ENGINEERING REPORT

REPORT NUMBER
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Amphenol Corporation **Aerospace Operations** **Sidney, NY 13838**

TITLE: QUALIFICATION OF LOW FORCE RUGGED VME64X BACKPLANE/MODULE CONNECTORS TO BS-VME64X-AA REV PA 11 SPECIFICATION SUBSET

Module Connector **10-509400-001**
Backplane Connector **10-509412-053**

REPORT TYPE
Qualification Summary

PROJECT NUMBER
-

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REFERENCES

1) **Amphenol BS-VME64X-AA Rev. PA11 Amphenol Rugged VME64x Connector Specification**
2) **VITA ANSI/VITA 1.1-1997 VME64x Specification**
3) **ANSI/EIA-364 Test Methods For Electronics And Electrical Components Parts**
4) **MIL-STD-1344A Test Methods For Electrical Connectors**
5) **MIL-C-55302E General Specification For Printed Circuit Subassemblies And Accessories Connectors**
6) **MIL-STD-202G Test Methods For Electronics and Electrical Component Parts**
7) **10-509400-001 Standard VME64x Configuration Omits Row Z of P0 Bay and has ESD Protection**
8) **10-509412-053 Standard VME64x Configuration Omits Row Z of J0 Bay**
9) **Amphenol Engineering Qualification Report ER-8764**
10) **Amphenol Engineering Report C1-1168**

1.0 PURPOSE

This testing was done to qualify two piece printed circuit board type rectangular connectors with pin and skeeter socket contacts. The connectors are compatible with the standard VME64x footprint, as described in **VITA ANSI/VITA 1.1-1997 VME64x Specification.**

This report is a summary of the actual qualification test report ER-8764.

2.0 BACKGROUND

Each sample was made up of a mated pair of connectors (Module and Backplane) mounted on test circuit boards. The Module connectors contain pin contacts with printed circuit board stud terminals positioned 90° to the engagement axis. These connectors mount directly to printed circuit boards, and are intermateable with Backplane connectors. Backplane connectors contain skeeter socket contacts with compliant/solderless terminations. These connectors mount directly to printed circuit boards and are intermateable with the Module series connectors.

The original qualification report for the skeeter socket contact type Rugged VME64x connectors was reported in C1-1168. This report (C1-1179) details the performance of a low mating force version of the same Rugged VME64x connector family. Changes in this product with respect to the samples tested in C1-1168 were solely on the backplane connector, 10-509412-053. These included low mating force skeeter socket contacts, with a tail-less compliant (solderless) termination. This tail-less compliant termination was tested in both urethane and parylene conformally coated test boards.

Not all testing as outlined in the test plan was performed. Group 4 and Group 5 tests were omitted due to similarity of parts to those tested in C1-1168. Groups 1, 2, and 3 also had tests omitted due to similarity to previous work in C1-1168. Group 6 testing was done at Amphenol Backplane Systems in Nashua, New Hampshire. All other testing performed at Amphenol Aerospace Operations in Sidney, New York.

3.0 CONCLUSIONS

The low force skeeter socket contact connectors met all of the requirements of the BS-VME64x-AA Rev PA11 specification. Most notable was the maximum mating force of 59.4 pounds.

The tail-less compliant connectors assembled to the urethane coated backplane test boards met all of the requirements specific to compliant/solderless termination of the BS-VME64x-AA Rev PA11 specification.

The tail-less compliant connectors assembled to the pre-connector assembly parylene coated backplane test boards did not meet the requirements specific to compliant/solderless termination of the BS-VME64x-AA Rev PA11 specification.

4.0 RECOMMENDATIONS

The BS-VME64x-AA specification should be changed to 68 pound maximum mating force for the low force skeeter connector design.

The tail-less compliant termination of the 10-509412-053 connector is suitable for use in both uncoated and urethane coated printed wiring boards.

The tail-less compliant termination of the 10-509412-053 connector does not perform adequately in pre-connector assembly parylene coated printed wiring boards, and should therefore not be used in boards which have parylene coating in the plated through holes prior to contact installation.

