EP 2.5 Connector System

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity (TE) EP 2.5 Connector System to determine its conformance to the requirements of Product Specification 108-2418.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the TE EP 2.5 Connector System. Testing was performed at the Harrisburg Electrical Components Test Laboratory from 14-March-2011 to 15-July-2011 and 15-December-2011 to 30-April-2012. The test file numbers for the testing is EA20110213T (Test Groups 1 and 2) and EA20110906T (Test Groups 3 through 11). This documentation is on file at and available from the Harrisburg Electrical Components Test Laboratory.

1.3 Conclusion

All part numbers listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2418.

1.4 Product Description

The EP 2.5 product is a wire-to-board connection consisting of crimp-snap contacts seated in a housing that mates to 0.6 mm diameter post headers on 2.5 mm centerline and is designed to be terminated to 22 to 26 AWG wire.

1.5 Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for test:

Table 1 – Test Specimen Identification

Test Group	Qty	Part Number	Description
1	5	2110992-2 Rev B	2 position EP 2.5 mm Receptacle Housing
1	10	2110989-1 Rev A	2.5 mm Receptacle Contacts with 22 AWG
1	5	2132230-2	2 Position Header Assembly, Vertical, EP 2.5 mm
1	5	2110992-5 Rev B	5 position EP 2.5 mm Receptacle Housing
1	25	2110989-1 Rev A	2.5 mm Receptacle Contacts with 22 AWG
1	5	2132230-5	5 position Header Assembly, Vertical, EP 2.5 mm
1	5	2-2110992-0	20 position EP 2.5 mm Receptacle Housing
1	100	2110989-1 Rev A	2.5 mm Receptacle Contacts with 22 AWG
1	5	2-2132230-0	20 position Header Assembly, Vertical, EP 2.5 mm
2	3	2-2110992-0	20 position EP 2.5 mm Receptacle Housing
2	60	2110989-1 Rev A	2.5 mm Receptacle Contacts with 26 AWG
2	3	2-2132230-0	20 position Header Assembly, Vertical, EP 2.5 mm
2	3	2-2110992-0	20 position EP 2.5 mm Receptacle Housing
2	60	2110989-1 Rev A	2.5 mm Receptacle Contacts with 24 AWG
2	3	2-2132230-0	20 position Header Assembly, Vertical, EP 2.5 mm
2	8	2110992-2 Rev B	20 position EP 2.5 mm Receptacle Housing
2	160	2110989-1 Rev A	2.5 mm Receptacle Contacts with 22 AWG
2	8	2-2132230-0	20 position Header Assembly, Vertical, EP 2.5 mm
3	5	2-1969442-0	20 position EP 2.5 mm Receptacle Housing with TPA
3	100	2110989-1	2.5 mm Receptacle Contacts with 22 AWG

Table 1 – Test Specimen Identification, continued

Test Group	Qty	Part Number	Description
4	30	2110989-1	2.5 mm Receptacle Contacts with 22 AWG
4	30	2110989-1	2.5 mm Receptacle Contacts with 26 AWG
5	5	2-2132415-0	20 position Header Assembly, Vertical, EP 2.5 mm
6	5	2-1969442-0	20 position EP 2.5 mm Receptacle Housing
6	5	2-2132415-0	20 position Header Assembly, Vertical, EP 2.5 mm
7	5	2-2132415-0	20 position Header Assembly, Vertical, EP 2.5 mm
8	5	2-1969442-0	20 position EP 2.5 mm Receptacle Housing
8	100	2110989-1	2.5 mm Receptacle Contacts with 22 AWG
9	5	2-1969442-0	20 position EP 2.5 mm Receptacle Housing
9	5	2-2132415-0	20 position Header Assembly, Vertical, EP 2.5 mm
9	100	2110989-1	2.5 mm Receptacle Contacts with 22 AWG
10	5	2-1969442-0	20 position EP 2.5 mm Receptacle Housing
10	5	2-2132415-0	20 position Header Assembly, Vertical, EP 2.5 mm
10	100	2110989-1	2.5 mm Receptacle Contacts with 22 AWG
11	5	2-1969442-0	20 position EP 2.5 mm Receptacle Housing
11	5	2-2132415-0	20 position Header Assembly, Vertical, EP 2.5 mm
11	100	2110989-1	2.5 mm Receptacle Contacts with 22 AWG

NOTE: Where needed PCB P/N 60-1042725-1 Rev A was utilized. This is a 20 position EP 2.5 PCB.

