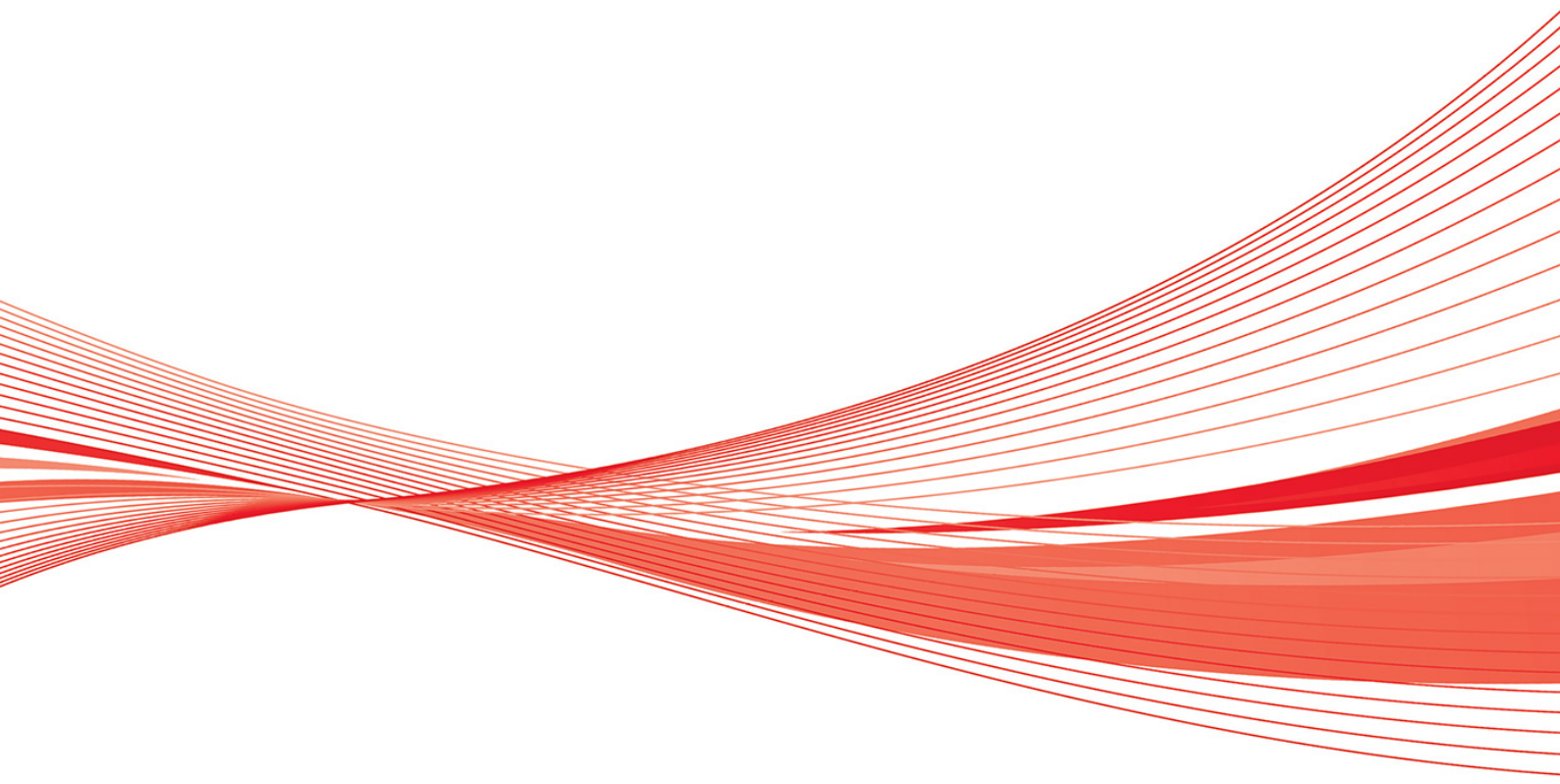
Harwin Test Report Summary

HT04301

M300 Connector Series Testing
Electrical, Mechanical & Environmental



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1. Introduction.

1.1. Description and Purpose.

The Harwin M300 Series is a range of High Reliability 5 & 10A Power connectors on a 3mm pitch. The following tests were carried out to establish or validate the claims made in the M300 component specification C048XX (where XX is issue 01, 02 etc.).

1.2. Conclusion.

The following data has been collated from Harwin test report 1106, with additional dimensional verification to be found in reports 1089-92, 1097-99 and 1101. The connectors met the test requirements set out in section 2.3 of this test report summary – all electrical, mechanical and environmental requirements were fulfilled. These results are representative of all the M300 series connectors. Further information available on request – please contact technical@harwin.com.

2. Test Method, Requirements and Results.

2.1. List of Test Samples.

a) M300-FV1034500 - Female Vertical SIL 3 Position PC Tail Connector.

b) M300-FV3064500 - Female Vertical DIL 6 Position PC Tail Connector.

c) M300-MV10345M1 - Male Vertical SIL 3 Position PC Tail Connector with Jackscrew.

d) M300-MV30645M1 - Male Vertical DIL 6 Position PC Tail Connector Jackscrew.

e) M300-0010045 - Female 18/20 AWG Cable Crimp Contacts.

f) M300-0020045 - Female 22 AWG Cable Crimp Contacts.

g) M300-1010045 - Male 18/20 AWG Cable Crimp Contacts.

h) M300-1020045 - Male 22 AWG Cable Crimp Contacts.

i) M300-2240600F2 - Female Cable DIL 6 Position Housing with Jackscrew.

j) M300-2250300F2 - Female Cable SIL 3 Position Housing with Jackscrew.

k) M300-3240600M1 - Male Cable DIL 6 Position Housing with Jackscrew.

l) M300-3250300M1 - Male Cable SIL 3 Position Housing with Jackscrew.

2.2. Specification Parameters.

Tests were carried out in accordance with the following standards:

Testing Standard	Description of Test	Page No.
EIA-364-01B: 2000	Acceleration: Test Condition A	3
EIA-364-05B: 1998	Contact Insertion, Release and Removal force in Housing	4
EIA-364-08B: 1998	Crimp Tensile Strength	5
EIA-364-09C: 1999	Durability (Mechanical Operations)	6
EIA-364-13C: 2006	Mating and Un-Mating Forces: Test Method B	6
EIA-364-17B: 1999	Temperature Life: Test Method A, Condition 6D	7
EIA-364-20C: 2004	Withstanding Voltage (Proof): Test Method B, Conditions I & IV	8
EIA-364-21C: 2000	Insulation Resistance	8
EIA-364-23B: 2000	Low Level Contact Resistance	9

EIA-364-28D: 2006	Vibration: Test Condition II and IV	9
EIA-364-31B: 2000	Humidity (Damp Heat): Test Method II, Conditions A and D	10
EIA-364-32C: 2000	Thermal Shock (Temperature Cycling): Test Condition V	11
EIA-364-70A: 1998	Temperature Rise v. Current (Power Rating): Test Method 2	11
BS EN 60068-2-27: 2009	Environmental Testing (Bump and Shock)	14
Note: BS EN 60068-2-27 is a replacement for obsolete standard EIA-364-27B – Bump and Shock.		

