5 Preparation of Samples:
Printed Wiring Test Board:
Four (4) test boards conforming to the applicable requirements of MIL-P-55110 and MIL-STD-275 shall be prepared as shown in Figure 5.

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

Sample Mounting :
Four connectors (one per board) shall be installed in, and hand soldered to , the test boards ; a flux more active than type A, in accordance with MIL-F-14256 may be used to insure that the solder joint does not contribute any degradation.

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TABLE 6 – SAMPLE CONFIGURATION

Sample No.	Terminated	Mating Header Required
1 - 2	NO	NO
3 - 6	YES	YES
7 - 8	NO	NO

9.4 Acceptance

9.4.1 Electrical and mechanical requirements placed on test samples as indicated in paragraphs 6.0 and 7.0 shall be established from test data using appropriate statistical techniques or shall otherwise be customer specified, and all samples tested in accordance with this product specification shall meet the stated requirements.

9.4.2 Failures attributed to equipment, test set up, or operator error shall not disqualify the product. If product failure occurs, corrective action shall be taken and samples resubmitted for qualification.

9.5 Qualification Testing

Qualification testing shall be performed on sample units produced with equipment and procedures normally used in production. The test sequence shall be as shown in Table 1.

9.6 Requalification Testing

If any of the following conditions occur, the responsible product engineer shall initiate re-qualification testing consisting of all applicable parts of the qualification test matrix, Table 1.

a. A significant design change is made to the existing product which impacts the product form, fit or function.
Examples of significant changes shall include, but not be limited to, changes in the plating material composition or thickness, contact force, contact surface geometry, insulator design, contact base material, or contact lubrication requirements.
b. A significant change is made to the manufacturing process which impacts the product form, fit or function.
c. A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.

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TABLE 1 – QUALIFICATION TESTING

TEST	PARA.	TEST GROUP										
		1	2	3	4	5	6	7	8			
		TEST SEQUENCE										
Examination of Product	5.4	1 8	1 8	1 14	1 16	1 14	1 11	1 5	1 3			
Contact Resistance Low Level	6.1			3 6 10 13	10 13 15	8 10 11 13	8 10					
Contact Resistance	6.2			2 5 9 12	5 7 9 11	5 7	4 6					
Insulation Resistance	6.3	3	3									
Dielectric Withstanding Voltage	6.4	6	6	8								
Current Rating	6.5											
Capacitance	6.6	4										
Mating Force	7.1				3	3	3					
Insertion / Withdrawal Force	7.2				2	2	2					
Contact Retention VCC	7.3	7	4 7									
Terminal Strength	7.4							2				
Thermal Shock	8.1	5	5	7								
Humidity, Steady State	8.2	2	2	4								
Hi Temperature Life	8.3			11								
Hydrogen Sulfide	8.4				12	9	7					
Salt Spray	8.5				14	12	9					
Vibration	8.6				6	6						
Mechanical Shock	8.7				4	4						
Durability	8.8				8		5					
Solderability	8.9							3				
Res. to Soldering Heat	8.10							4				
Resistance to Solvents	8.11								2			

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10.0 Reference Documents : N/A

11.0 Notes and Definitions

Insulator Bar

The bar, available as an option in a double row horizontal connector, prohibits contact between the tip of a pin,mated with a bottom row terminal, and the tail of the upper row terminal immediately above

Total Mating Force

The higher population connectors may, because of their size, prohibit manual mating or un-mating of the header with its header. This condition represents a human limitation and not necessarily a connector malfunction. (See 7.1)

Contact Resistance

Differences in contact resistances 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 6.1 & 6.2)

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 Figure 5)

Alloy 725 Solderability

Efforts to provide >95% solderability using mildy active fluxes with this alloy have proven futile. This coverage is possible with more active fluxes, but they present corrosion problems if not adequately removed by cleaning.(See 8.9)

Lubrication of Card Connectors

All gold plated contact systems have been found to be improved by suitable lubrication which enhance durability and lower insertion forces. The PV's in this product 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 application. The recommended lubrication is Nye 176 oil as a 5% solution in a vanishing type solution. 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 vanishing solution 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 window s 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.