1.6 Qualification Test Sequence

Table 2 - Test Sequence

Test or Examination	Test Group (a)										
	1	2	3	4	5	6	7	8	9	10	11
	Test Sequence (b)										
Initial Examination of Product	1	1	1	1	1	1	1	1	1	1	1
LLCR	3,7	2,7							2,4	2,4	2,4
Withstanding Voltage			2,4								
Temperature Rise vs. Current		3,8									
Sinusoidal Vibration	5	6(c)									
Mechanical Shock	6										
Durability	4										
Mating Force	2										
Unmating Force	8										
Crimp Tensile				2							
Contact Retention			5								
Resistance to Soldering Heat					2						
Connector locking strength						2					
Post Retention							2				
Contact insertion force								2			
Thermal shock			3								
Humidity/Temperature cycling		4(d)									
Temperature life		5									
Salt Spray									3		
Hydrogen sulfide										3	
Ammonia											3
Final examination of product	9	9	6	3	3	3	3	3	5	5	5

Note: (a) See paragraph 1.5
(b) Numbers indicate sequence which tests were performed.
(c) Discontinuities shall not be measured. Energize at 18°C level for 100% loadings per Quality Specification 102-950.
(d) Precondition specimens with 10 durability cycles.

1.7 Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

Temperature:	15°C to 35°C
Relative Humidity	20% to 80%

2. SUMMARY OF TESTING

2.1 Initial examination of product – All Test Groups

A Certificate of Conformance stating that all specimens submitted for testing were representative of normal production lots and met the requirements of the application drawing was provided. Where specified, specimens were visually examined, and no evidence of physical damage detrimental to product performance was observed.

2.2 LLCR – Test Groups 1, 2, 9, 10 and 11

All low level contact resistance measurements recorded were less than 10 milliohms initially and 20 milliohms for final. Refer to Table 3 for the summary data.

Table 3 – Summary Resistance Data

Test Group	Number of Data points	Low Level Contact Resistance in milliohms							
		Initial				Final			
		Min	Max	Mean	Std Dev	Min	Max	Mean	Std Dev
1	135	2.15	4.02	2.89	0.31	2.11	9.11	4.23	1.04
2	100	2.17	3.69	2.80	0.25	3.40	7.41	4.57	0.86
9	100	2.43	3.43	2.72	0.17	2.75	9.23	3.90	1.18
10	100	2.44	3.2	2.71	0.15	2.81	8.98	3.75	0.98
11	100	2.42	3.12	2.68	0.14	2.57	5.70	3.26	0.55

Approximately 7.5 inches of wire bulk has been removed from each of the data points.

2.3 Withstanding voltage – Test Group 3

There were no withstanding voltage breakdowns, or flashover, and the leakage current did not exceed 1.3 milliamperes, when subjected to a test potential of 1000 volts AC for 60 seconds.

2.4 Temperature Rise vs. Current – Test Group 2

All temperature rise vs. current measurements recorded had a temperature rise less than 30°C when energized at a single current level. Refer to Table 4 for the Current Rating Factor Table and Figure 1 for the Current Carrying curve.

Table 4 – Current Rating Factors (F)

Percent Connector Loading	Wire Size AWG		
	26	24	22
Single Contact	0.797	0.889	1
50	0.639	0.712	0.801
100	0.519	0.578	0.650

To determine acceptable current rating for percentage connector loading and w ire gage indicated, use the Multiplication Factor (F) from the above chart and multiply it times the Base Rated Current for a single circuit at the desired ambient operating temperature shown in Figure 1.

