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HARWiN

Test Report Summary

HT07103

Electrical, Mechanical & Environmental Testing of
M225 Series

1. Introduction

1.1. Description and Purpose

The Harwin M225 series connector is a new range of 2.00mm pitch connector, utilising high-performance connector design techniques to create a product range ideal for demanding industrial applications. The following tests were carried out to confirm the expected Component Specification criteria.

1.2. Conclusion

The following data has been collated from Harwin test reports 1562, 1779, 1782, 1783, 1784, 1785, 1786, 1787, 1804, 1806, 1808, 1813 and 1820. The results were used to compile the Component Specification for the M225 range, which can be downloaded here:
https://cdn.harwin.com/pdfs/C050XX_M225_Series_Connectors.pdf

The tests indicate that the M225 connector products perform as required from the initial design requirements, and exceed the performance levels of commercial connectors on a similar pitch.

2. Test Method and Requirements

2.1. Specification Parameters

Tests were either carried out in general accordance with EIA 364 standards or to BS9520 (in accordance with BS9525 F0033). The list of tests covered in this summary are as follows:

Testing Standard	Description of Test	Section	Page No.
EIA-364-06C: 2006	Contact Resistance	3.1	3
EIA-364-70A: 1998	Power Rating	3.2	3-6
EIA-364-09C: 1999	Durability	3.3	7
EIA-364-17B: 1999	Temperature Life (without loading)	3.4	8
EIA-364-05B: 1998	Contact Insertion & Retention	3.5	8
EIA-364-08B: 1998	Crimp Strength	3.6	9
EIA-364-32C: 2000 (BS EN 60068-2-14: 2009)	Thermal Shock (Temperature Cycling)	3.7	10
EIA-364-26B: 1999 (BS EN 60068-2-11: 1999)	Salt Spray	3.8	11
EIA-364-31B: 1999 (BS EN 60068-2-78: 2013)	Humidity	3.9	12
EIA-364-28D: 1999 (BS EN 60068-2-6: 2008)	Vibration	3.10	13
EIA-364-27B: 1996 (BS EN 60068-2-27: 2009)	Mechanical Shock	3.11	14-15
EIA-364-20C: 2004	Withstand Voltage	3.12	15
EIA-364-21C: 2000	Insulation Resistance	3.13	15
N/A	Connector Locking System Retention	3.14	16

3. Test Results

3.1. Contact Resistance: EIA-364-06C: 1999

Methodology: Each connector was measured for resistance prior to any electrical, mechanical or environmental testing. The mated connector pairing was wired in series using M225-2830046 contacts and 200mm lengths of 22AWG wire. The total resistance of the complete circuit was measured (including wire).
Specification: Initial Contact Resistance = 20mΩ max per contact
Results: Initial Contact Resistance

Part Numbers	Connector Resistance (mΩ)	
	Total	Per Contact
M225-4551098 & M225-5201098 – 10 contacts	107	10.70
M225-4552098 & M225-5202098 – 20 contacts	204	10.20
M225-4552698 & M225-5202698 – 26 contacts	262	10.08
M225-4553498 & M225-5203498 – 34 contacts	342	10.06
M225-4555098 & M225-5205098 – 50 contacts	497	9.94

Results: Post-Conditioning Resistance (10 contacts only)

Test		Connector Resistance (mΩ)	
		Total	Per Contact
Initial		107.0	10.70
Power Rating		107.0	10.70
Durability		117.0	11.70
Temperature Life	96 hours	110.7	11.07
	250 hours	123.8	12.38
	1,000 hours	95.6	9.56
Salt Spray		184.7	18.47
Humidity		111.4	11.14
Thermal Shock		109.1	10.91

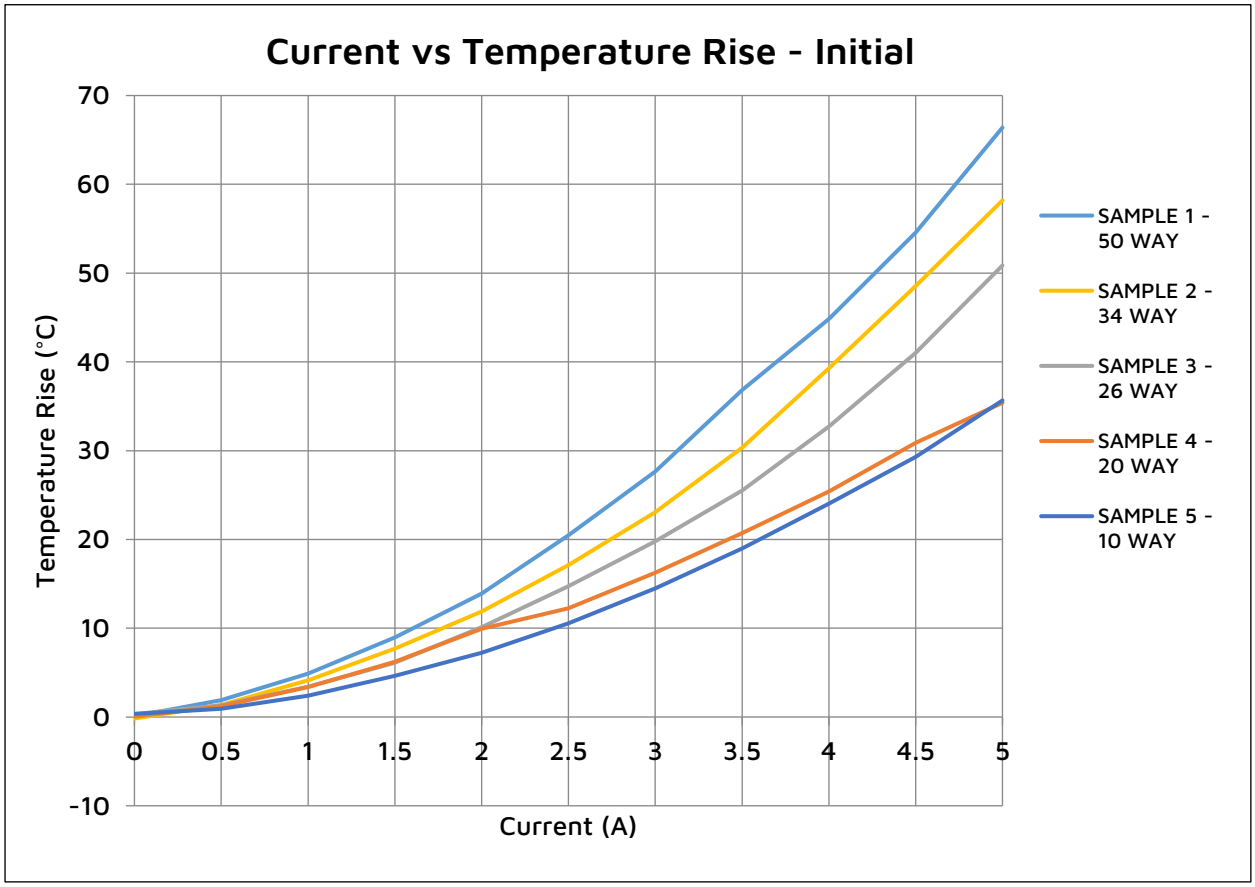
Contact resistance was also measured on a single contact pairing without wiring before and after mechanical insertion/withdrawal of 50 cycles.