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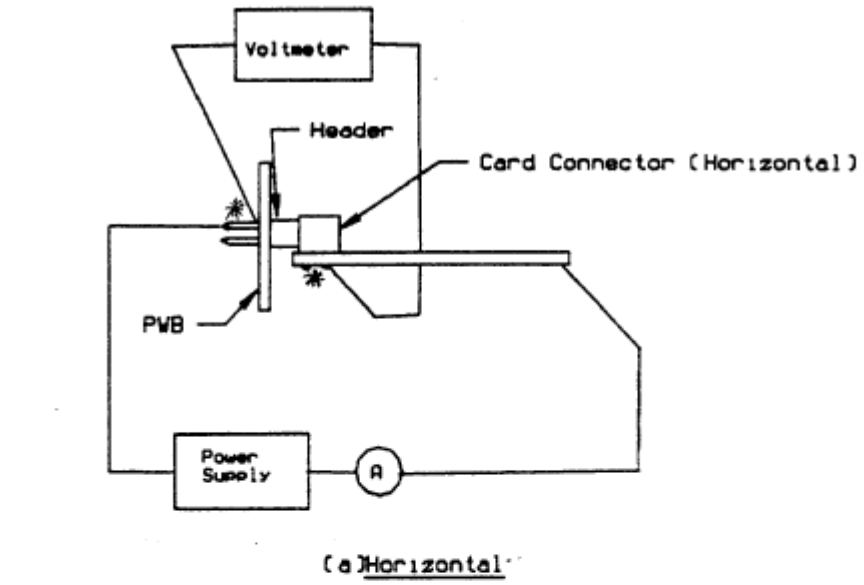
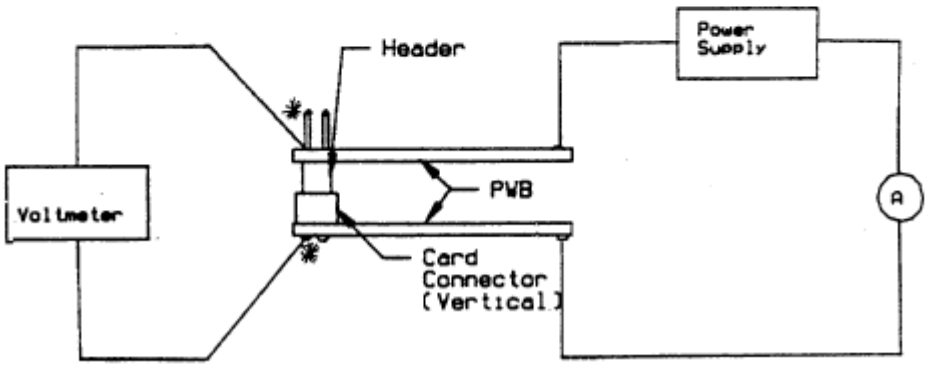
FIGURE 1-CONTACT RESISTANCE