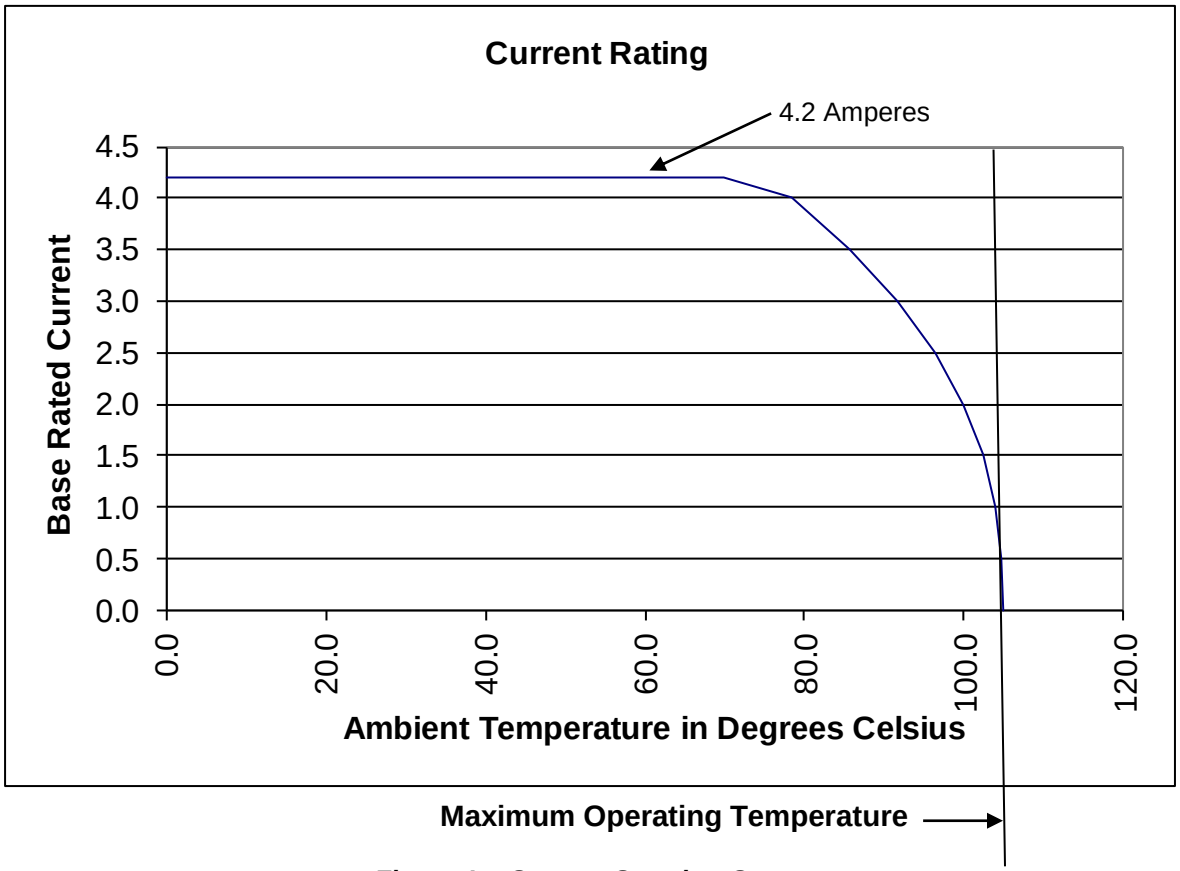

Figure 1 – Current Carrying Curve

2.5 Sinusoidal Vibration – Test Groups 1 and 2

No discontinuities of 1 microsecond or longer duration were detected during random vibration testing.

2.6 Mechanical Shock – Test Groups 1

No discontinuities of 1 microsecond or longer duration were detected during mechanical shock testing.

2.7 Durability – Test Group 1

No evidence of physical damage detrimental to product performance was visible as a result of durability cycling.

2.8 Mating force – Test Group 1

All mating force measurements were less than the maximum requirement of 8.9 N (2.0 pounds).

2.9 Unmating force – Test Group 1

All unmating force measurements were greater than the minimum requirement of 0.9 N (0.20 pounds).

2.10 Crimp tensile – Test Group 4

All crimp tensile measurements were greater than the minimum requirement of 73.7 N (16.58 pounds) for 22 AWG and 24.1 N (5.43 pounds) for 26 AWG.

2.11 Contact retention – Test Group 3

All contact retention measurements were greater than the minimum requirement of 25.6 N (5.76 pounds) for parts with TPA.

2.12 Resistance to soldering heat – Test Group 5

No evidence of physical damage detrimental to product performance was visible as a result of exposure to a reflow soldering heat profile having a peak temperature of 265°C.