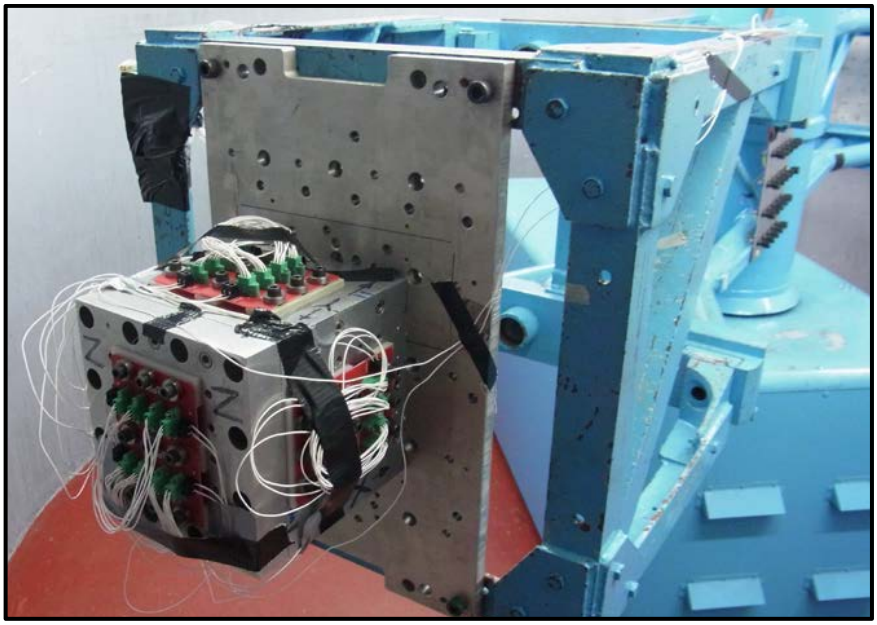
2.3. Test Method and Results.

All testing was carried out using standard parts. For the mating force testing, Female Jackscrews were removed.

a) Acceleration to EIA-364-01A Test Condition A

Specification: 50G (490m/s^2), 5 minutes, 3 Axes both directions.

Method: 2 samples of all types of connectors listed in section 2.1 in Cable-to-Board combinations, with a minimum of 200mm free length of 22 AWG wire assembled to the cable connectors. Mated pairs are mounted to the test equipment as shown. During this test, the samples were monitored continuously for discontinuity with a constant current source of 100mA DC. Parts were visually inspected for damage after testing.



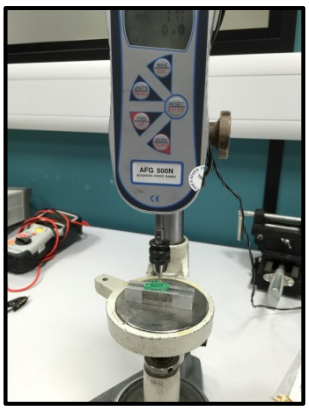
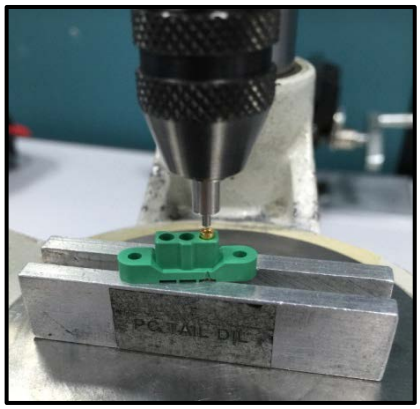
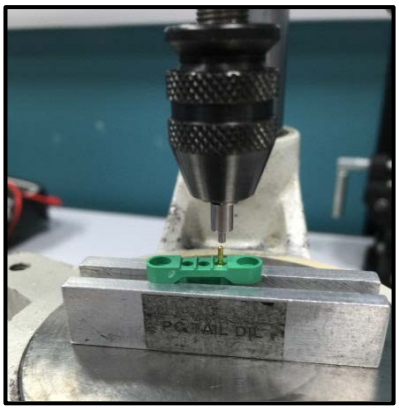
A summary of the findings are as follows:

Mated Connector Pair Type	Pass/Fail	Visual Insp. Damage	Observation
Female PC Tail / Male Cable SIL 3 Position No Jackscrew	Pass	Pass	None
Female PC Tail / Male Cable DIL 6 Position No Jackscrew	Pass	Pass	None
Female Cable / Male PC Tail SIL 3 Position With Jackscrew	Pass	Pass	None
Female Cable / Male PC Tail DIL 6 Position With Jackscrew	Pass	Pass	None

b) Contact Insertion and Removal Force in Housing to EIA-364-05B

Specification: 45N max. Insertion / 15N min. Removal. (Specification will be increased.)

Method: 3 samples of all types of connectors listed in section 2.1 had contacts assembled to their specified assembly position in housings, while having the force required to insert each contact measured. Then the force required to remove the contact was also measured.

The average, maximum and minimum forces recorded for each type is as follows:

Connector Type	Insertion Force (N)	Removal Force (N)
Female Vertical PC Tail	73.1 avg., 93.3 max.	61.1 avg., 49.5 min.
Male Vertical PC Tail	53.3 avg., 67.7 max.	43.2 avg., 33.5 min.
Female Cable	57.2 avg., 71.1 max.	45.6 avg., 33.1 min.
Male Cable	59.4 avg., 72.3 max.	72.3 avg., 61.2 min.

c) Contact Replacement in Housing to EIA-364-05B

Specification: 2 Replacements minimum. (Specification will be increased.)

Method: 3 samples of all Cable types of connectors listed in section 2.1 had contacts assembled to their specified assembly position in housings, while having the force required to insert each contact measured. Then the force required to remove the contact also measured. This operation was then repeated using the same contacts and housings 10 times, or until the force required for removing contact fell below the minimum requirement of 15N.

The average, maximum and minimum forces recorded for each type is as follows:

Connector Type / Replacements	Insertion Force (N)	Removal Force (N)
Female Cable 1st Operation	52.6 avg., 63.1 max.	44.7 avg., 31.6 min.
Female Cable 3rd Operation	41.2 avg., 48.4 max.	35.9 avg., 27.7 min.
Female Cable 10th Operation	22.7 avg., 28.1 max.	21.8 avg., 16.1 min.
Male Cable 1st Operation	63.8 avg., 81.5 max.	72.3 avg., 59.1 min.
Male Cable 3rd Operation	45.1 avg., 53.9 max.	44.2 avg., 30.6 min.
Male Cable 10th Operation	23.4 avg., 29.9 max.	23.8 avg., 20.1 min.