5.0 SUMMARY OF TESTING

Table 1. Summary of Testing

Sample	Test/Inspection	Pass/Fail	BS-VME64x-AA Rev PA11 Requirement
Group 1	Visual and Mechanical Inspection 10X	Pass	Workmanship
	Interchangeability	Pass	First Article Dimensions
	Mating and Unmating Forces	Pass	108.5 lb. Maximum[1] 17.4 lb. Minimum[1]
	Low Level Contact Resistance	Pass	20 mO max.
	Contact Resistance	Pass	20 mO max.
	Contact Retention	Pass	J1/J2 3 lbs with 0.015" max disp. J0 1 lb 0.015" max disp.
	Dielectric Withstanding Voltage at Sea Level	Pass	500 V.A.C. @ 60 Hz
	Insulation Resistance	Pass	1 Gigaohm @ 500 V.D.C.
	Electro Static Discharge (ESD) Protection Approved by Similarity to C1-1168	Pass	HBM 25 KV. attn. < 40 V
	Mating and Unmating Forces (sequence was changed to permit capture of initial mating force)	Pass	108.5 lb. Maximum[1] 17.4 lb. Minimum[1]
Group 2	Dielectric Withstanding @ 70,000 ft. Approved by Similarity to C1-1168	Pass	100 V.A.C. @ 60 Hz
	Contact Life	Pass	500 mating cycles
	Mating and Unmating Forces	Pass	108.5 lb. Maximum[1] 17.4 lb. Minimum[1]
	Low Level Contact Resistance	Pass	20 mO max.
	Vibration 15 g peak max.	Pass	No elec. discont. > 1 µs
	Shock 100 g max.	Pass	No elec. discont. > 1 µs
	Low Level Contact Resistance	Pass	20 mO max.
	Contact Resistance	Pass	20 mO max.
	Mating and Unmating Forces	Pass	108.5 lb. Maximum[1] 17.4 lb. Minimum[1]
	Salt Atmosphere 500 hours	Pass	Inspect for Degradation
	Low Level Contact Resistance	Pass	20 mO max.
	Contact Resistance	Pass	20 mO max.
	Visual and Mechanical Inspection 10X	Pass	Inspect for Degradation
	Backplane to Compliant Contact Resistance	Pass[2]	26 mO maximum[2]
Group 3	Temperature Cycling	Pass	-65C to 125C, 5 cycle
	Mating and Unmating Forces	Pass	108.5 lb. Maximum[1] 17.4 lb. Minimum[1]
	Humidity Not Tested. Approved by Similarity to C1-1168	Pass	1 Gigaohm @ 100 V D.C.
	Low Level Contact Resistance	Pass	20 mO maximum
	Visual and Mechanical Inspection 10X	Pass	Degradation
	Temperature Difference	Pass	20 C below ambient, 40 C above ambient
	Backplane to Compliant Contact Resistance	Pass[2]	26 mO maximum[2]

5.0 SUMMARY OF TESTING- continued

Table 1. Summary of Testing – continued

Sample	Test/Inspection	Pass/Fail	BS-VME64x-AA Rev PA11 Requirement
Group 4	Not Tested. Approved by Similarity to C1-1168	Pass	
	Solderability (Module connector only)	Pass	95% coverage
	Resistance to Soldering Heat	Pass	260C wave for 20 sec.
	Visual and Mechanical Examination	Pass	
	Interchangeability	Pass	
	Mating and Unmating (was omitted since no Group 4 testing was being conducted)	N/A	108.5 lb. Maximum[1] 17.4 lb. Minimum[1]
Group 5	Not Tested. Approved by Similarity to C1-1168	Pass	
	Capacitance	Pass	See Table V of Test Spec.
	Inductance	Pass	See Table V of Test Spec.
	Characteristic Impedance	Pass	See Table V of Test Spec.
	Propagation Delay	Pass	See Table V of Test Spec.
	Signal Skew	Pass	See Table V of Test Spec.
	Crosstalk	Pass	See Table V of Test Spec.
	Reflection Factor	Pass	See Table V of Test Spec.
	VSWR	Pass	See Table V of Test Spec.
	Reflection Loss	Pass	See Table V of Test Spec.
Group 6	Tested at ABS		
	Compliant Contact Retention	Pass[3]	1.5 lb min. to 40 lbs max.
	Plated Through Hole Integrity	Pass	microsectioned
	Plated Through Hole Deformation	Pass	Avg. rad. deform. <0.0015" Meas. from drilled hole Abs. Max deform. 0.002"
	Plated Through Hole Wall Damage	Pass	Min. avg. Cu thickness remaining between compliant components and printed wiring laminate shall be = 0.0003" No cracks, separations, or delaminations
	Backplane to Compliant Contact Resistance	Pass[3]	17 mV @ 3 amps

1. **The mating and unmating force values shown were calculated from BS-VME64x-AA Rev PA11 for the specified connectors under test: 108.5 lbs equals 0.25 lbs X 434 contacts, 17.4 lbs equals 0.04 lbs X 434 contacts.**
2. **The Backplane to Compliant Contact Resistance was not included in BS-VME64x-AA, and was requested as supplemental data at the end of the qualification testing. The contacts installed in the urethane coated test boards consistently met the requirement. The contacts installed in the parylene coated test boards did not consistently meet the requirement.**
3. **The contacts installed in the urethane coated test boards consistently met the requirement. The contacts installed in the parylene coated test boards did not consistently meet the requirement.**

6.0 SAMPLES

Sample connectors 1 through 4 were mounted to test boards L-39887-444DB (Module) and L-39887-444MB (Backplane). The backplane contacts were pressed into the test boards, while the module contacts were soldered. These boards were configured so that when mated, the contacts in a row of each bay formed a continuous series circuit out to two test points.

Table 2. Samples

Sample	Module Connector	Backplane Connector	Group 1	Group 2	Group 3	Conformal Coating
1	10-509400-001	10-509412-053	X	X		Urethane
2	10-509400-001	10-509412-053	X	X		Parylene
3	10-509400-001	10-509412-053	X	X[1]	X	Urethane
4	10-509400-001	10-509412-053	X		X	Parylene

1. Sample 3 was substituted for Sample 2 and placed through the Group 2 test sequence after completing the Group 3 test sequence. Open circuits found in the Sample 2 and Sample 4 backplane test boards were caused by the compliant tails of the contacts not piercing the parylene conformal coating of the backplanes.