2.13 Connector locking strength – Test Group 6

All connector locking strength measurements were greater than the minimum requirement of 25.8 N (5.81 pounds).

2.14 Post retention – Test Group 7

All post retention measurements were greater than the minimum requirement of 4.00 N (0.90 pounds).

2.15 Contact insertion force – Test Group 8

All contact insertion force measurements were less than the maximum requirement per contact of 6.9 N (1.5 pounds).

2.16 Thermal shock – Test Group 3

No evidence of physical damage detrimental to product performance was visible as a result of exposure to a thermal shock environment.

2.17 Humidity/temperature cycling – Test Group 2

No evidence of physical damage detrimental to product performance was visible as a result of exposure to a humidity/temperature cycling environment.

2.18 Temperature life – Test Group 2

No evidence of physical damage detrimental to product performance was visible as a result of exposure to a temperature life environment.

2.19 Salt spray – Test Group 9

No evidence of physical damage detrimental to product performance was visible as a result of exposure to a salt spray environment.

2.20 Hydrogen sulfide – Test Group 10

No evidence of physical damage detrimental to product performance was visible as a result of exposure to hydrogen sulfide.

2.21 Ammonia – Test Group 11

No evidence of physical damage detrimental to product performance was visible as a result of exposure to ammonia.

2.22 Final examination of product – All Test Groups

Where specified, specimens were visually examined, and no evidence of physical damage detrimental to product performance was observed.

3. TEST METHODS

3.1. Initial Examination of Product

A Certificate of Conformance was issued stating that all specimens in this test package were produced, inspected, and accepted as conforming to product drawing requirements, and were manufactured using the same core manufacturing processes and technologies as production parts.

3.2 LLCR

Low level contact resistance measurements were taken using a four wire measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. Measurements were taken according the method identified in Figure 2. Wire bulk was removed from each resistance value.

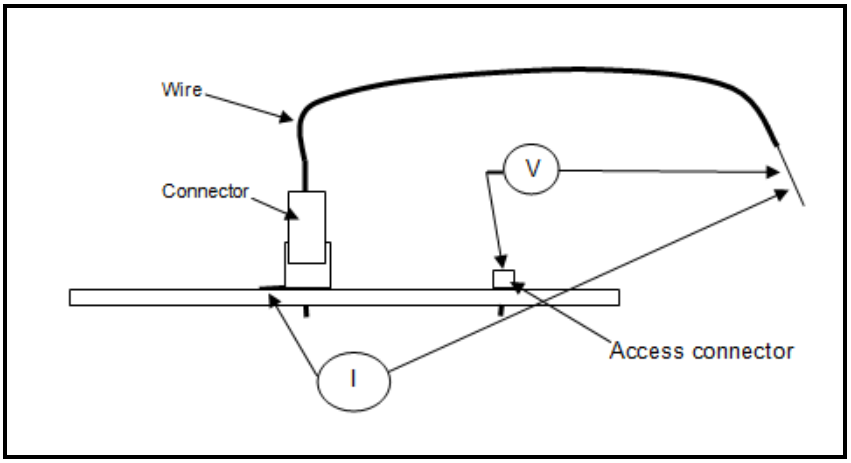

Figure 2 – Low Level Contact Resistance Measurement Points

3.3 Withstanding voltage

Using a dielectric withstanding voltage test system, a 60 Hz 1000 VAC test voltage was applied between the adjacent contacts of the receptacle. The voltage was applied at a rate of 500 volts per second and maintained for a period of 60 seconds while the leakage current was monitored. The maximum leakage current permissible was 1.3 milliamperes.

3.4 Temperature Rise vs. Current

Temperature rise vs. current testing was performed by welding a 36 AWG type T thermocouple to the contact in the crimp area. The specimens were energized at 5 progressive current levels and the temperatures were recorded at each level. The ambient temperature was subtracted from each measured temperature reading to find the temperature rise. When the temperature rise of 3 consecutive readings taken at 5 minute intervals did

not differ by more than 1°C, the temperature measurement was recorded. The data was used to produce a temperature rise vs. current curve and an F-factor table.