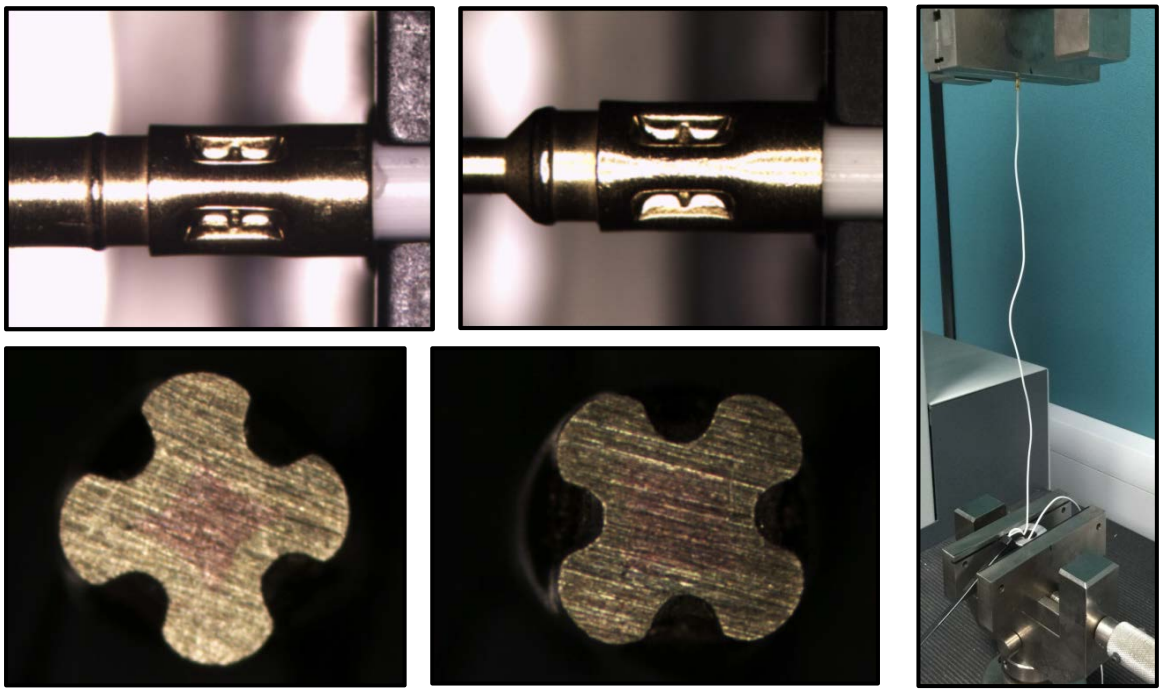
d) Contact Crimp Integrity to EIA-364-08B

Specification: 22 AWG = 50N min., 20 AWG = 80N min., 18 AWG = 140N min.

Method: 3 Samples of all types of Cable Crimp contacts listed in section 2.1 were assembled with the following types of wire as applicable:

- 22 AWG (19x0.15) BS 3G 210 Type A
- 20 AWG (19x0.20) BS 3G 210 Type A
- 18 AWG (19x0.25) MIL-16878 Type E

Crimping was completed using crimp tool M22520/2-01 (position 8) fitted with Z80-058 positioner. Parts were inspected for cracks under at least 10x magnification. The wire was then separated from the contact at a speed of 25mm per minute, and the force required to achieve separation of wire from contact recorded, as well as the type of separation (Wire Break or Pull Out). Samples were also micro sectioned to check for voids.



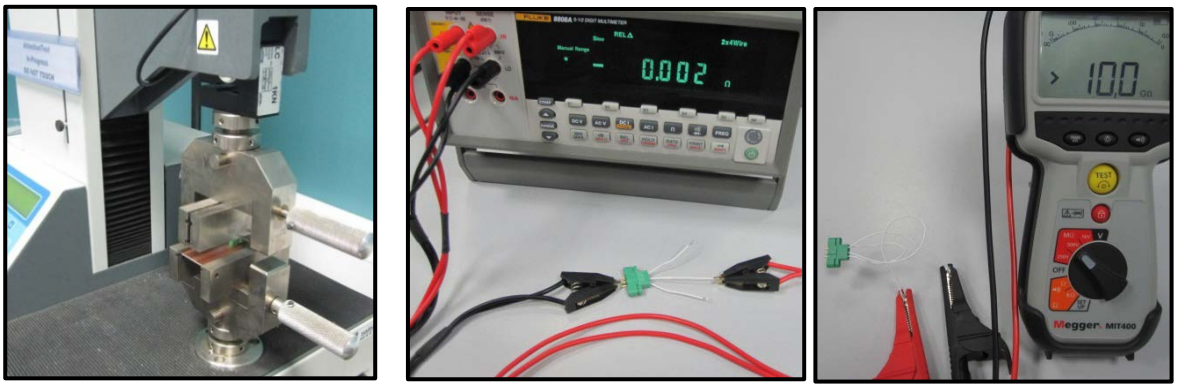
A summary of the findings are as follows:

Contact and Wire Type	Crack Inspection Pass/Fail	Void Inspection Pass/Fail	Wire Separation Force (Min.)	Separation Type
Female Contact with 18 AWG wire	Pass	Pass	186N	Wire Break
Male Contact with 18 AWG wire	Pass	Pass	150N	Wire Break
Female Contact with 20 AWG wire	Pass	Pass	106N	Wire Break & Pull-Out
Male Contact with 20 AWG wire	Pass	Pass	119N	Wire Break & Pull-Out
Female Contact with 22 AWG wire	Pass	Pass	50N	Wire Break
Male Contact with 22 AWG wire	Pass	Pass	57N	Wire Break

e) Durability (Mechanical Operations) to EIA-364-09C

Specification: 1000 Operations.

Method: For this test, 3 sets of Female cable SIL 3 position connectors and mating Male PC Tail connectors were used (as listed in section 2.1). In separate tests, the mated pairs were clamped in a holding fixture, allowing one-half of the pair to float. Automatic of cycling took place at 25.4mm/minute, fully mating by 4.45mm after female enters male moulding, for 1000 cycles.



Contact Resistance, Insulation Resistance and Dielectric Withstanding Voltage were measured prior to cycling. Mating/Un-Mating forces were measured throughout cycling. After 10, 30, 50, 100, 200, 300, 400, 500, 750 and 1000 cycles, electrical tests and visual inspection took place. After 1000 cycles and other tests completed, Contact retention in housing also measured and recorded.