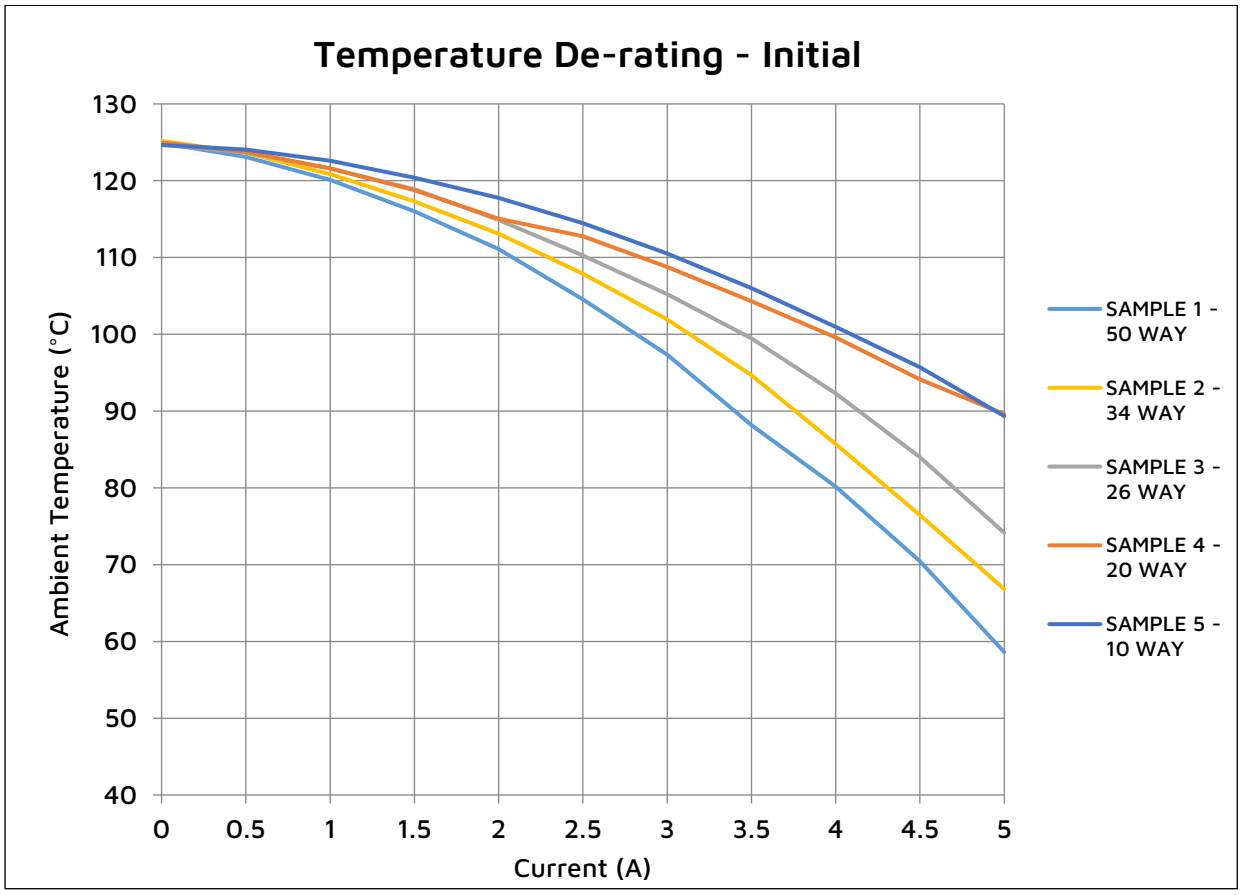
Contact Number	Contact Conditioning	Maximum (mΩ)	Minimum (mΩ)	Average (mΩ)
M225-2830046	Virgin Contact	4.1	3.2	**3.6**
	Post-Cycling (50 cycles)	4.3	2.1	**2.8**
M225-2840046	Virgin Contact	3.3	3.1	**3.2**
	Post-Cycling (50 cycles)	3.7	2.8	**3.4**

3.2. Power Rating (Current versus Temperature Rise): EIA-364-70A: 1998, Method 2

Methodology: The test demonstrates the current carrying capability of the M225 connector system, both pre and post-environmental conditioning. The mated connector pairing was wired in series using M225-2830046 contacts and 200mm lengths of 22AWG wire. 0.5A increments were applied to the system and the temperature rise above ambient recorded in each case. The test was performed up to 5A (at an ambient temperature of 25±2°C) or until maximum operating temperature of 125°C had been reached.
Specification: Current Rating (when all contacts are electrically loaded) = 3.0A max
Results:

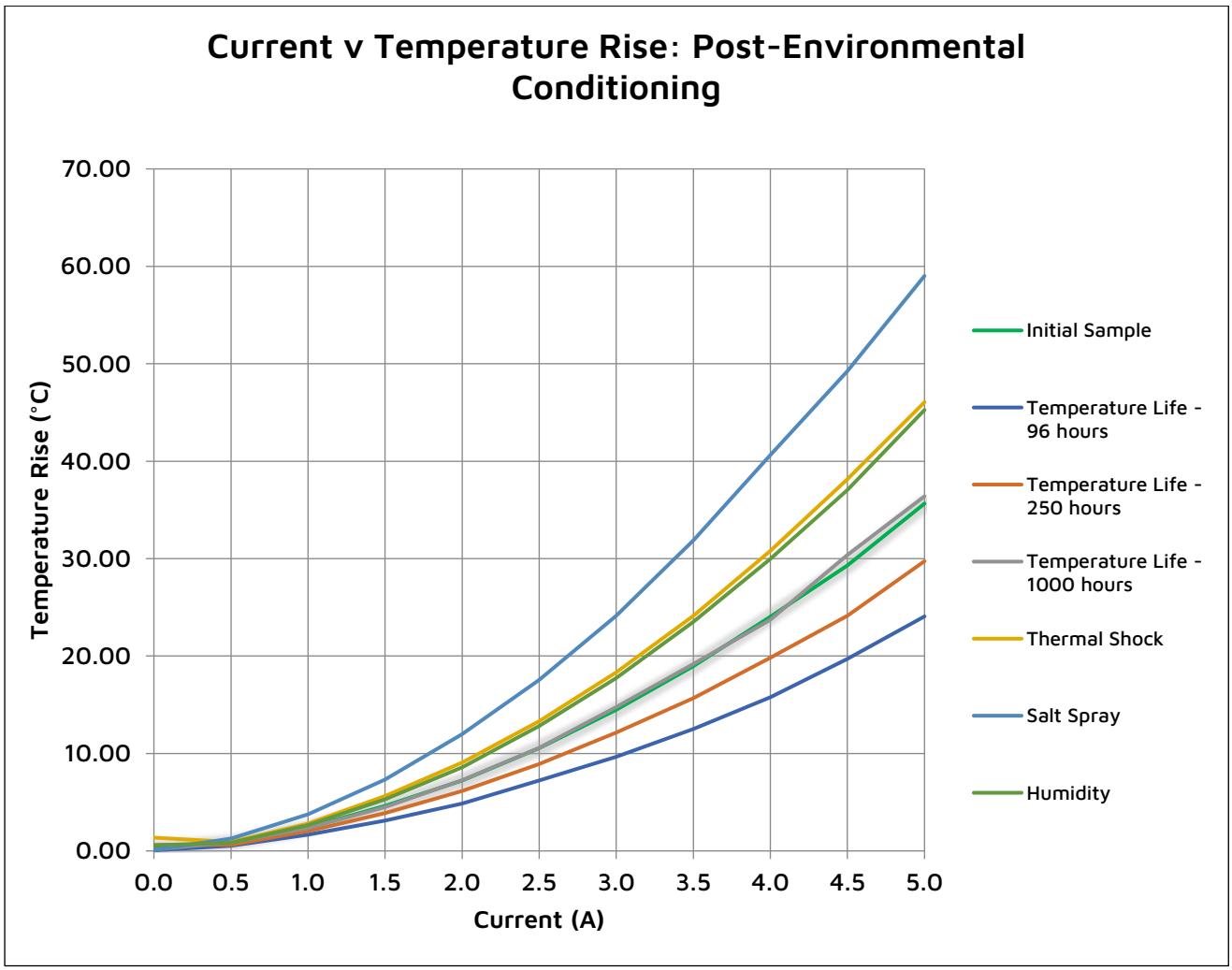
Part Numbers	Current causing 30°C Rise (A)
M225-4551098 & M225-5201098 – 10 contacts	5.0
M225-4552098 & M225-5202098 – 20 contacts	4.5
M225-4552698 & M225-5202698 – 26 contacts	4.0
M225-4553498 & M225-5203498 – 34 contacts	3.5
M225-4555098 & M225-5205098 – 50 contacts	3.5

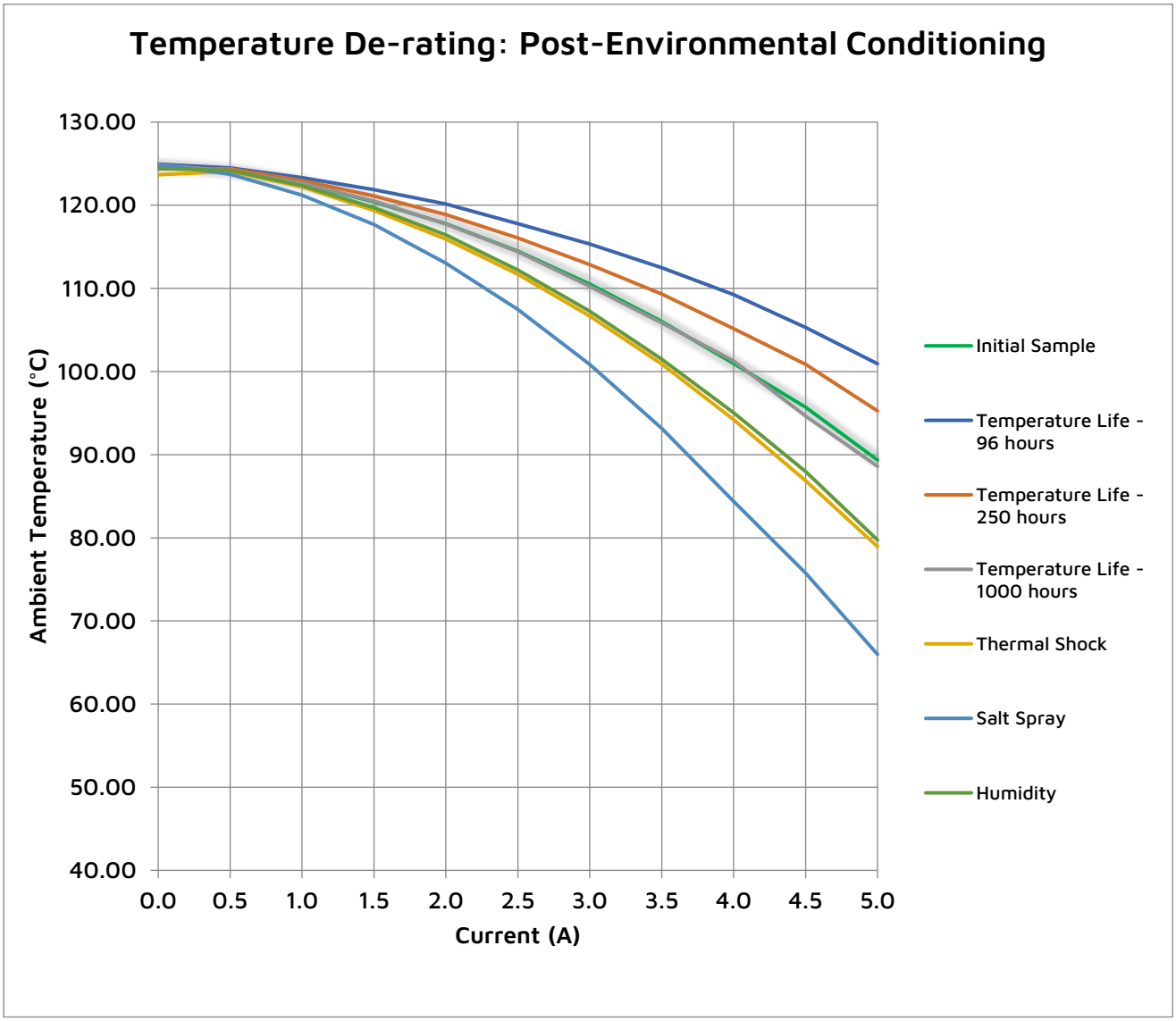

Current vs Temperature Rise - Initial
Temperature Rise (°C)
70
60
50
40
30
20
10
0
-10
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Current (A)
SAMPLE 1 - 50 WAY
SAMPLE 2 - 34 WAY
SAMPLE 3 - 26 WAY
SAMPLE 4 - 20 WAY
SAMPLE 5 - 10 WAY


Temperature De-rating - Initial
Ambient Temperature (°C)
130
120
110
100
90
80
70
60
50
40
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Current (A)
SAMPLE 1 - 50 WAY
SAMPLE 2 - 34 WAY
SAMPLE 3 - 26 WAY
SAMPLE 4 - 20 WAY
SAMPLE 5 - 10 WAY

Post-Conditioning Power Testing (10 contacts only):

Test		Current Causing 30°C Rise (A)
Initial		5.0
Temperature Life	96 hours	NOT REACHED
	250 hours	NOT REACHED
	1,000 hours	4.0
Salt Spray		3.5
Humidity		4.5
Thermal Shock		4.0