7.0 TEST SEQUENCE AND METHODS

Pictures of equipment and test setups are included in section 8.0 Test Results.

7.1 Equipment Used

Table 3. Equipment Used

ID	Cal. In	Cal. Out	Description	Manufacturer	Model
IC 3391	N/A	N/A	Thermal Chamber	Sun	
IC 4163	7/15/03	1/13/04	Thermocouple Reader	Fluke	
IC 2672	calibrated	monthly	130 Circuit Tester	AAO	
IC 4176	9-9-03	3-8-04	Thermal Shock Chamber	Blue M	
IC 4165	4-16-03	10-13-03	Micro-ohmeter	Keithley	580
IC 4089	6-17-03	12-16-03	Multimeter	Keithley	2000
IC 3991	8-21-03	11-20-03	Power Supply	HP	6038A
PG-2539	8-14-02	2-13-03	Tensile Tester	Instron	
E-5564	N/A	N/A	Linear Cycling Machine	AAO	

7.2 Testing

Table 4. Tests Performed

Group #	Description	BS-VME64x-AA Rev PA11 Requirement¶	BS-VME64x-AA Rev PA11 Requirement ¶	Other Spec.
Group 1	Visual and Mechanical Inspection 10X	3.4-3.4.13	4.4.2	---
	Interchangeability	3.4.14	4.4.3	---
	Mating and Unmating Forces	3.5.1	4.6.1	---
	Low Level Contact Resistance	3.6.4	4.6.6	**MIL-STD-1344A Method 3002.1**
	Contact Resistance	3.6.1	4.6.3	**MIL-STD-1344A Method 3004.1**
	Contact Retention	3.5.2	4.6.2	**MIL-STD-1344A Method 2007**
	Dielectric Withstanding Voltage at Sea Level	3.6.2	4.6.4	**MIL-STD-1344A Method 3001**
	Insulation Resistance	3.6.3	4.6.5	**MIL-STD-1344A Method 3003.1**
	Mating and Unmating Forces	3.5.1	4.6.1	---
Group 2	Dielectric Withstanding Voltage at 70,000 ft	3.6.2	4.6.4	**MIL-STD-1344A Method 3001**
	Contact Life	3.7.1	4.6.9	---
	Mating and Unmating Forces	3.5.1	4.6.1	---
	Low Level Contact Resistance	3.6.4	4.6.6	**MIL-STD-1344A Method 2005.1**
	Vibration 15 g peak max.	3.7.2	4.6.10	**MIL-STD-1344A Method 2004.1 Test Conditon G**
	Shock 100 g max.	3.7.5	4.6.13	**MIL-STD-1344A Method 3002.1**
	Low Level Contact Resistance	3.6.4	4.6.6	**MIL-STD-1344A Method 3002.1**
	Contact Resistance	3.6.1	4.6.3	**MIL-STD-1344A Method 3004.1**
	Mating and Unmating Forces	3.5.1	4.6.1	---
	Salt Atmosphere 500 hours	3.7.3	4.6.11	**MIL-STD-1344A Method 1001**

7.2 Testing (continued)

Table 4. Tests Performed (continued)

Group #	Description	BS-VME64x-AA Rev PA11 Requirement¶	BS-VME64x-AA Rev PA11 Requirement ¶	Other Spec.
Group 2 (continued)	Low Level Contact Resistance	3.6.4	4.6.6	**MIL-STD-1344A Method 3002.1**
	Contact Resistance	3.6.1	4.6.3	**MIL-STD-1344A Method 3004.1**
	Visual and Mechanical Inspection 10X	3.4-3.13	4.4.2	**---**
	Backplane to Compliant Contact Resistance	N/A[1]	N/A[1]	
Group 3	Temperature Cycling	3.7.4	4.6.12	**MIL-STD-1344A Method 1003**
	Mating and Unmating Forces	3.5.1	4.6.1	**---**
	Low Level Contact Resistance	3.6.4	4.6.6	**MIL-STD-1344A Method 3002.1**
	Contact Resistance	3.6.1	4.6.3	**MIL-STD-1344A Method 3004.1**
	Visual and Mechanical Inspection 10X	3.4-3.13	4.4.2	**---**
	Temperature Difference	3.7.9	4.6.17	**---**
	Low Level Contact Resistance	3.6.4	4.6.6	**MIL-STD-1344A Method 3002.1**
	Contact Resistance	3.6.1	4.6.3	**MIL-STD-1344A Method 3004.1**
	Backplane to Compliant Contact Resistance	N/A[1]	N/A[1]	
Group 6	Compliant Contact Retention	3.4.15.2	4.6.18.1	**MIL-A-28870**
	Plated Through Hole Integrity	3.4.15.3	4.6.18.2	**MIL-A-28870**
	Plated Through Hole Deformation	3.4.15.3.1	4.6.18.2	**MIL-A-28870**
	Plated Through Hole Wall Damage	3.4.15.3.2	4.6.18.2	**MIL-A-28870**
	Backplane to Compliant Contact Resistance	3.4.15.4	4.6.18.3	**MIL-A-28870 & EIA/IS 753**

1. The indicated Backplane to Compliant Contact Resistance after exposure to environments was accidently omitted from BS-VME64x-AA Rev PA11, which is why there were no reference paragraphs listed.