Result: No failures reported.

f) Mating and Un-Mating Force to EIA-364-13C

Specification: 9N max. mating (Insertion) force, 1N min. un-mating (Withdrawal) force per contact.

Method: 3 samples of all types of connectors listed in section 2.1, in separate tests, were clamped in holding fixture allowing one half of set to float. The pairs were then fully mated and un-mated at 25.4mm/minute (same setup as Durability). Peak mating and un-mating forces measured and recorded.

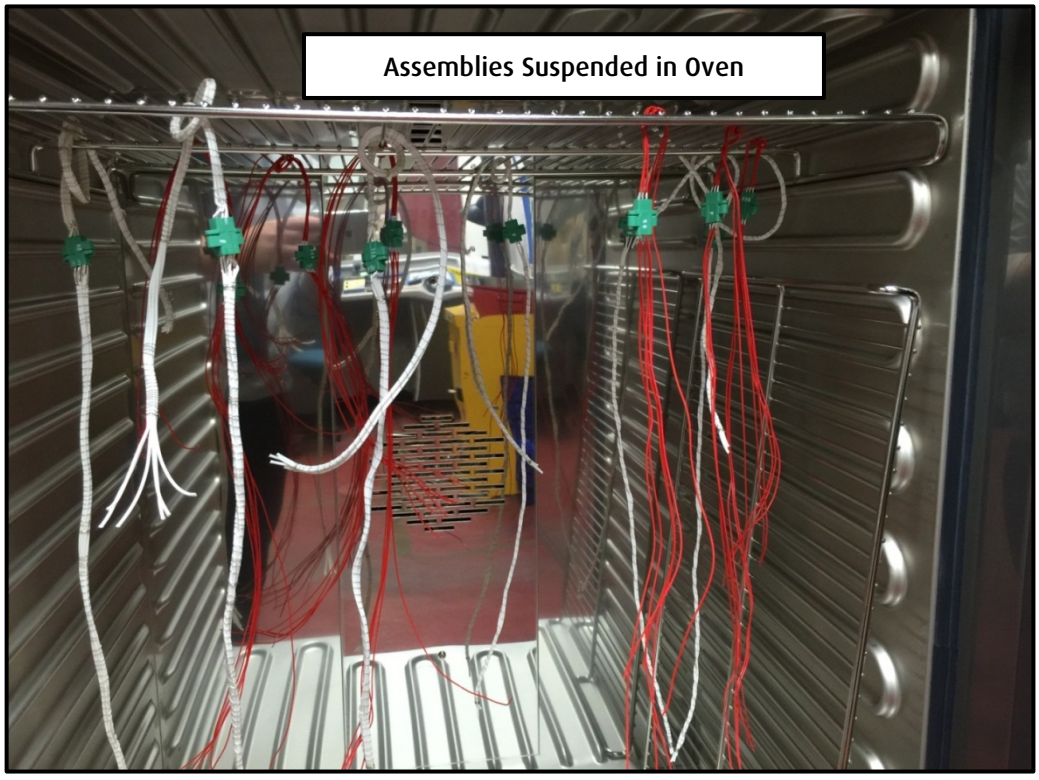
The average, maximum and minimum forces recorded for each type is as follows:

Mated Connector Pair Type	Mating Force (N)	Un-Mating Force (N)	Pass/Fail
Female PC Tail / Male Cable SIL 3 Position	10.6 avg., 11.5 max.	8.3 avg., 7.7 min.	Pass
Female Cable / Male Cable SIL 3 Position	15.0 avg., 16.9 max.	10.8 avg., 9.5 min.	Pass
Female Cable / Male PC Tail SIL 3 Position	13.1 avg., 15.4 max.	9.2 avg., 8.4 min.	Pass
Female PC Tail / Male PC Tail SIL 3 Position	10.6 avg., 11.6 max.	9.2 avg., 8.2 min.	Pass
Female PC Tail / Male Cable DIL 6 Position	24.3 avg., 26.7 max.	18.5 avg., 17.4 min.	Pass
Female Cable / Male Cable DIL 6 Position	21.2 avg., 21.7 max.	15.6 avg., 14.9 min.	Pass
Female Cable / Male PC Tail DIL 6 Position	31.2 avg., 36.6 max.	18.3 avg., 16.1 min.	Pass
Female PC Tail / Male PC Tail DIL 6 Position	21.0 avg., 23.1 max.	17.2 avg., 16.0 min.	Pass

g) Temperature Life, Test Method A, Condition 6D to EIA-364-17B

Specification: After conditioning at 175°C for 1000 hours the following specifications must be met: Un-mating force per contact = 1N min.; Contact resistance per contact = 25mΩ max.; Visual inspection to reveal no sign of cracking, crazing, delamination or damage caused by fusing or seizure; 15N min. contact removal force in housing; 50N min. contact crimp integrity pull out force on 22AWG wire and 140N on 18AWG.

Method: 12 samples of all cable connector assemblies listed in section 2.1 had 45cm of wire crimped to each contact: 6 with 18 AWG wire and 6 with 22 AWG. These were checked before conditioning that parts met specification. Half of these were then suspended as shown in an oven set at 175±5°C and remained there for 1000 hours. The remaining samples were then suspended in a similar manner but at normal ambient temperature for the same period of time.



Assemblies Suspended in Oven

After conditioning, samples were removed, visually inspected and checked that all properties were in specification. A summary of the findings are as follows:

Mated Connector Pair Type	Un-Mate Force Pass/Fail	Contact Resistance Pass/Fail	Contact Removal Force Pass/Fail	Contact Crimp Integrity Pass/Fail	Visual Inspection Pass/Fail
Female/Male Cable SIL 3 Pos. 18 AWG	Pass	Pass	Pass	Pass	Pass
Female/Male Cable SIL 3 Pos. 22 AWG	Pass	Pass	Pass	Pass	Pass
Female/Male Cable DIL 6 Pos. 18 AWG	Pass	Pass	Pass	Pass	Pass
Female/Male Cable DIL 6 Pos. 22 AWG	Pass	Pass	Pass	Pass	Pass
Note: Visual Inspection showed housings conditioned at 175°C darkened in colour due to Oxidation. But Electrical and Mechanical properties were not significantly affected.					

h) Withstanding Voltage (Proof) Test Method B, Conditions I and IV to EIA-364-20C

Specification: Condition I (Sea Level 913/1050mb) = 1200V DC min. and Condition IV (Altitude 70,000ft. / 44mb max.) = 300V DC min. (Specification will be increased.)

Method: 3 Samples of all types of connectors listed in section 2.1 were mated with connectors that had all adjacent contacts linked in series with 22 AWG wire. A voltage was passed through all contacts and maintained for 60 seconds – this was raised at 500V per second to various test voltages, each level maintained for 60 seconds. Voltage is then reduced back to zero, while being monitored for leakage current not to exceed 5mA, or evidence of disruptive discharge (Flashover or Spark).