Temperature De-rating: Post-Environmental Conditioning
Ambient Temperature (°C)
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Current (A)
Initial Sample
Temperature Life - 96 hours
Temperature Life - 250 hours
Temperature Life - 1000 hours
Thermal Shock
Salt Spray
Humidity

3.3. Durability: EIA-364-09C: 1999

Methodology: For this test, pairs of M225-2830046 & M225-2840046 contacts were mated with a male pin (M80-0200046) at a speed of 25.4mm/min for 50 cycles. Inspection of the contact plating was performed post-cycling.
Specification:

- 5.0N maximum contact insertion force (per contact, using mating contact)
- 0.5N minimum contact insertion force (per contact, using mating contact)
- 4.0N maximum contact withdrawal force (per contact, using mating contact)
- 0.2N minimum contact withdrawal force (per contact, using mating contact)
- 50 Mechanical Operations

Results: Single Contact forces

Contact Part No.	Conditioning	Insertion Forces (N)			Withdrawal Forces (N)		
		Max	Min	Average	Max	Min	Average
M225-2830046	Initial Force	2.43	2.07	**2.27**	2.85	2.78	**2.80**
	Cycling Force	2.61	2.43	**2.50**	2.97	2.01	**2.59**
	Final Force	2.15	2.00	**2.07**	2.75	2.08	**2.51**
M225-2840046	Initial Force	2.69	2.45	**2.56**	2.81	2.51	**2.67**
	Cycling Force	2.80	2.45	**2.60**	2.81	2.68	**2.76**
	Final Force	2.05	1.97	**2.00**	2.11	2.00	**2.06**

Each size of M225 housing (M225-454xx98) was then assembled with M225-2830046 contacts and mated to the applicable size of male connector (M225-520xx46). The mating was cycled at 25.4mm/min for 50 cycles.

No. of contacts	Insertion Force (N)				Withdrawal Force (N)			
	Initial	Max	Min	Max per contact	Initial	Max	Min	Min per contact
10 contact	18.70	23.70	15.50	**2.37**	17.90	18.50	11.20	**1.12**
20 contact	62.50	62.70	53.20	**3.14**	51.30	60.80	42.20	**2.11**
26 contact	52.00	60.20	33.10	**2.32**	59.10	59.70	27.70	**1.07**
34 contact	70.90	85.70	70.80	**2.52**	63.80	83.50	50.60	**1.49**
50 contact	100.80	136.80	100.70	**2.74**	137.40	137.10	83.20	**1.66**
			Average	**3.05**			**Average**	**1.49**

Durability testing was then performed on environmentally conditioned test samples of the 10 contact version.

Test		Insertion Force (N)				Withdrawal Force (N)			
		Initial	Max	Min	Max per contact	Initial	Max	Min	Min per contact
Initial		18.70	23.70	15.50	**2.37**	17.90	18.50	11.20	**1.12**
Temperature Life	96 hours	10.64	11.25	9.79	**1.13**	11.82	12.55	10.47	**1.05**
	250 hours	15.50	16.71	14.90	**1.67**	13.21	16.37	11.23	**1.12**
	1,000 hours	17.30	18.43	14.88	**1.84**	11.68	14.88	11.77	**1.18**
Salt Spray		18.54	23.83	18.54	**2.38**	13.93	19.10	13.93	**1.39**
Humidity		15.66	15.66	11.69	**1.57**	28.73	28.73	21.60	**2.16**
Thermal Shock		14.54	15.85	11.96	**1.59**	20.82	21.19	16.34	**1.63**

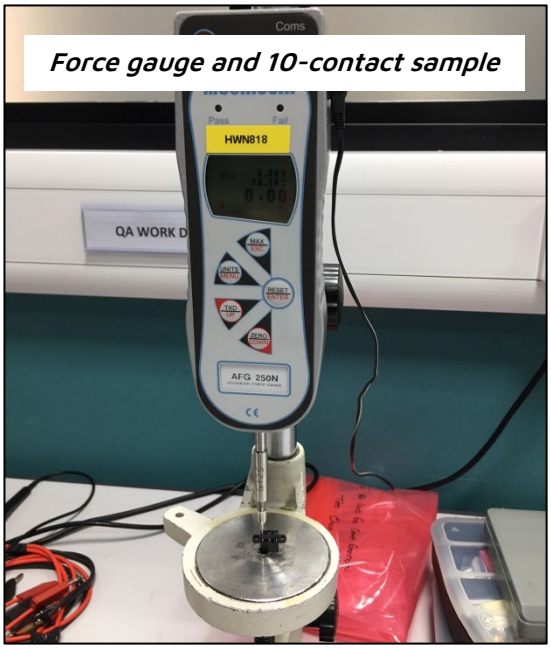
3.4. Temperature Life (without load): EIA-364-17B: 1999, Condition 5, Method A

Methodology: Two mated pairs of connectors were subjected to 96 hours, 250 hours and 1,000 hours at 125±2°C. The change in contact resistance must be less than 10mΩ, and the connectors must show no evidence of physical damage.
Specification: Operating temperature = -55°C to +125°C
Results:

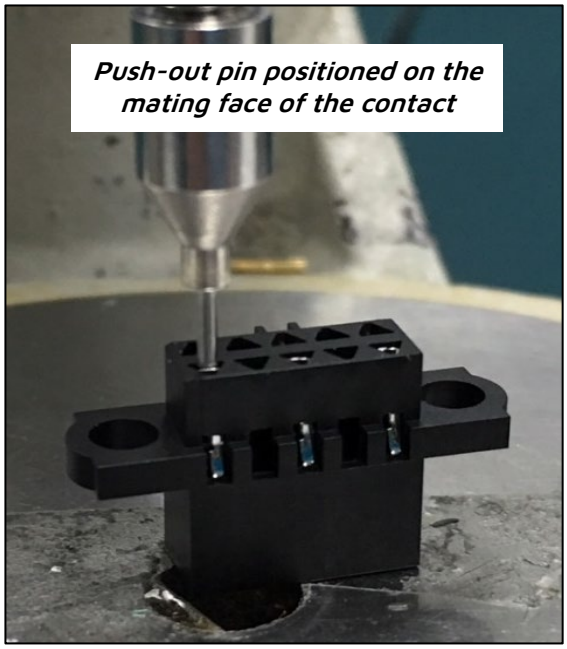
Mated Assembly Part No.	Duration in Temperature Testing Oven		
	100hrs	250hrs	1,000hrs
M225-4541098 & M225-5201098	PASS	PASS	PASS

3.5. Contact Insertion & Retention: EIA-364-05B: 1998

Methodology: 6 contacts were assembled at each end and the centre of each housing sample, measuring the force required to do so. The contacts were then pushed out of the housing and the force was recorded.