3.5 Sinusoidal Vibration

The test specimens were subjected to a simple harmonic motion having an amplitude of 0.06 inch double amplitude (maximum total excursion). The vibration frequency was varied uniformly between the approximate limits of 10 to 55 Hertz (Hz). The entire frequency range of 10 to 55 Hz and return to 10 Hz was traversed in approximately 1 minute. The motion was applied for a period of 2 hours in each of the three mutually perpendicular axes, so the motion was applied for a total period of approximately 6 hours. The test specimens for group 1 were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.6 Mechanical Shock

The test specimens were subjected to a mechanical shock test with a half-sine waveform with acceleration amplitude of 30 gravity units (g's peak) and duration of 11 milliseconds. Three shocks in each direction were applied along the three mutually perpendicular axes of the test specimens, for a total of eighteen shocks. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes. Refer to Figure 3 for an image of the test setup.

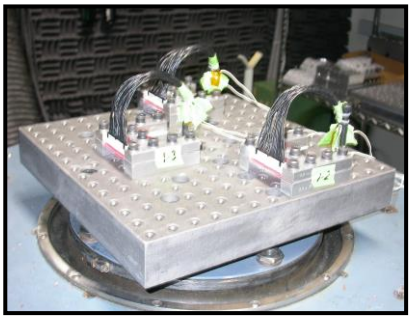

Figure 3 – Mechanical Shock Test Setup

3.7 Durability

All Test Group 1 specimens were subjected to 15 cycles of manual durability at a rate not exceeding the maximum rate of 500 cycles per hour.

3.8 Mating force

Mating force testing was performed with a tensile machine a distance of 5.08 mm from point of initial contact. The printed circuit board with the header was secured at the base of the machine to a floating x-y table, and the receptacle was aligned with the header. Force was applied to the back of the receptacle in the downward direction at a rate of 12.7 mm per minute. The maximum force was recorded to fully mate the two halves. Refer to Figure 4 for a detailed image of the setup.

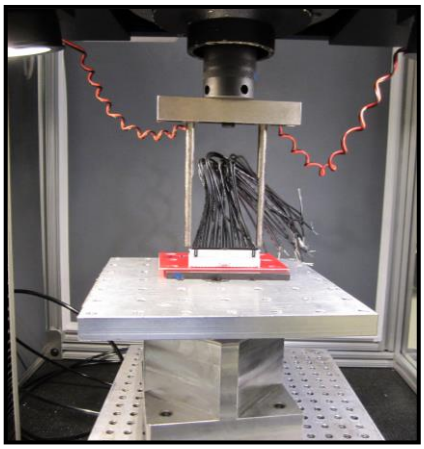

Figure 4 – Mating Force Test Setup

3.9 Unmating force

Unmating force testing was performed with a tensile machine. The mated connector system was secured to the base of the machine, and a fixture attached to the moveable load cell was placed around the receptacle. Force was applied in the upward direction at a rate of 12.7 mm per minute until the specimen was unmated. The maximum force was recorded. Refer to Figure 5 for an image of the test setup.

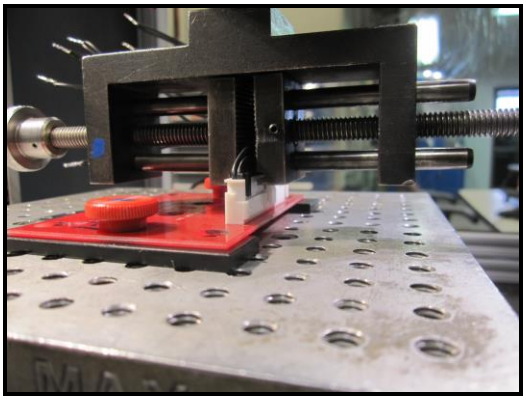

Figure 5 – Unmating Force Test Setup

3.10 Crimp tensile

Crimp tensile testing was performed on a tensile machine. The crimp (insulation crimp was de-activated) was secured in a vise at the base of the machine, and the wire was clamped in a set of pneumatic jaws attached to the load cell. Force was applied in the upward direction at a rate of 25.4 mm per minute, until the wire was removed from the crimp. The maximum force was recorded.

3.11 Contact retention

Contact retention testing was performed by placing the receptacle housing under a slotted fixture at the base of the machine. Each wire was clamped in the pneumatic jaws (attached to the load cell), and force was applied in the upward direction at a rate of 12.7 mm per minute until the contact retention tabs yielded but before the contact interfered with the contact housing locking device. Refer to Figure 6 for a detailed image of the test setup.