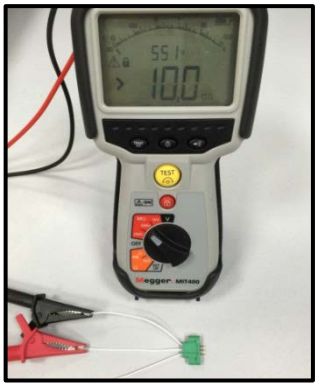
A summary of the findings are as follows:

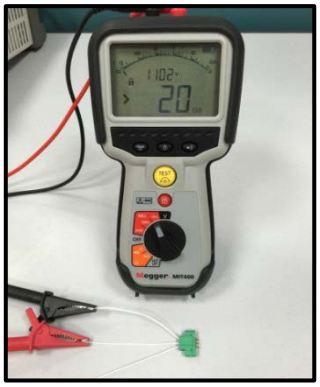
Connector Type	300V DC Altitude Pass/Fail	400V DC Altitude Pass/Fail	450V DC Altitude Pass/Fail	1200V DC Sea Level Pass/Fail	1600V DC Sea Level Pass/Fail	1800V DC Sea Level Pass/Fail
All Single Row Female Conn.	Pass	Pass	Pass	Pass	Pass	Pass
All Dual Row Female Conn.	Pass	Pass	Pass	Pass	Pass	Pass
All Single Row Male Conn.	Pass	Pass	Pass	Pass	Pass	Pass
All Dual Row Male Conn.	Pass	Pass	Pass	Pass	Pass	Pass

i) Insulation Resistance to EIA-364-21C

Specification: 100MΩ min. at 500V DC. (Specification will be increased.)

Method: 3 Samples of all types of connectors listed in section 2.1 were assembled with 22 AWG, BS 3G 210 Type A wire, so a voltage could be passed through all adjacent contacts. Results were monitored using a Megger MIT400 insulation tester, set at 500V DC for a 2 minute period. The test was then repeated at 1000V DC.





Results: All results for 500V DC were greater than 10,000MΩ. All results for 1000V DC were greater than 20,000MΩ.

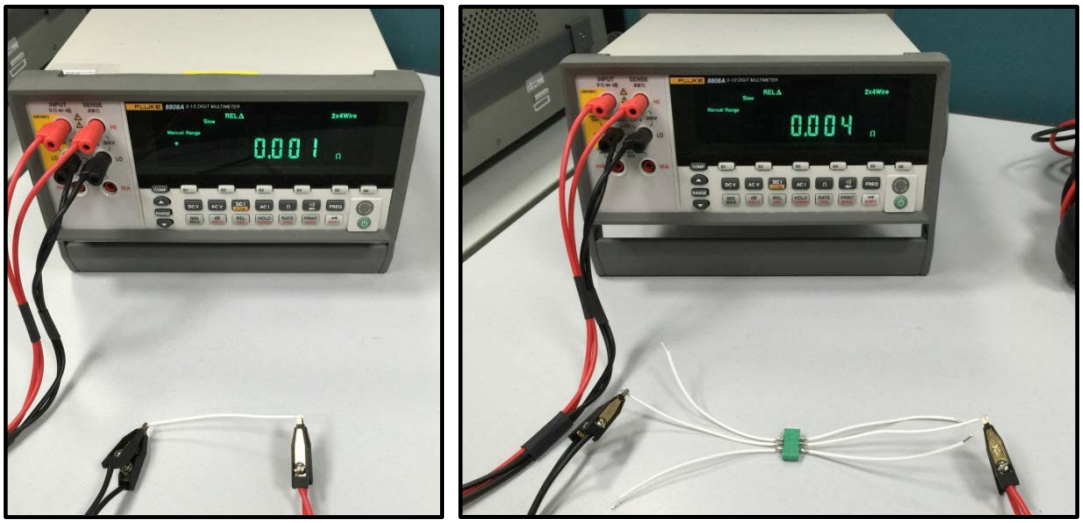
j) Low Level Contact Resistance to EIA-364-23C

Specification: 25mΩ max. (Specification will be reduced.)

Method: Unused mated combinations (shown in the table below), made from the connectors listed in section 2.1 were prepared by attaching 100mm of 18 AWG (19/30) MIL-16878E Type E wire to all contacts.

Using a Fluke 8808A multimeter, the test current was set at 100mA max., 20mV open circuit (source) voltage max. The resistance of two of the 100mm lengths of the 18AWG wire only were measured, to establish the wire resistance alone.

Connectors were mated for the first time, then each mated contact (including wire) measured for resistance. The initial results were recorded as this reading minus the wire resistance. The connectors were then separated and mated for a second time, before re-measuring for an "After conditioning" result.



A summary of the findings are as follows:

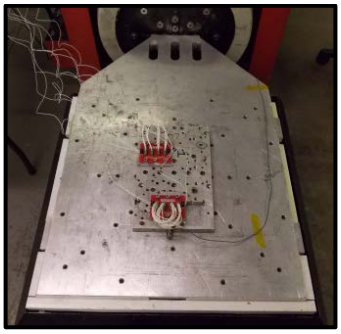
Mated Connector Pair Type	Contact Resistance (Initial)	Contact Resistance (After Conditioning)	Pass/Fail
Female PC Tail / Male PC Tail SIL 3 Position	2mΩ max.	2mΩ max.	Pass
Female PC Tail / Male Cable DIL 6 Position	2mΩ max.	2mΩ max.	Pass
Female Cable / Male Cable DIL 6 Position	3mΩ max.	3mΩ max.	Pass
Female Cable / Male PC Tail DIL 6 Position	3mΩ max.	3mΩ max.	Pass
Female PC Tail / Male PC Tail DIL 6 Position	3mΩ max.	3mΩ max.	Pass

k) Vibration Test Condition II and IV to EIA-364-28D

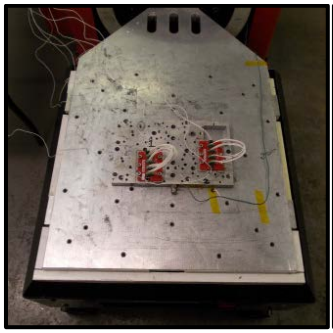
Specification: Condition II – 10Hz to 500Hz, 1.52mm, 98.1m/s^2 (10G), 9 hours. Specification will be increased.

Method: 2 samples of all types of connectors listed in section 2.1, in cable-to-board combinations, were subjected to above Condition II vibration in all 3 Axes, while being monitored for discontinuities of 1 millisecond or more using a constant current source of 100mA. Parts were visually inspected for damage or wear before and after. The same samples were then tested again to a higher level of vibration: Condition IV – 10Hz to 2000Hz, 1.52mm, 196.1m/ s^2 (20G), 12 hours.