(a) Horizontal



(b) Vertical

* **PROBE POSITIONED AT PIN TO BOARD AND TERMINAL TO BOARD SOLDER CONNECTION**

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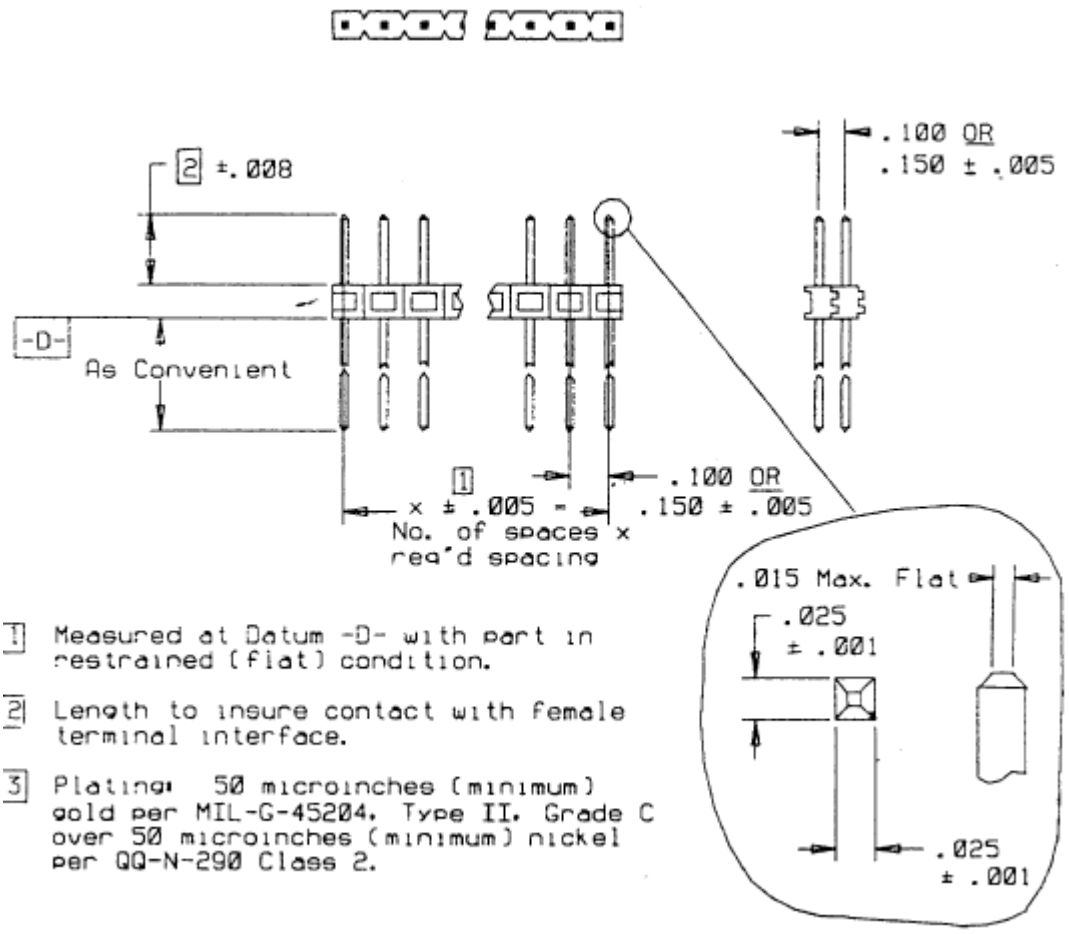
FIGURE 2- MATING HEADER



[1] Measured at Datum -D- with part in restrained (flat) condition.

[2] Length to insure contact with female terminal interface.

[3] Plating: 50 microinches (minimum) gold per MIL-G-45204, Type II, Grade C over 50 microinches (minimum) nickel per QQ-N-290 Class 2.

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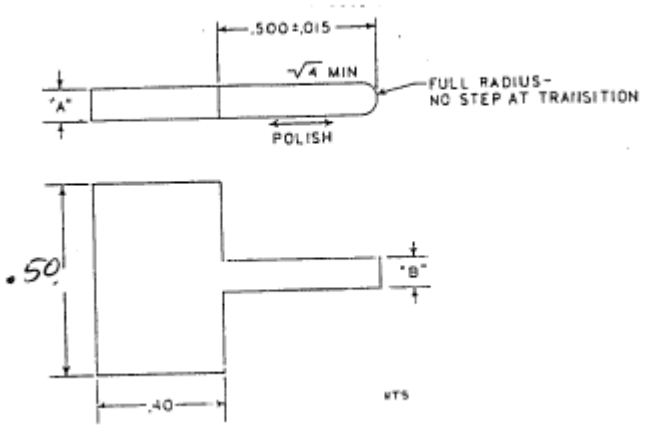
FIGURE 3- INSERTION/ WITHDRAWAL FORCE GAGE



DIMENSIONS-INCH

Gage	A	Tol.	B	Tol.
Min.	.0240	+ .0000 - .0002	.25	+/- .001
Max.	.0260	+ .0002 - .000	.25	+/-.0001

Material: M2 steel, hacksaw blade or shim stock at. 64 Rockwell grind working surface in direction of polish.