Force gauge and 10-contact sample

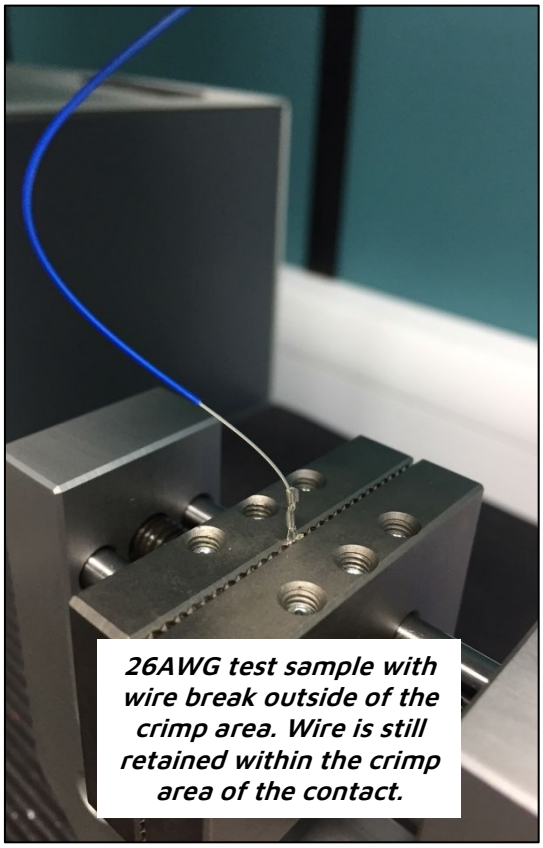

Push-out pin positioned on the mating face of the contact

Specification: Contact Retention in Housing = 6N min, Contact Insertion in Housing = 0.5N min.
Results:

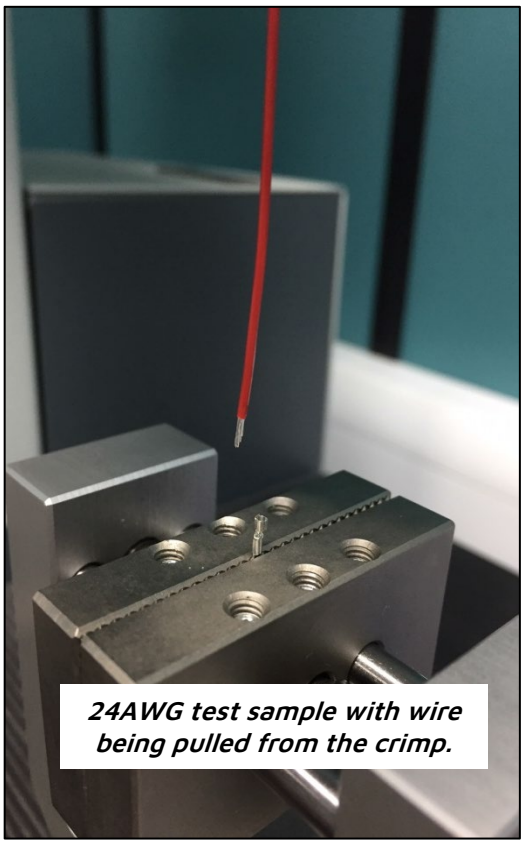
Housing Part No.	Contact M225-2830046		Contact M225-2840046	
	Insertion (N)	Removal (N)	Insertion (N)	Removal (N)
M225-4541098	2.24	14.18	1.33	10.53
M225-4542098	2.01	13.74	1.27	10.40
M225-4542698	1.99	13.53	1.26	9.70
M225-4543498	2.01	15.55	1.16	11.23
M225-4545098	2.00	13.06	1.07	9.86
Average	**2.05**	**14.01**	**1.22**	**10.34**

3.6. Crimp Strength: EIA-364-08B: 1998

Methodology: Five 200mm samples of each wire size were crimped into their respective contacts using crimp tool Z80-255 fitted with contact locator (Z80-259). The wire was then separated from the contact at a speed of 25.4mm/min, and the force required to achieve separation of wire from contact recorded, as well as the type of separation (either wire break inside or outside of crimp area, or wire pulled out from the crimp area).



26AWG test sample with wire break outside of the crimp area. Wire is still retained within the crimp area of the contact.



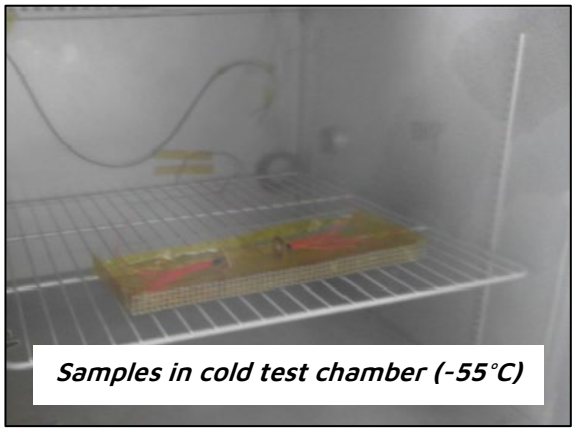
24AWG test sample with wire being pulled from the crimp.

Results:

Contact Part Number	Wire Size	Specification	Max (N)	Min (N)	Average (N)
M225-2830046	22AWG	45N min	77.0	68.8	72.6
	24AWG	30N min	53.3	35.4	46.0
M225-2840046	26AWG	20N min	32.7	30.8	31.4
	28AWG	9.5N min	15.0	10.7	13.1

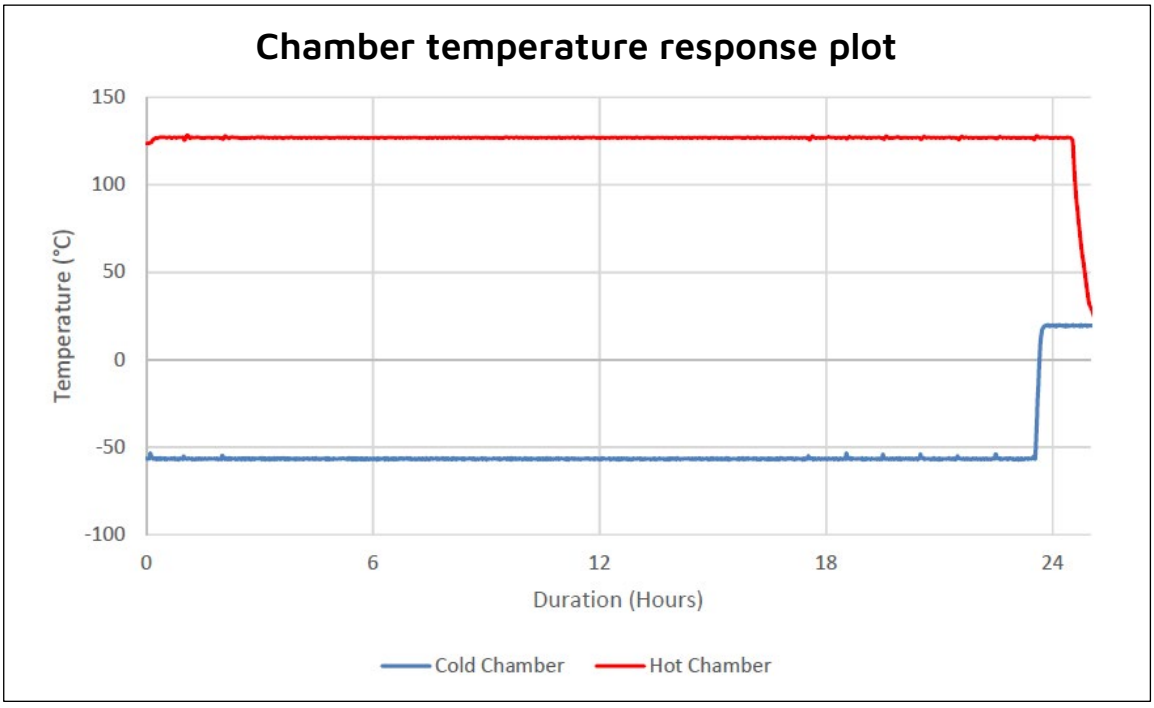
3.7. Thermal Shock (Temp. Cycling): EIA-364-32C: 2000/BS EN 60068-2-14: 2009