8.0 TEST RESULTS

8.1 Group 1 Results

8.1.1 Visual and Mechanical Examination

Group 1 samples were inspected at 10X and met the requirements of BS-VME64x-AA Rev PA11 sections 3.4 to 3.4.14. No defects were found.

8.1.2 Interchangeability

Mating samples were picked at random. First Article inspection found three minor dimension discrepancies on the backplane connector. The design engineer has signed them off and will incorporate changes to the appropriate drawings.

8.1.3 Mating and Unmating Forces

Mating and unmating forces were measured prior to any other engagement cycles so as to capture initial mating force values.. The initial mating force testing was conducted with the module card engaging into a single slot rack, which was installed on the backplane test board to guide the connectors into engagement (see Figure 1). This approach was extremely sensitive to test set-up, and easily introduced erroneously high mating force values due to uncontrolled friction between the rack and the module test sample. Unfortunately this was not discovered until after the initial mating cycle had been completed for Sample 1. The data has been compiled in Table 6.

TABLE 6. MATING AND UNMATING FORCE, PRE-ENVIRONMENT

Sample	Initial Mating (lbs.)	4th Cycle Mating (lbs.)	Initial Unmating (lbs.)	4th Cycle Unmating (lbs.)
1	N/A [1]	52.8[2]	N/A[1]	39.9[2]
2	50.8	41.2	42.4	35.5
3	52.8	46.3	46.1	40.0
4	54.4	50.3	49.7	43.4

1. Sample 1 initial data was not included, as the significance of the friction between the rack and the module test sample had not been understood prior to the first mating cycle, and was only recognized after.
2. These data points were actually on the 6th cycle, as it was not until after the 5th cycle that the friction between the rack and module test sample had been minimized.

FIGURE 1. INITIAL MATING FORCE TEST SET-UP.

8.1.4 Low Level Contact Resistance

All samples were tested on millivolt drop bench which is a computer controlled test system comprised of a power supply, a micro-ohmeter, a multimeter and a switch box. The switch box connects two, two wire probes to either the micro-ohmeter or the multimeter as well as reverses the polarity of the applied currents. These probes had a correction factor of 3.8 milliohms. The probes were held by hand to the solder tail or compliant tail of each of seven contacts per bay per sample. The contacts that were measured as referenced to the module side, bay, row, and contact number can be found in Table 5.

The test current was 100 milliamps with an open circuit voltage of 20 mVDC. All of the samples of Group 1 exhibited less than the required 20 milliohms of resistance; the average resistance was 11.5 milliohms.

Table 5. Contacts measured for Low Level Contact Resistance

P0A1	P0A19	P0B10	P0C5	P0E17	P0F1	P0F19
P1A1	P1A32	P1B10	P1C15	P1D17	P1E1	P1E32
P2A1	P2A32	P2B10	P2C15	P2D17	P2E1	P2E32

8.1.5 Contact Resistance

The test setup was the same as that described in 8.1.3. The contacts tested were those listed in Table 5. The test current was 2.5 amps with an open circuit voltage of 1.5 VDC when testing bays P1/J1 and P2/J2. The test current was 1 amp with an open circuit voltage of 1.5 VDC when testing bay P0/J0. All of the samples of Group 1 exhibited less than the required 20 milliohms of resistance; the average resistance was 11.4 milliohms.

8.1.6 Contact Retention

Contact retention was performed on the backplane connectors of the samples. For contacts in bays J1 and J2 at a force of 3 pounds no displacement was larger than 0.006 inches, meeting the less than 0.015 inches requirement. For Bay J0, a force of 1 pound produced displacements no greater than 0.001 inches meeting the less than 0.015 inches requirement.

8.1.7 Dielectric Withstanding Voltage At Sea Level

Samples were tested on a bench in open air in the mated condition. The AAO 130 circuit tester was used to perform the test. The test boards were designed such that, when mated, the contacts in a row formed a series circuit. Because of this, the test was performed between each row and all other rows, including those in other bays. The shell was tied to ground via alligator clip to a mounting screw head on the module side. The test voltage was 500 VAC 60 Hz for a duration of 60 seconds. All samples showed no fluctuation in readings and no other signs of electrical breakdown such as flashover, buzzing, or leakage current greater than 1 mA on any circuit.

8.1.8 Insulation Resistance

Samples were tested in a like manner to 8.1.6. Applied voltage was 100 VDC. All samples exhibited insulation resistance values higher than the required 1 Gigaohm.

8.1.9 Mating and Unmating Forces

This test was omitted, as the initial mating and unmating forces were measured in 8.1.3, and since Group 1 testing did not include any environmental exposure, it was assumed that the mating and unmating forces would not have changed.