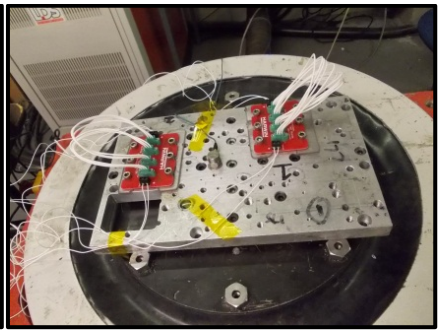
X-axis typical setup



Y-axis typical setup



Z-axis typical setup.



A summary of the findings are as follows:

Mated Connector Pair Type	Condition II (10G) Pass/Fail	Condition IV (20G) Pass/Fail	Visual Insp. Damage/Wear	Observation
Female PC Tail / Male Cable SIL 3 Position, no Jackscrew	Pass X, Z Fail Y	Pass X, Z Fail Y	Pass	Failure due to mated pair separating
Female PC Tail / Male Cable DIL 6 Position, no Jackscrew	Pass	Pass	Pass	None
Female Cable / Male PC Tail SIL 3 Position, with Jackscrew	Pass	Pass	Pass	None
Female Cable / Male PC Tail DIL 6 Position, with Jackscrew	Pass	Pass	Pass	None

l) Humidity (Damp Heat) Test Method II, Conditions A and D to EIA-364-31B

Specification: 96 hour or 56 day, 90% RH (relative humidity) at 40°C.

Method: Samples of all cable-to-board, mated and un-mated pairs of connectors listed in section 2.1 were prepared with sufficient lengths of wire, and suspended vertically in a drying oven while having a polarising voltage applied. They were subject to 50°C for 24 hours. Immediately after conditioning, the samples were measured for bulk contact resistance (including test circuit) in ambient conditions. The samples were returned to the test chamber with a 100V DC polarising voltage, a relative humidity of 90-95% and 40±2°C. After 96 hours, a sample of each type was removed, leaving the remaining samples to complete the 56 day period. Bulk contact resistance on 1 control sample was measured immediately after removal from the test chamber. All sampleswere measured after 5 hours (to recover to standard ambient conditions).

A summary of the findings are as follows:

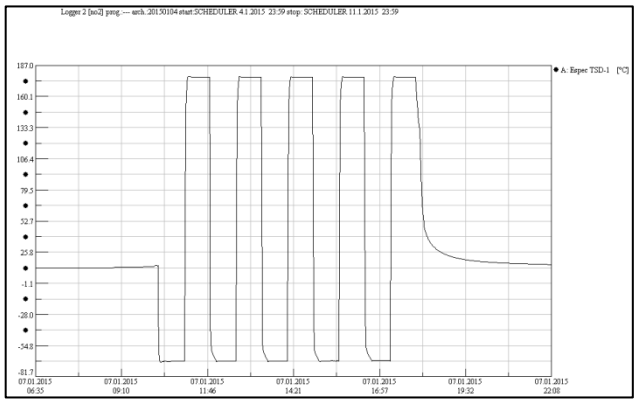
Mated or Un-mated Connector Pair Type	Pre-Test bulk Contact Resistance	Post-Test bulk Contact Resistance	5 hrs Post-Test bulk Contact Resistance	Observations
Female Cable / Male PC Tail SIL 3 Position, Mated	0.138 Ω max.	n/a	0.140 Ω max.	None
Female PC Tail / Male Cable SIL 3 Position, Un-Mated	0.138 Ω max.	n/a	0.140 Ω max.	None
Female Cable / Male PC Tail DIL 6 Position, Mated	0.138 Ω max.	0.138 Ω max.	0.138 Ω max.	None
Female PC Tail / Male Cable DIL 6 Position, Un-Mated	0.139 Ω max.	n/a	0.141 Ω max.	None

m) Thermal Shock (Temperature Cycling) Test Condition V to EIA-364-32C

Specification: +175/-65°C.

Method: Samples of all cable-to-board mated pairs of connectors listed in 2.1, prepared with sufficient lengths of wire, were checked for Mating/Un-Mating force, Voltage Proof, Insulation Resistance and Contact Resistance. Parts were also visually inspected for signs of damage, cracking, crazing or delamination of surfaces or finishes.

These samples were then placed in a Temperature Cycling oven as shown, cycled 5 times from +175/178°C to -65/70°C with dwell time 30 minutes min. Parts were then removed from the oven and allowed to return to ambient temperature before final checks were made.



A summary of the findings are as follows:

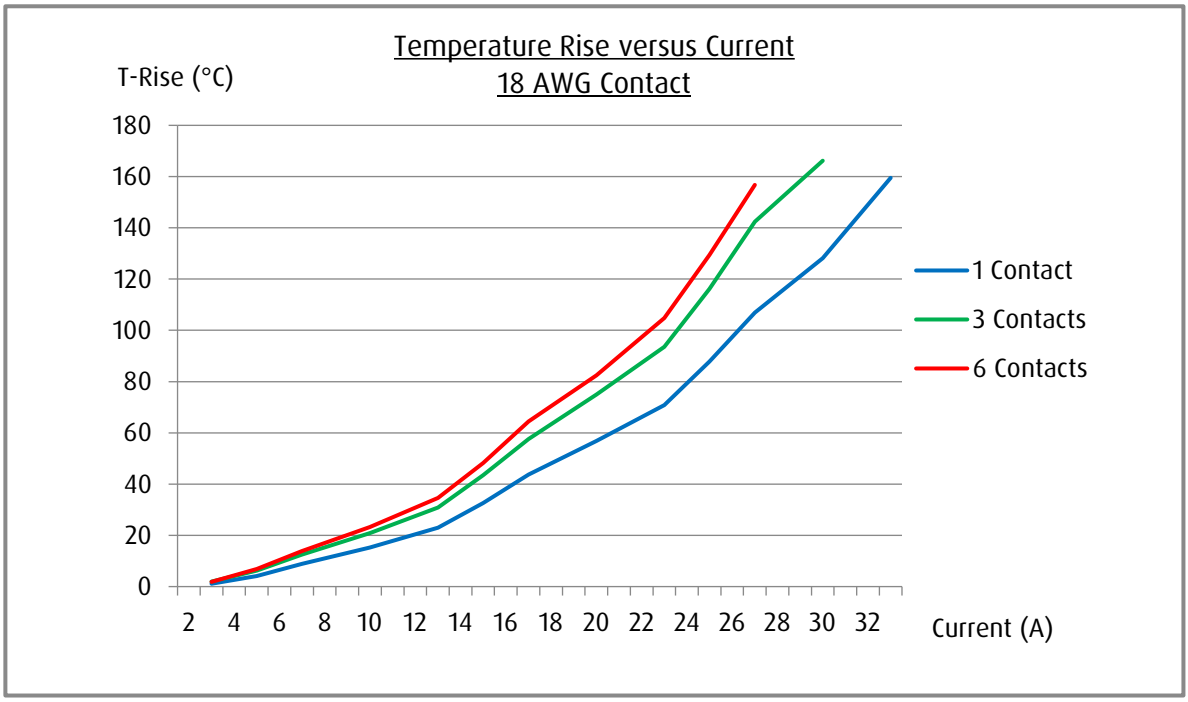
Mated Connector Pair Type	Mate / Un-Mate Force Pass/Fail	Voltage Proof Pass/Fail	Insulation Resistance Pass/Fail	Contact Resistance Pass/Fail	Visual Inspection Pass/Fail
Female Cable / Male PC Tail SIL 3 Pos.	Pass	Pass	Pass	Pass	Pass
Female PC Tail / Male Cable SIL 3 Pos.	Pass	Pass	Pass	Pass	Pass
Female Cable / Male PC Tail DIL 6 Pos.	Pass	Pass	Pass	Pass	Pass
Female PC Tail / Male Cable DIL 6 Pos.	Pass	Pass	Pass	Pass	Pass