Methodology: Samples were tested in general accordance with BS EN 60068-2-14: 2009 and EIA-364-32C: 2000 Test Condition 3. This test was conducted by manually transferring the samples between climatic chambers at the two temperature extremes. The connectors were measured for contact resistance, power and durability, as well as a visual inspection after testing.



Samples in cold test chamber (-55°C)

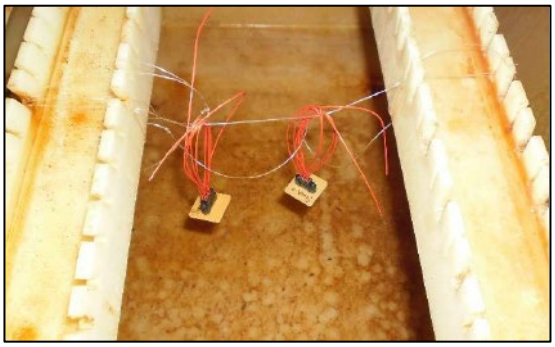
Samples in hot test chamber (+125°C)



Specification: -55°C to +125°C
Result: There were no obvious changes as a result.

3.8. Salt Spray: EIA-364-26B: 1999/BS EN 60068-2-11: 1999

Methodology: Samples were tested in general accordance with BS EN 60068-2-11: 1999 Test Ka and EIA-364-26B Test Condition A. The samples were placed into a high humidity chamber for an extended period and measured for contact resistance, power and durability, as well as visual inspection post-testing.



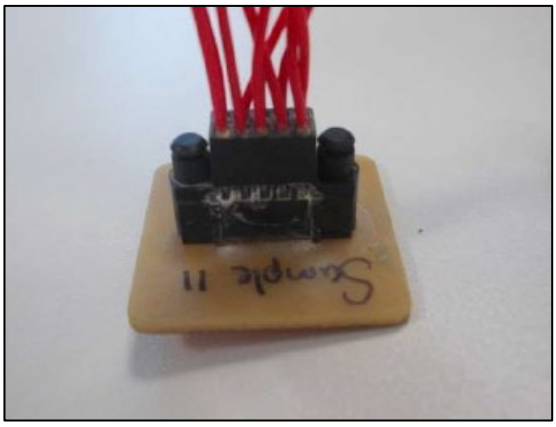
Samples in salt mist chamber

Samples in drying chamber

Specification:

- 96hrs continuous salt spray
- Salt Solution = 5% NaCl
- Salt Mist Chamber Temp. = +35°C
- Fallout rates= 0.5-3ml/hr
- pH level = 6.5-7.2 at +35°C

Results: There were no obvious changes as a result.

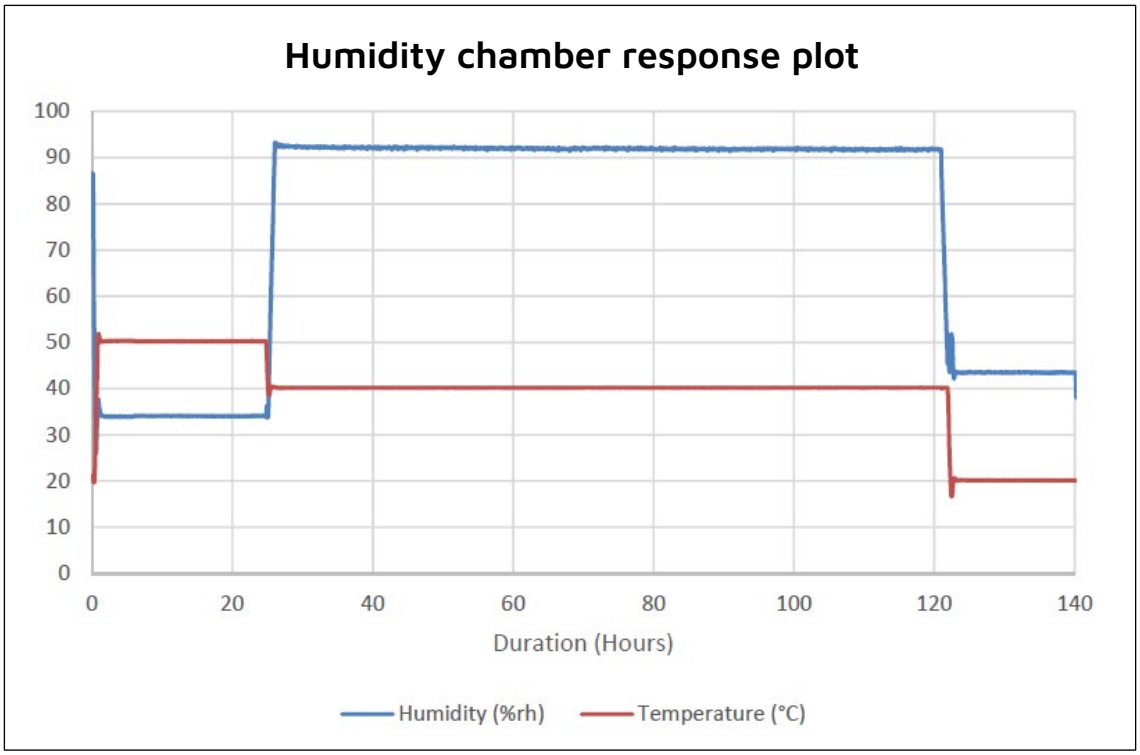


Sample 11 after salt spray testing

Sample 12 after salt spray testing

3.9. Humidity: EIA-364-31B: 1999/BS EN 60068-2-78: 2013

Methodology: Samples were tested in general accordance with BS EN 60068-2-78: 2013 Test Cab and EIA-364-31B: 1999 Method 2 Test Condition A. The samples were preconditioned for 24 hours at 50°C then suspended in a humidity chamber for 96 hours at 40°C with 90-95% relative humidity. The connectors were measured for contact resistance, power and durability, as well as a visual inspection post-testing.