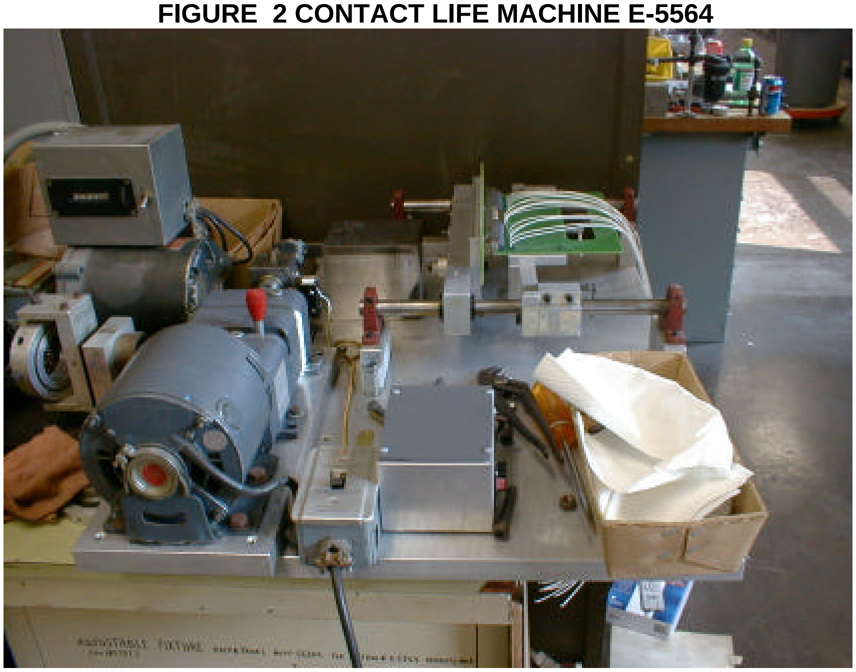
8.2 Group 2 Results

8.2.1 Contact Life

Group 2 samples were fixtured in to a linear cycling machine. The backplane side was mounted first. Then the module side was mounted to the fixed bar after alignment to the backplane module. The fixed bar was then adjusted along with the throw adjustment to ensure a full mate/unmate cycle. Full mate and unmate cycle was verified visually and by continuity check. Speed was set to 500 cycles/hr.

A 10x visual inspection revealed some minor burnishing on the connector shells, which was considered typical.

FIGURE 2 CONTACT LIFE MACHINE E-5564



8.2.2 Mating and Unmating Forces

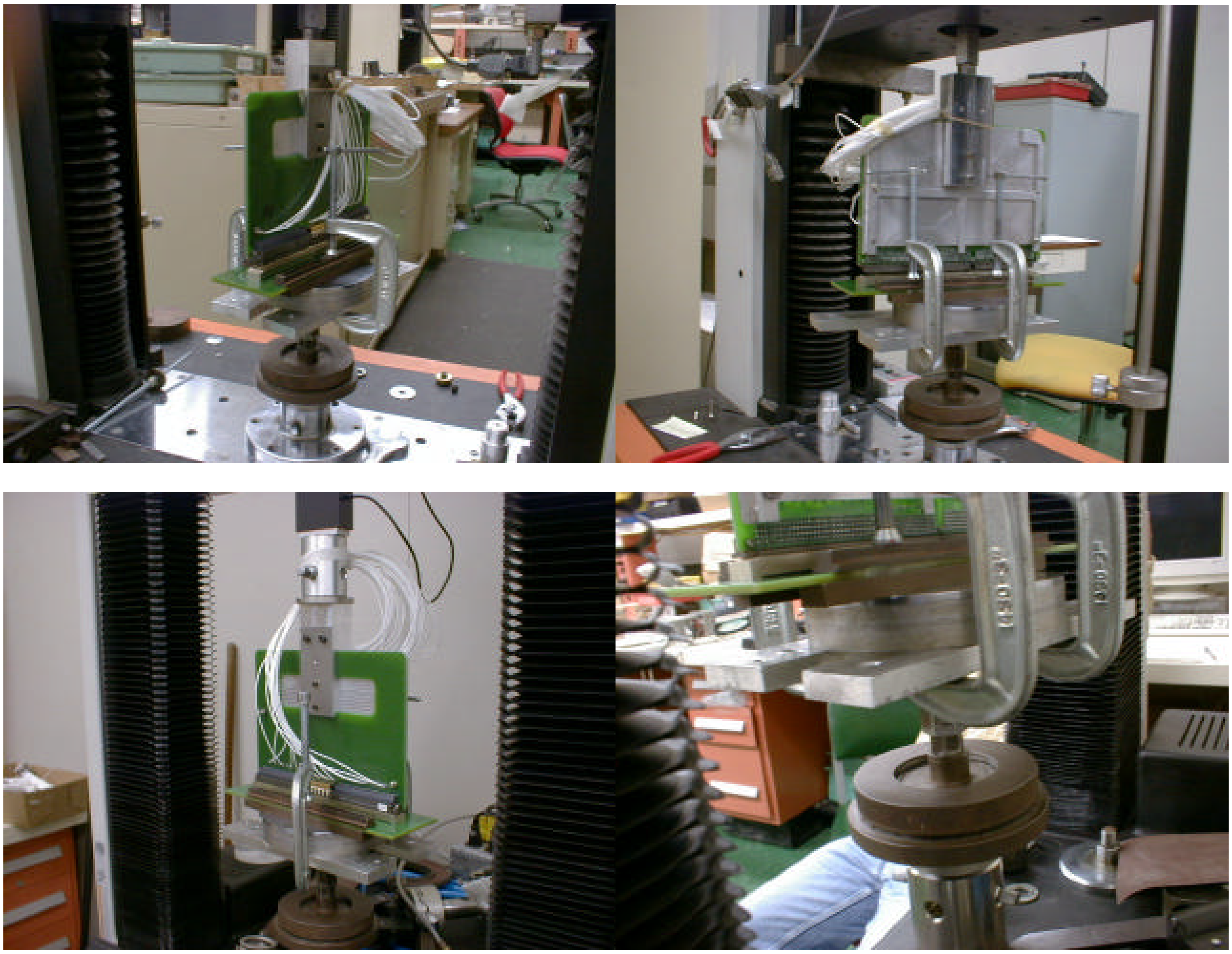
After the initial testing that was described in 8.1.3, a new test technique was developed. As depicted in Figure 3, the single slot rack was completely eliminated, thereby eliminating the frictional force of the module card in the slot. In an attempt to mitigate inaccuracy due to set up variations from cycle to cycle, five readings were recorded, and the average listed in Table 8.