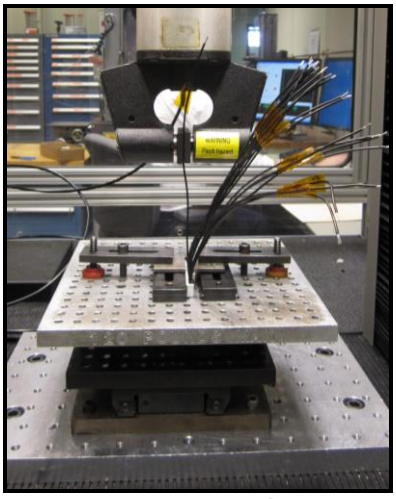

Figure 6 – Contact Retention Test Setup

3.12 Resistance to soldering heat

All specimens were placed in an air circulating oven at a temperature of 150°C ±5°C for a period of at least two minutes prior to the solder exposure. Each specimen was removed from the pre-heat oven and placed directly on a PCB substrate that had no traces or plated through holes. The PCB material dimensions were 51 mm x 111 mm x 1.55 mm thick, with the drilled holes being 1.69 mm in diameter. The PCB with the test specimen on it was then placed in flux designated as type RMA (mildly activated flux) until the bottom of the PCB was resting on the flux for a period of 5 seconds. The PCB and specimen was removed from the flux and allowed to drip for 5 to 15 seconds. The dross was removed from the surface of the solder and the test specimen mounted to the PCB was then immersed in melted solder (having a composition of 60% Sn and 40% Pb and a temperature of 265°C ±5°C) until the PCB was resting on the surface. The mounted specimen was held in the solder for a period of 10 ±2 seconds. The specimen was then removed and allowed to return to ambient conditions. After returning to ambient conditions, the solder exposure was repeated for a second time in the same manner as the first exposure. After cooling to ambient conditions the specimens and PCBs were cleaned in an ultrasonic cleaner using isopropyl alcohol for a period of 5 minutes. The specimens were then given a visual examination using a microscope at 10X magnification.

3.13 Connector locking strength

Connector locking strength testing was performed on the mated connector system, without receptacle housing contacts. The printed circuit board with the soldered header was secured at the base of the tensile machine to a floating xy table. The receptacle was clamped in a fixture attached to the load cell. Force was applied in the upward direction at a rate of 12.7 mm per minute until the connector housing was separated from the header. The maximum force was recorded. Refer to Figure 7 for a detailed image of the test setup.

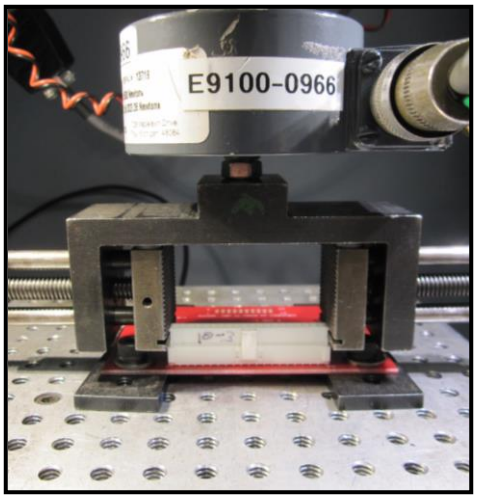

Figure 7 - Connector Locking Strength Setup

3.14 Post retention

The force required to dislodge the post from the housing was measured by placing the header in a vise. A concave tipped pin was attached to the moveable load cell and the pin was aligned with the contact post. Force was applied in the downward direction at a rate of 12.7 mm per minute until the probe dislodged the contact from the housing. The maximum force was recorded. Refer to Figure 8 for a detailed imaged of the test setup.