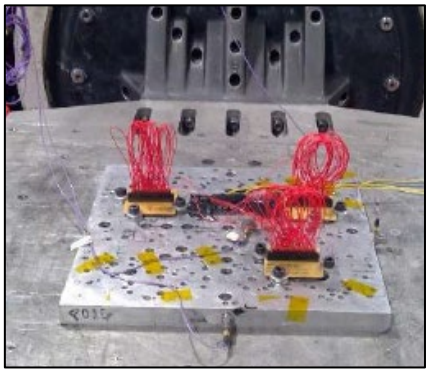
Specification:

- 24hrs preconditioning at +50°C
- Humidity = 90-95%
- Temperature = +40°C
- Duration = 96hrs

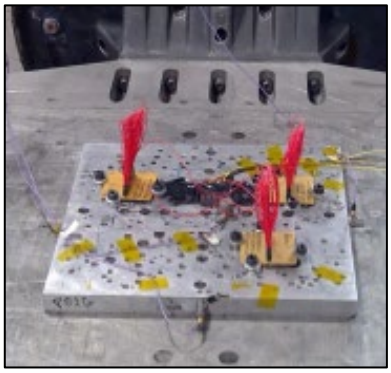
Results: There were no obvious changes as a result.

3.10. Vibration: EIA-364-28D: 1999/BS EN 60068-2-6: 2008

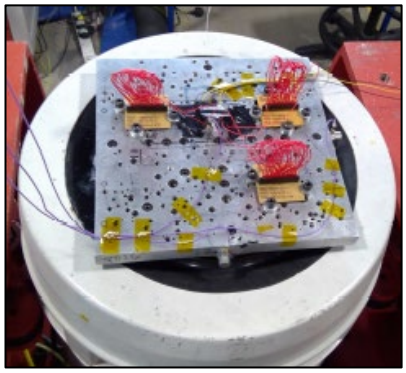
Methodology: Samples were tested in general accordance with BS EN 60068-2-6: 2008 Test Fc and EIA-364-28D Test Condition 3. The samples were subjected to a Swept Sine Test with continuous monitoring at ≥1 microsecond.



Lateral Axis



Longitudinal Axis

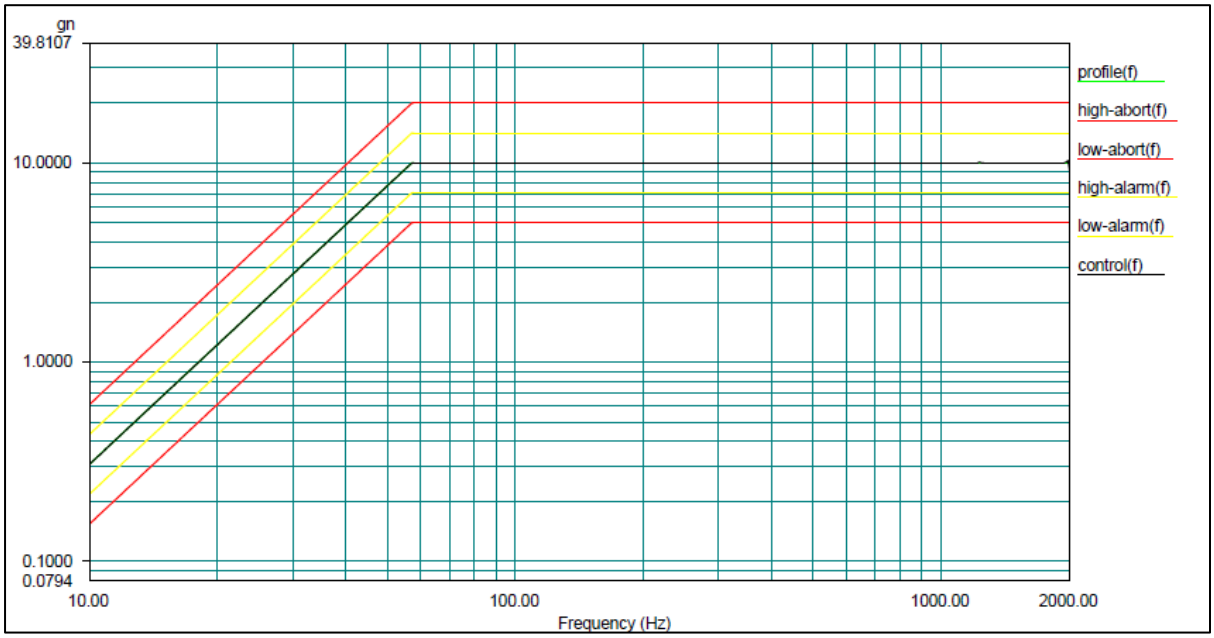


Vertical Axis

Specification:

- 10Hz to 2,000Hz
- 1.52mm pk-pk displacement or 10G pk (whichever is less)
- 98.1m/s^2 (10G)
- 12 cycles per axis, 20 minutes per cycle

Results: No discontinuities were noted during the testing on all three axes along with no obvious changes to the samples.



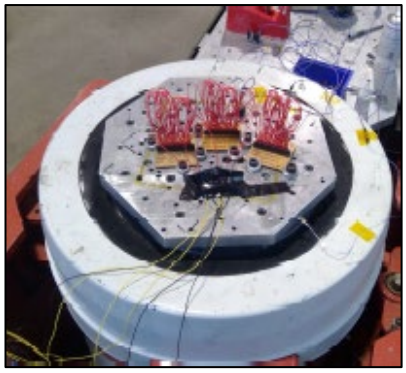
Sine sweep vibration response

3.11. Mechanical Shock: EIA-364-27B: 1996/BS EN 60068-2-27: 2009

Methodology: 50-position female mouldings were populated with M225-2830046 contacts (22/24AWG) and mated to Male PC-Tail connectors for this test, with connectors being wired in series. Shock Test Sequence was carried out on three samples. During the test, the samples were monitored continuously for discontinuities of ≥1 microsecond, using a constant current source of 100mA.