Polish: To accomplish a 4u " finish, use 400 grit paper with Metadi fluid as lubricant or equivalent method to obtain 4 u " finish

Clean gage as follows before each use:

A. Wash surface with Freon or equivalent and dry with clean cotton. DO NOT TOUCH SURFACE WITH FINGERS.
B. Scour surface with pink Pearl eraser.

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FIGURE 4- SHOCK & VIBRATION FIXTURING

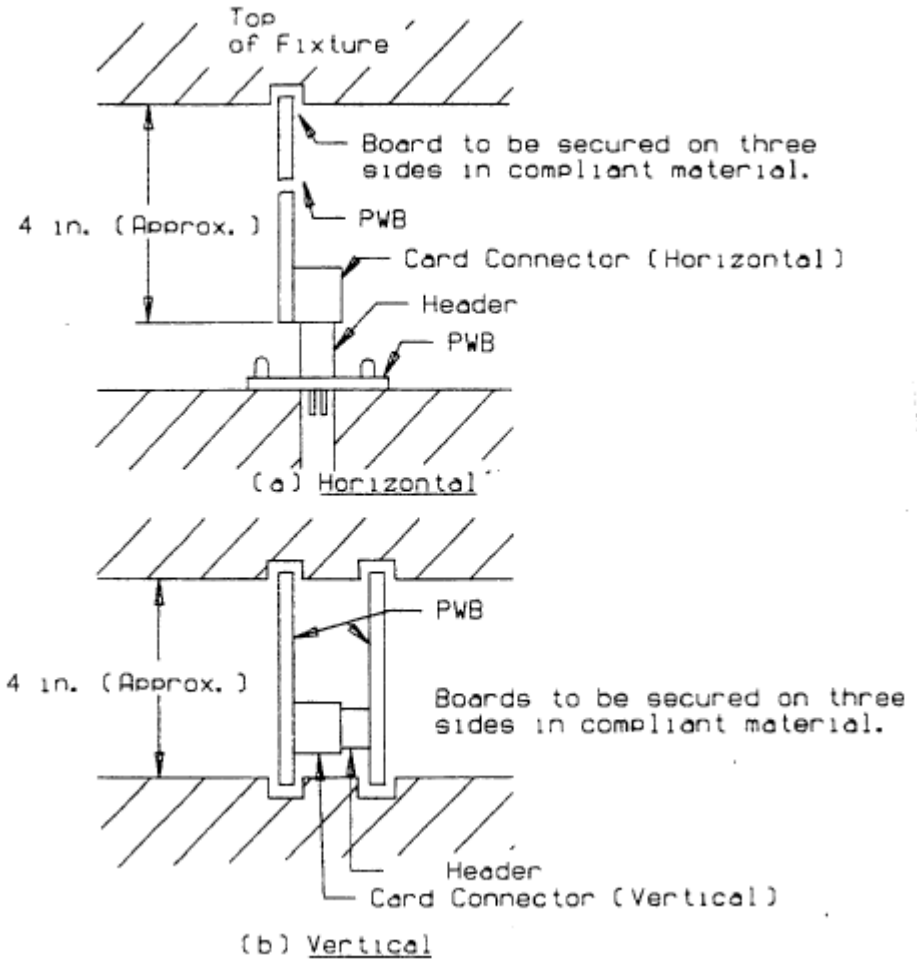

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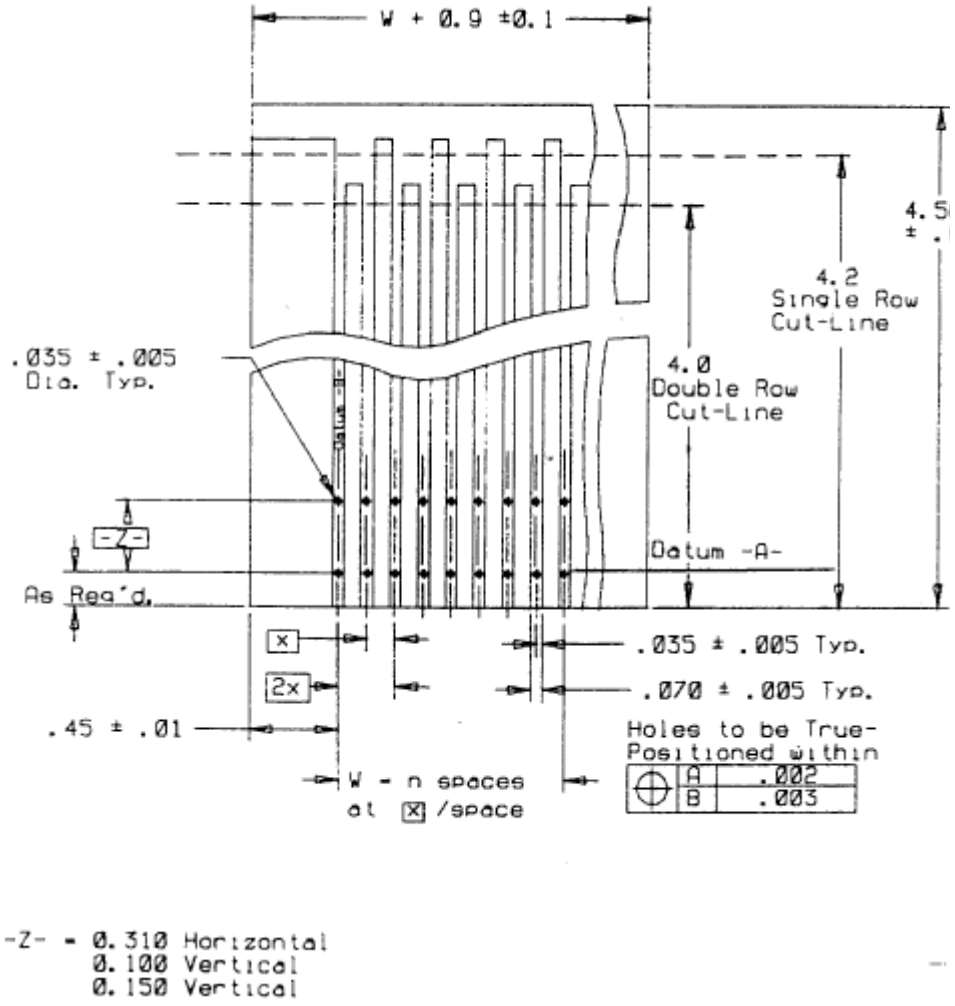
FIGURE 5 – PRINTED WIRING BOARD



NOTES:
1. X=.100 +- .005. or .150 +-.005
2. Datum –A- located as best average position of front row holes.
3. Datum –B- located through average center-line of first hole(s).
4. Board to be 2 ounce, single-side, copper clad, glass filled epoxy 0.062 +- 0.010 think.
5. Land areas to be plated with solder 100 to 300 micro inches thick.

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REVISION RECORD

REV	PAGE	DESCRIPTION	EC #	DATE