TABLE 8. MATING AND UNMATING FORCE, POST CONTACT LIFE

Sample	Mating (lbs)	Unmating (lbs)
1	55.2	54.2
2	51.2	44.6
3[1]	59.4[1]	67.3[1]

1. Prior to contact life, Sample 3 had been exposed to all of the Group 3 testing (see Table 2)

FIGURE 3 – MATING AND UNMATING FORCE TEST SET UP



8.2.3 Low Level Contact Resistance

Low level contact resistance was measured on the same contacts listed in Table 5 as was done in 8.1.4. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 10.9 milliohms.

8.2.4 Contact Resistance

The test setup was the same as that described in 8.1.3. The contacts tested were those listed in Table 5. The test current was 2.5 amps with an open circuit voltage of 1.5 VDC when testing bays P1/J1 and P2/J2. The test current was 1 amp with an open circuit voltage of 1.5 VDC when testing bay P0/J0. All of the samples of Group 2 exhibited less than the required 20 milliohms of resistance; the average resistance was 10.9 milliohms.

8.2.5 Vibration

Both the module and backplane test boards were cut down in size to facilitate a better fit into the vibration fixture and to cut down on side loading. Twenty gauge wire was soldered in the test vias of the module test boards so that the rows of the sample formed a large series circuit for discontinuity monitoring.

It was during this wiring that discontinuities were found on the Sample 2 backplanes. Subsequent evaluation found them on Sample 4 as well. Both samples were assembled to parylene coated test boards. Sample 3 had completed its test sequence for Group 3, it was run through the Group 2 sequence to the vibration testing. After which it continued with Sample 1 through the remainder of the Group 2 tests. Sample 2 was set aside and Sample 4 had completed its Group 3 sequence.

For the vibration testing, the discontinuity monitor trip level was set for one microsecond. Samples 1 and 3 met all of the requirements. There were no discontinuities greater than one microsecond. There was no disengagement or loosening of any parts during the test. Post visual inspection at 10X showed no physical damage to the connector body or the contacts that would be detrimental to performance.

8.2.6 Shock

Samples 1 and 3 were attached to the mechanical shock tester by the same fixtures as for the vibration testing of 8.2.5. The same discontinuity monitor was used with it's trip level set to one microsecond. There were no discontinuities greater than one microsecond. There was no disengagement or loosening of any parts during the test. Post visual inspection at 10X showed no physical damage to the connector body or the contacts that would be detrimental to performance.

8.2.7 Low Level Contact Resistance

Low level contact resistance was measured on the same contacts listed in Table 5 as was done in 8.1.3. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 10.7 milliohms.

8.2.8 Contact Resistance

Contact resistance was measured on the contacts listed in Table 5 as was done in 8.1.4. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 10.8 milliohms.

8.2.9 Mating and Unmating Forces

Mating and unmating forces were measured using the Instron tensile tester as in 8.2.2. In an attempt to mitigate inaccuracy due to set up variations from cycle to cycle, five readings were recorded, and the average listed in Table 9.

TABLE 9. MATING AND UNMATING FORCE, POST VIBRATION/SHOCK

Sample	Mating (lbs)	Unmating (lbs)
1	51.4	47.7
3	53.2	51.8

8.2.10 Salt Atmosphere

Samples were each suspended in a NEMA Type 4X electrical enclosure that was 10" wide, 12 " tall and 6" deep (see Figure 4). Enclosures had 2, 1/8" holes drilled into the bottom to simulate the drain holes in the connector's environment application. After 500 hours suspended in salt atmosphere, enclosures were removed and samples examined. Condensed water droplets and salt deposits were found on each sample. Samples were rinsed in warm tap water and salt deposits were brushed off the circuit boards with a soft bristle brush. The connectors were not unmated. After baking dry in an oven at 50C for one hour, boards were tested for Low Level Contact Resistance and Contact Resistance. Visual inspection showed no evidence of exposure of base metals, pitting, or porosity. There was no cracking or delaminating of finishes or components.

FIGURE 4. NEMA TYPE 4X ENCLOSURE USED FOR SALT ATMOSPHERE TESTING

8.2.11 Low Level Contact Resistance

Low level contact resistance was measured on the same contacts listed in Table 5 as was done in 8.1.3. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 10.6 milliohms.