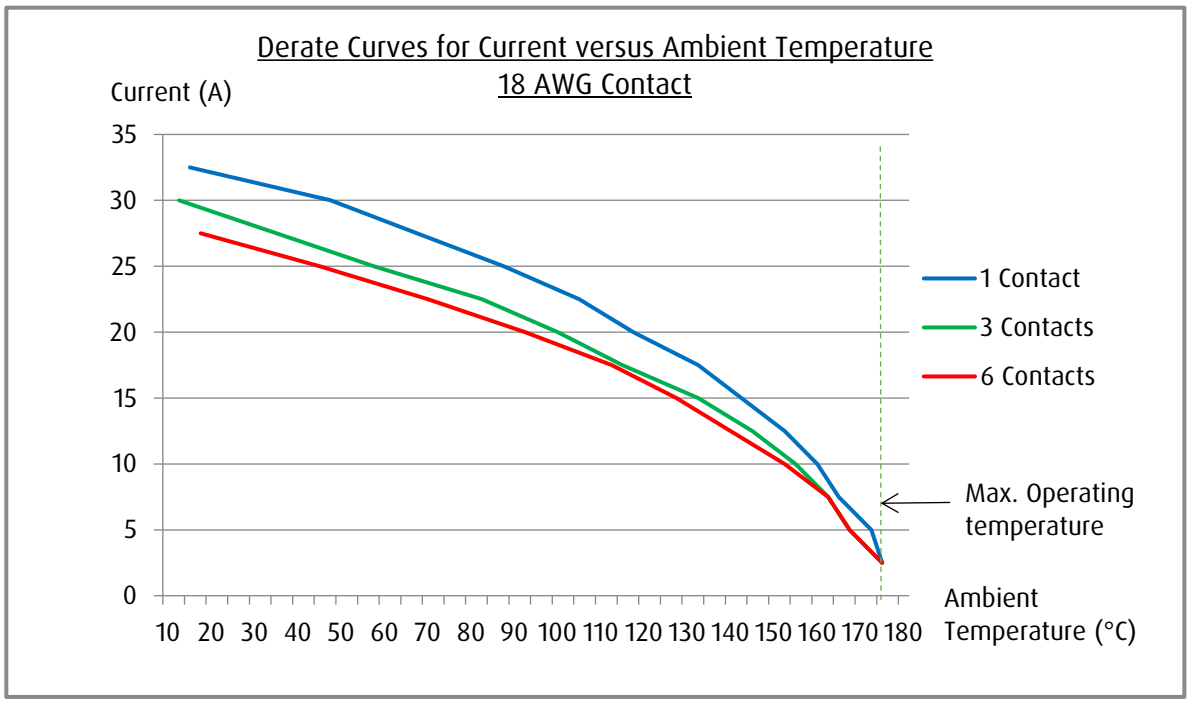
n) Temperature Rise versus Current (Power Rating) Test Method 2 to EIA-364-70A

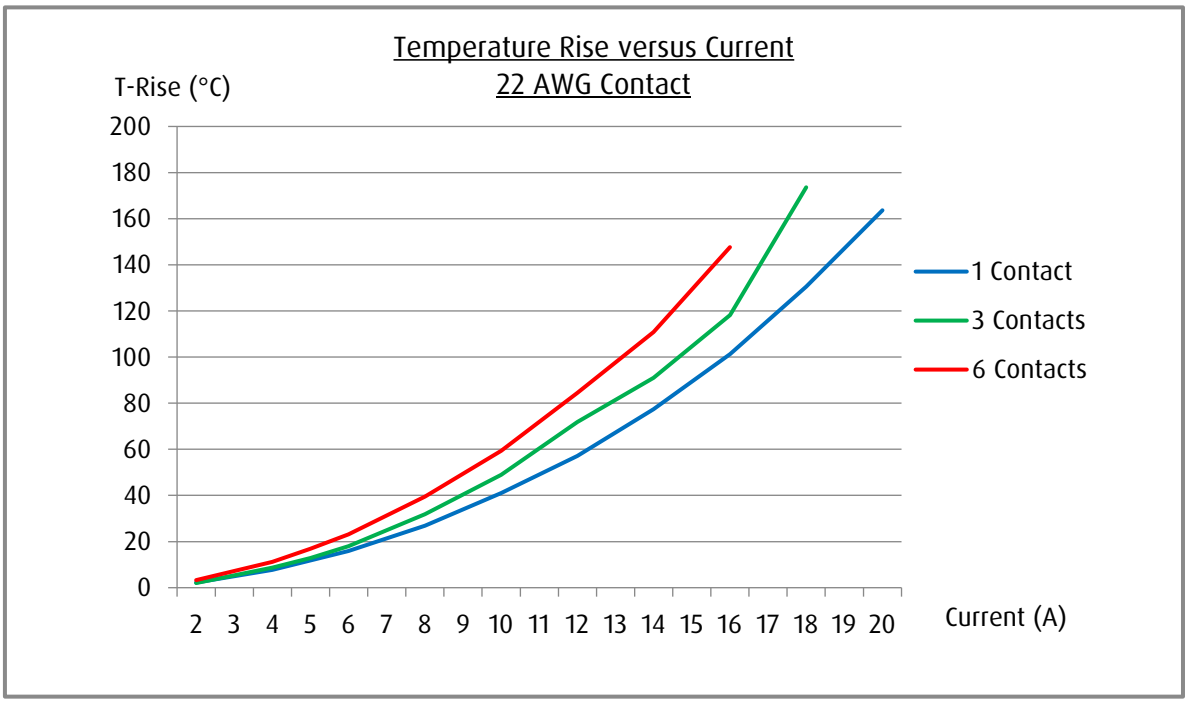
Specification: 10A for all contacts with 18 AWG wire, 30°C max. rise. 5A for 22 AWG wire.