F	ALL	Retype spec and add "150-200 Knoop Hardness" to 3.3.1.1 and 3.3.1.3	14788	05/19/88
G	ALL	Reformat spec and change one-half hard brass to one-quarter hard brass in 3.2.1.1; add 3.3.2 "Soldertail" information	V02103	12/21/90
H	1, 9, 11, 17, 21, 23	Add Requalification Testing to 1.0 Delete Quality Conformance and Acceptance Inspection from 1.0; Delete 3.5.7 and "Best estimate paragraph from 3.6.3; Change Mating Cycles in Table IV; Replace 4.4 with Requalification section Delete Table VII, Table VIII, Table IX; Change 5.5 to reflect no lubrication of parts during manufacture, replace Freon with Trichloroethane as lubricant	V01412	02/27/91
J	15	Change 3.7.9 (a) to "G" procedure. Change 3.7.10 (a) to Trichloroethane 1.1.1		
K	3	Add 3.2.2.5 Spelling change in 3.2.2.2	V60508	5/13/96
L	ALL	Add HTN Nylon Housing material & update spec per Bus-01-059	V00744	11/01/00
M	1,4	Add lead free information	M06-0266	7/11/06
N	1,11	Delete colums 9,10,11 in table 1 , on page 11	M08-0100	8/09/08

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