8.2.12 Contact Resistance

Contact resistance was measured on the contacts listed in Table 5 as was done in 8.1.4. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 11.0 milliohms.

8.2.13 Visual and Mechanical Examination

No deformed parts, scratches, corrosion, or other defects other than what was described in section 8.2.1 Contact Life were noted. Parts mated and unmated without difficulty.

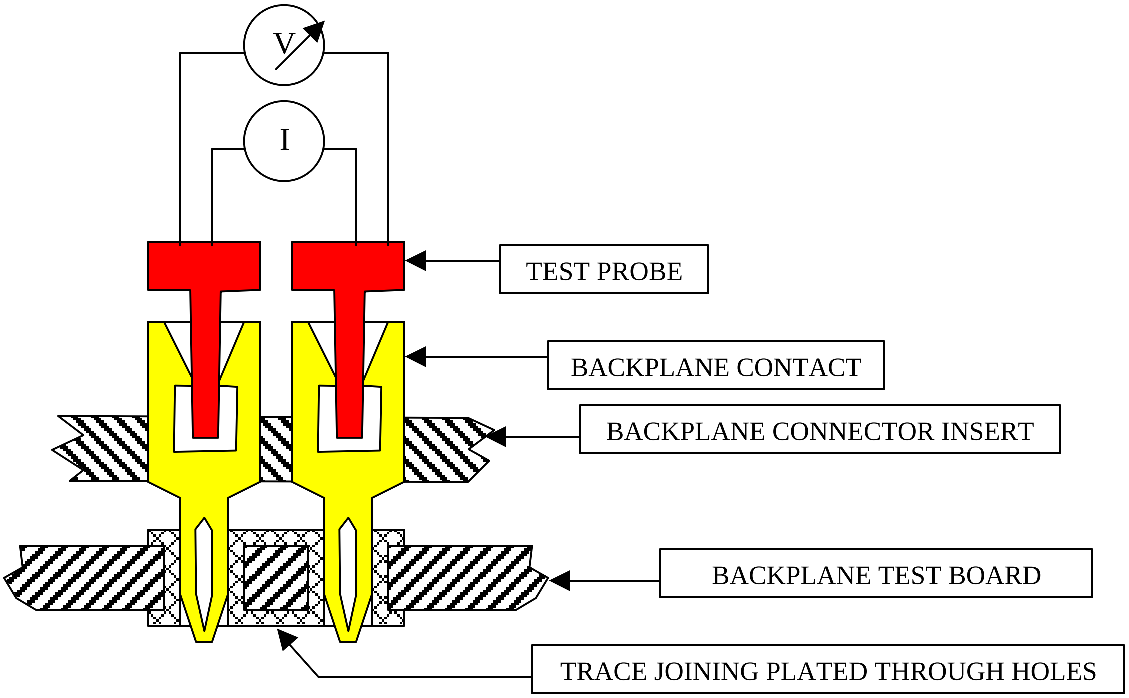
8.2.14 Backplane to Compliant Contact Resistance

Using the test circuit depicted in Figure 5, all contact pairs tested on Sample 1 were well within the 26 milliohm maximum requirement, which indicted that the junction between the compliant eye of the contact and the Urethane coated plated through hole of the test board had not been degraded by exposure to the environments of Group 2. The average resistance was 10.3 milliohms per the 8.1.3 method, and 11.5 per the 8.1.4 method.

Though the circuit in Figure 5 was not the preferred circuit to accurately measure the resistance between the backplane and the compliant contact, it was the most repeatable. The 26 milliohm requirement was derived as follows: a maximum resistance of 7 milliohms per probe and main body of the socket contacts, and a maximum resistance of 6 milliohms from each compliant eye to the plated through hole of the backplane test board. The resistance was measured with both the Low Level Contact Resistance method defined in 8.1.3 and the contact resistance method of 8.1.4.

Not all contact pairs of Sample 2 met the 26 milliohm maximum requirement, which confirmed the findings of 8.2.5, that the compliant eye of the contacts were not consistently piercing the parylene conformal coating.

FIGURE 5. TEST CIRCUIT FOR BACKPLANE TO COMPLIANT CONTACT MEASUREMENT.