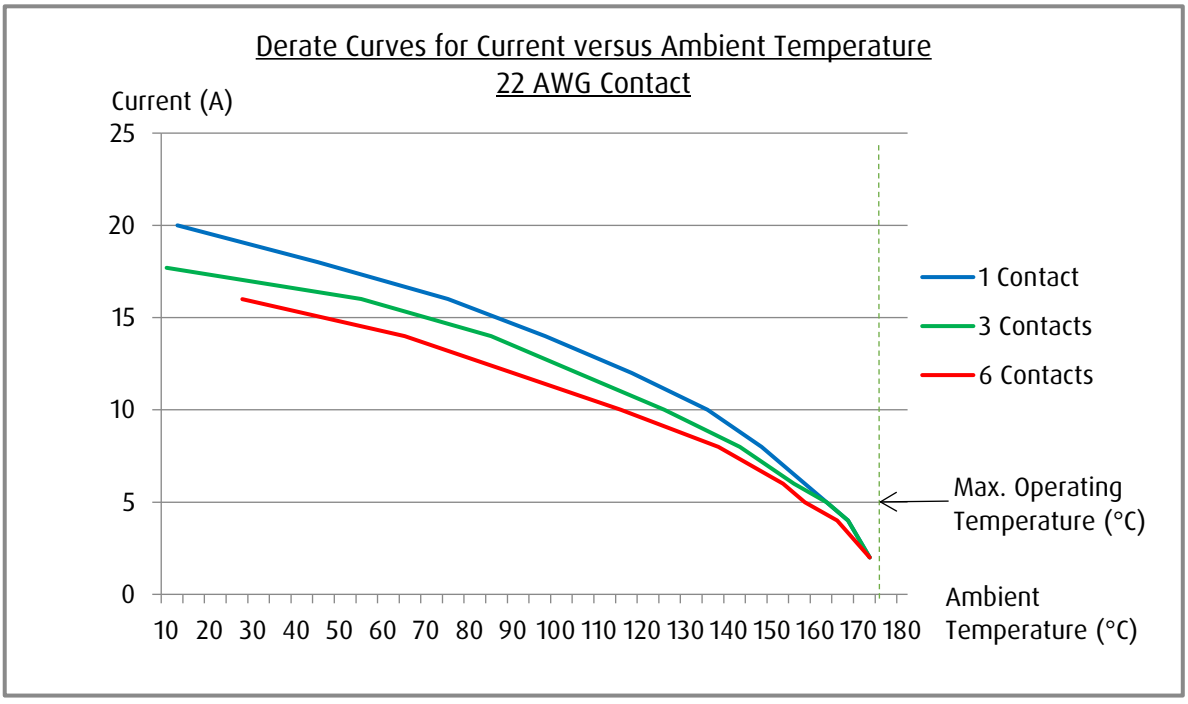
Method: 3 samples of all possible cable-to-cable mated variants, listed in section 2.1 were prepared with 18 and 22 AWG wire. These samples were tested for temperature rise v. current, for a single contact through to all contacts. The test started with a load of 2A: after the temperature stabilised, it was recorded. The current was increased by a similar amount and left to stabilise before recording. This was repeated until the maximum working temperature of 175°C reached.

The following temperature rise and de-rate curve graphs were produced from the recorded results:






Temperature Rise versus Current
22 AWG Contact
T-Rise (°C)
200
180
160
140
120
100
80
60
40
20
0
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Current (A)
1 Contact
3 Contacts
6 Contacts


Derate Curves for Current versus Ambient Temperature
22 AWG Contact
Current (A)
25
20
15
10
5
0
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
Ambient Temperature (°C)
1 Contact
3 Contacts
6 Contacts
Max. Operating Temperature (°C)

o) Bump Environmental Testing to BS EN 60068-2-27

Specification: 40G (392m/s^2), 6ms, Half-Sine, 4000 Bumps (split between 3 axes, both directions).

Method: 2 samples of all types of connectors listed in section 2.1, in cable-to-board combinations, were subjected to the above test specification, whilst being monitored for discontinuities of 1 millisecond min., using a constant current source of 100mA. Parts were visually inspected for damage or wear before and after. The typical test setup was as shown for Vibration testing.

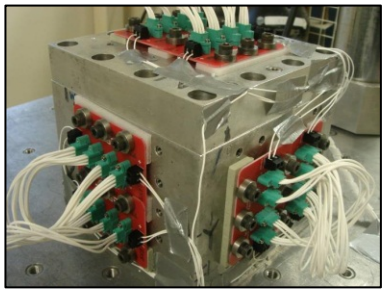
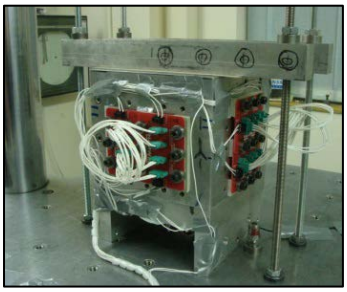
A summary of the findings are as follows:

Mated Connector Pair Type	Pass/Fail	Visual Inspection: Damage/Wear	Observation
Female PC Tail / Male Cable SIL 3 Position, no Jackscrew	Pass Z Fail X,Y	Pass	Failure due to mated pair separating
Female PC Tail / Male Cable DIL 6 Position, no Jackscrew	Pass	Pass	None
Female Cable / Male PC Tail SIL 3 Position, with Jackscrew	Pass	Pass	None
Female Cable / Male PC Tail DIL 6 Position, with Jackscrew	Pass	Pass	None

p) Shock Environmental Testing to BS EN 60068-2-27

Specification: 100G (981m/s^2), 6ms, Trapezoidal, 6 Shocks (one in all 3 axes, both directions).

Method: 2 samples of all types of connectors listed in section 2.1, in cable-to-board combinations, were subjected to the above test specification, while being monitored for discontinuities of 1 millisecond min., using a constant current source of 100mA. Parts were visually inspected for damage or wear before and after. The typical test setup is shown:

A summary of the findings are as follows:

Mated Connector Pair Type	Pass/Fail	Visual Inspection: Damage/Wear	Observation
Female PC Tail / Male Cable SIL 3 Position, no Jackscrew	Pass X, Y Fail Z	Pass	Failure due to mated pair separating
Female PC Tail / Male Cable DIL 6 Position, No Jackscrew	Pass	Pass	None
Female Cable / Male PC Tail SIL 3 Position, with Jackscrew	Pass	Pass	None
Female Cable / Male PC Tail DIL 6 Position, with Jackscrew	Pass	Pass	None