Lateral Axis

Longitudinal Axis

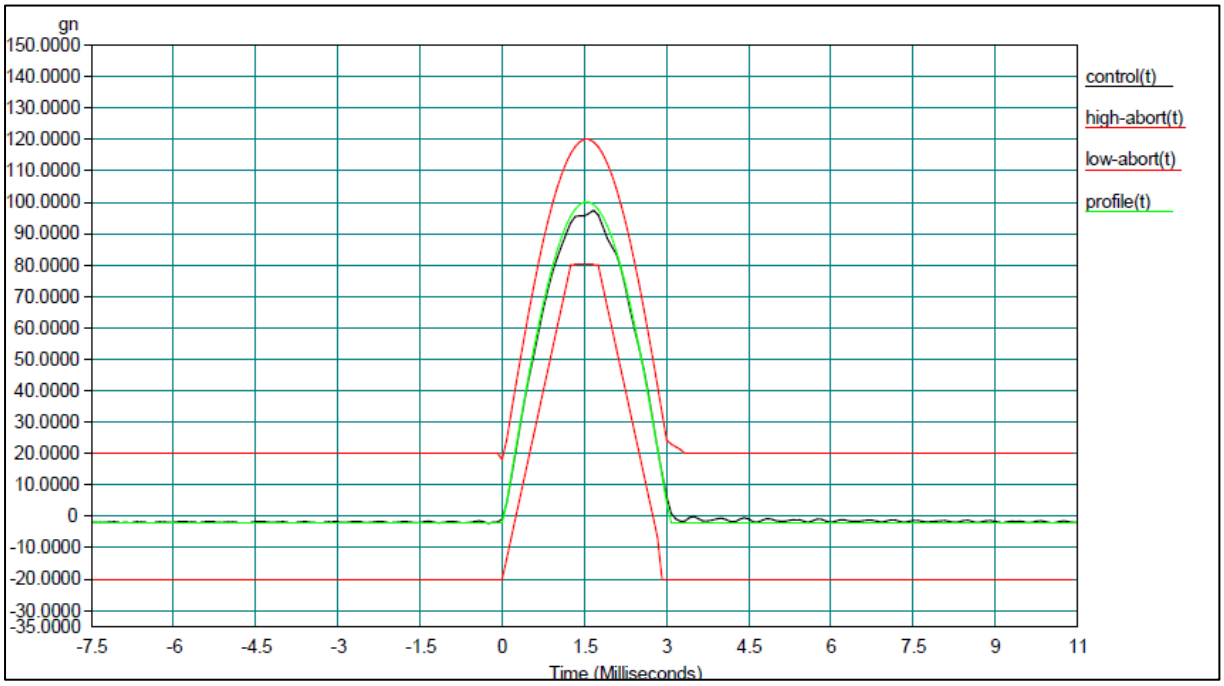


Vertical Axis

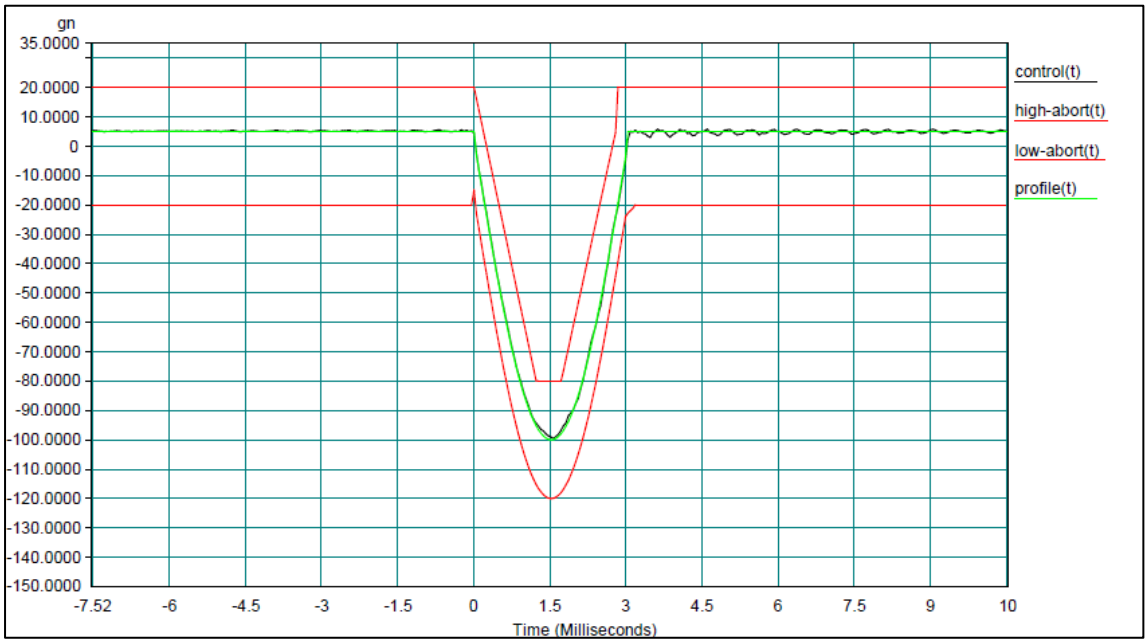
Specification:

- Acceleration = 100G
- Shock Duration = 3ms
- Shock Shape = Half Sine Pulse, 3 shocks in each axis

Results: No discontinuities were found on any samples during any axis of the test, and a visual inspection revealed no distortion or bending to any components.



Positive shock pulse plot



Negative shock pulse plot

3.12. Withstand Voltage: EIA-364-20C: 2004

Methodology: 1,200V DC voltage was applied to connector pairs wired in two series to determine whether breakdown or flashover occurred. Samples of both contact types (M225-2830046 and M225-2840046) were visually inspected following the test.
Specification:

- Voltage Proof (1013mbar/sea level) = 1,200V DC/AC
- Working Voltage (1013mbar/sea level)= 800V DC/AC

Results: Test passed by both contacts, no obvious changes to the connectors.

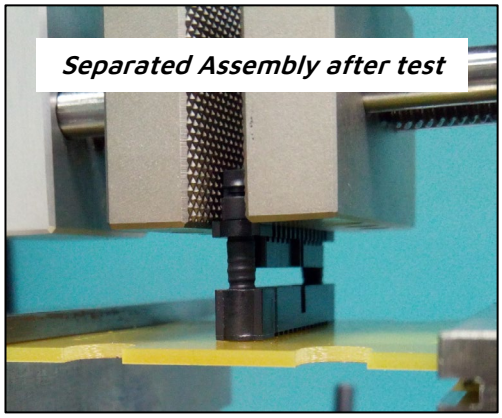
3.13. Insulation Resistance: EIA-364-21C: 2000

Methodology: 500V DC and 1,000V DC voltages were applied to connector pairs wired in two series to determine whether the resistance satisfies the required specification values of >10GΩ and >20GΩ respectively. Samples were visually inspected following the test.
Specification: Insulation Resistance = 1,000MΩ min
Results: No obvious changes to the samples.

Part No.	Insulation Resistance	
	500V (>10GΩ)	1kV (>20GΩ)
M225-2830046	PASS	PASS
M225-2840046	PASS	PASS

3.14. Connector Locking System Retention

Methodology: A male connector assembly and a female connector housing (without contacts) were fixed into opposing jaws of an auto-force gauge and separated at a rate of 25.4mm/min. The maximum force required to separate the assembly was recorded.



Separated Assembly after test

Results:

Mated Assembly Part Numbers	Connector Retention (N)		
	Max	Min	Average
M225-4551098 & M225-5201046	20.10	10.25	15.86
M225-4552098 & M225-5202046	20.73	11.15	14.89
M225-4552698 & M225-5202646	23.61	9.66	15.41
M225-4553498 & M225-5203446	25.28	11.32	18.60
M225-4555098 & M225-5205046	24.99	15.05	19.72
Average	**25.28**	**9.66**	**17.27**