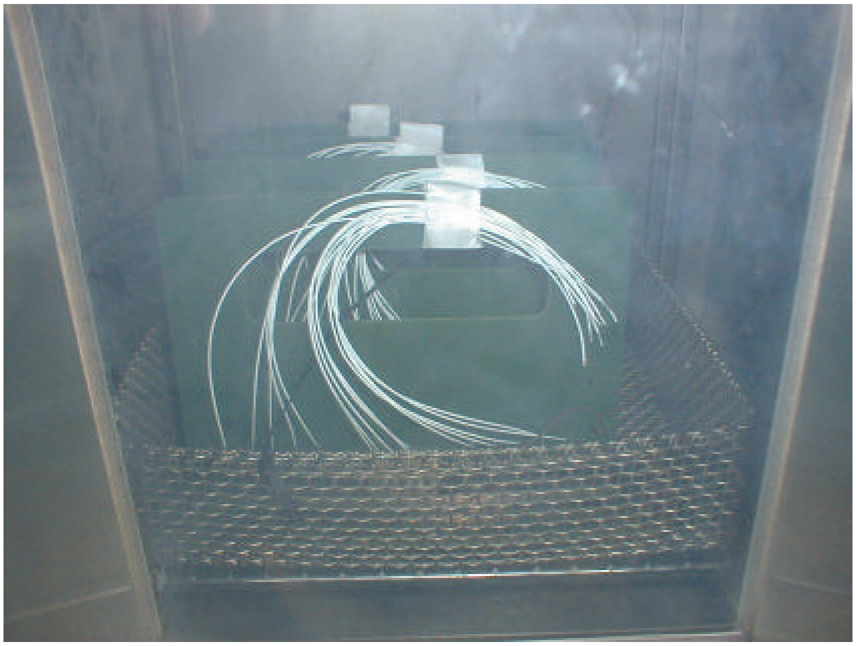
8.3 Group 3 Results

8.3.1 Temperature Cycling

Group three samples were placed into the basket of the Thermal Cycling Chamber in the mated condition as shown in Figure 6 and 7. Samples were exposed to –65 C to + 125 C with a less than 5 minute transfer time and one hour dwells for 5 cycles. The samples were not mated and unmated at the temperature extremes during the fifth cycle. Instead a sixth cycle was run where the samples were individually brought down to –65C in the unmated state, then
mated and unmated. The samples were then individually brought up to 125 C in the unmated state and again mated and unmated. No difficulties were had performing these mates and unmates.

FIGURE 6. THERMAL CYCLING (SHOCK) CHAMBER

FIGURE 7. CLOSE UP OF SAMPLES IN THERMAL CYCLING CHAMBER



8.3.2 Mating and Unmating Forces

Mating/unmating forces were measured as described in 8.1.9. As summarized in Table 10, the forces decreased significantly.

TABLE 10. MATING AND UNMATING FORCE, POST THERMAL CYCLING

Sample	Mating (lbs)	Unmating (lbs)
3	39.0	35.6
4	39.0	35.0

8.3.3 Low Level Contact Resistance

Low level contact resistance was measured on the same contacts listed in Table 5 as was done in 8.1.3. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 11.1 milliohms.

8.3.4 Contact Resistance

Although not required by the test specification Contact Resistance as in section 8.1.3 was performed. Contact resistance was measured on the contacts listed in Table 5 as was done in 8.1.4. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 11.1 milliohms.

8.3.5 Visual and Mechanical Examination

Samples were visually inspected at 10X. Minor burnishing and small wear particles were found within the connectors, as would typically be observed during connector testing.

8.3.6 Temperature Difference

The backplane side test boards were mounted to the mounting fixture and placed in a temperature chamber where they were cooled 20 C below ambient temperature. The backplane samples were then taken out of the chamber and mated to their respective module test sample that was at room ambient. For all two samples in Group 3, there was no difficulty in mating and unmating the samples and no observable damage occurred.

The backplane side of the samples, mounted to the mating fixture, were placed back into the chamber and heated to 40 C above ambient. The backplanes were then removed from the chamber and mated to their respective module test sample that was at room ambient. For all two samples in Group 3, there was no difficulty in mating and unmating the samples and no observable damage occurred.

8.3.7 Low Level Contact Resistance

Although not required by the test specification, Low level contact resistance was measured on the same contacts listed in Table 5 as was done in 8.1.3. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 11.4 milliohms.

8.3.8 Contact Resistance

Although not required by the test specification, Contact Resistance was performed. Contact resistance was measured on the contacts listed in Table 5 as was done in 8.1.4. All samples showed almost no change in resistance and all were well below the 20 milliohm requirement; the average resistance was 11.3 milliohms.

8.3.9 Backplane to Compliant Contact Resistance

Samples 3 and 4 were tested as defined in 8.2.14. The resistance of the circuits tested on Sample 3 were consistently less than the 26 milliohm maximum requirement, indicating that the compliant to test board circuits had not been degraded by the exposure to the Group 3 environments. The average resistance was 10.0 per the 8.1.3 method, and 9.9 per the 8.1.4 method.

Not all contact pairs of Sample 4 met the 26 milliohm maximum requirement, which confirmed the findings of 8.2.5, that the compliant eye of the contacts were not consistently piercing the parylene conformal coating.

8.4 Group 6 Results

8.4.1 Compliant Contact Retention

The retention forces in urethane coated test boards were consistently in excess of the 1.5 pound requirement. The average was in excess of 3.75 pounds.

The retention forces in the parylene coated test boards were as low as the 1.5 pound requirement, and therefore did not pass this requirement.

8.4.2 Plated Through Hole Integrity

The compliant contacts met the Plated Through Hole Deformation and Wall Damage requirements easily, with minimum damage observed.

8.4.3 Backplane to Compliant Contact Resistance

The millivolt drop of a single compliant contact to the backplane was well within 17 millivolts at a current of 3 amps (or 5.67 milliohms) for the contacts installed in the urethane coated test boards; the initial insertion average was 4.0 milliohms for the J0 contacts, and 2.4 milliohms for the J1/J2 contacts. This indicated that a low resistance electrical connection was established both on the initial insertion, as well as the third insertion.

The millivolt drop of the compliant contacts to the parylene coated backplane test board did not consistently meet the 17 millivolts at 3 amps requirement, indicating a poor electrical joint when parylene was present.