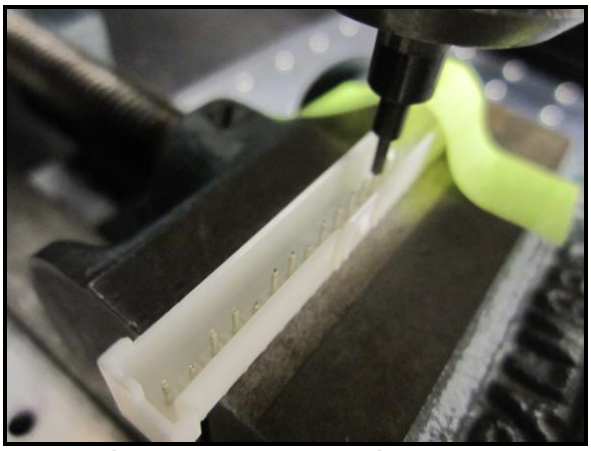

Figure 8 – Post Retention Setup

3.15 Contact insertion force

Contact insertion force testing was performed on the EP 2.5 housing with single contacts. The wire on each terminal was cut just above the insulation crimp, and the contact was loosely placed into the cavity. A probe mounted in a drill chuck attached to the load cell applied force in the downward direction to the wire inserting the contact into the housing at a rate of 12.7 mm per minute. The maximum force required to fully seat the contact was recorded. Refer to Figure 9 for an image of the test setup.

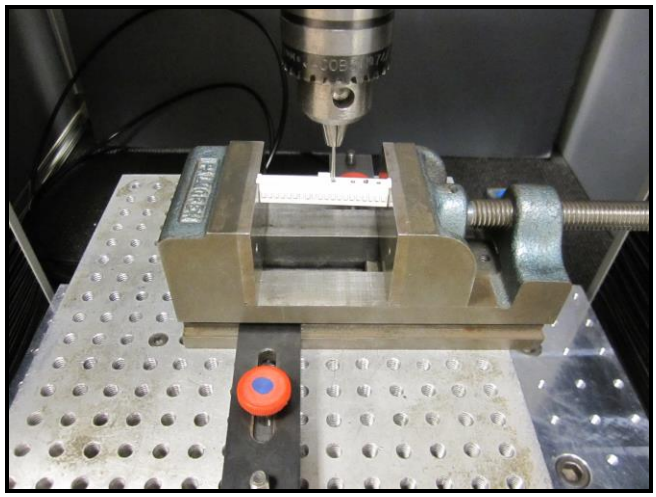

Figure 9 - Contact Insertion Force Setup

3.16 Thermal shock

The mated test specimens were subjected to 10 cycles of thermal shock testing. Each cycle consisted of cycling the temperature between -55 and 105°C with 30 minute dwells at each temperature extreme. The transition time between temperatures was 1 minute.

3.17 Humidity/temperature cycling

The mated test specimens were subjected to 10 cycles of humidity/temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25°C and 65°C twice while maintaining high humidity per the humidity/temperature cycling profile illustrated in Figure 10.

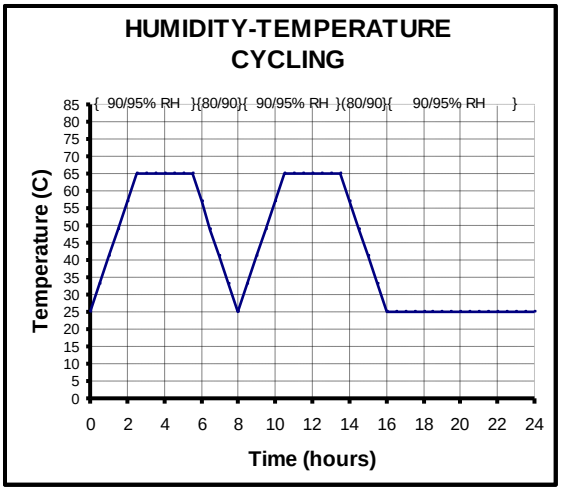

Figure 10 – Humidity Temperature Cycling Profile

3.18 Temperature life

The mated test specimens were subjected to 500 hours of temperature life testing in an air circulating oven at a temperature of 105°C.

3.19 Salt spray

The mated test specimens were subjected to 48 hours of salt spray testing with a 5% salt concentration.

3.20 Hydrogen sulfide

The mated specimens were subjected to 96 hours of hydrogen sulfide testing with 3 ±1 ppm H_2S gas concentration maintained at 40 ± 2°C.

3.21 Ammonia

The mated specimens were subjected to ammonia testing in a 10 liter desiccator with 500 mL of 3% ammonia solution for a duration of 7 hours.

3.22 Final examination of product

Specimens were visually examined for evidence of physical damage detrimental to product performance.