Scalable LED Holder

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity Scalable LED Holder to determine its conformance to the requirements of Product Specification 108-133005, Rev. A.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the Scalable LED Holder. Testing was performed at the Harrisburg Electrical Components Test Laboratory between 21 November 2012 and 8 March 2013. Original testing data and results are available under EA20120787T.

1.3 Conclusion

The Scalable LED Holder listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-133005, Rev A.

1.4 Product Description

The scalable LED socket is designed to interface with various chip-on-board (COB) LEDs. This socket allows direct attachment of a COB LED to a cooling device using two customer-supplied standard No. 4 or M3 screws and provides poke-in termination to electrically connect to the LED. This socket is available in a 1-piece or 2-piece configuration to support various LED lighting applications.

1.5 Test Specimens

The test specimens were representative of normal production lots, and specimens identified with the following part numbers were used for test (See Table 1):

Table 1 - Specimen Description

Test Set ID	Qty	Part Number	Description	LED Type	Test Group
1	10	5-2154874-2	Not terminated with 18 AWG solid wire	Cree CXA15XX LED	1
2	10	5-2154874-2	Not terminated with 20 AWG solid wire	Cree CXA15XX LED	1
3	10	5-2154874-2	Not terminated with 22 AWG solid wire	Cree CXA15XX LED	1
4	10	5-2154874-2	Not terminated with 18 AWG pre-bond wire	Cree CXA15XX LED	1
5	10	5-2154874-2	Not terminated with 20 AWG pre-bond wire	Cree CXA15XX LED	1
6	10	5-2154874-2	Not terminated with 18 AWG 16 strand wire	Cree CXA15XX LED	1
7	10	5-2154874-2	Terminated with 18 AWG solid wire.	Cree CXA15XX LED	2
8	2	5-2154874-2	Terminated with 18 AWG pre-bond wire	Cree CXA15XX LED	2
9	2	5-2154874-2	Terminated with 18 AWG 16 strand wire	Cree CXA15XX LED	2
10	1	5-2154874-2	Terminated with 20 AWG solid wire	Cree CXA15XX LED	2
11	1	5-2154874-2	Terminated with 20 AWG pre-bond wire	Cree CXA15XX LED	2
12	1	5-2154874-2	Terminated with 22 AWG solid wire	Cree CXA15XX LED	2
13	15	6-2154874-2	Terminated with 18 AWG solid wire.	Citizen CLL030 LED	3
14	15	2-2154857-2	Terminated with 18 AWG solid wire.	Cree CXA15XX LED	3
15	15	1-2154857-3	Terminated with 18 AWG solid wire.	Cree CXA2011 LED	3
16	20	6-2154874-2	Non-Terminated	Citizen CLL030 LED	4

Test fixture p/n 2154906 used for 5-2154874-2 and 2-2154857-2
Test fixture p/n 2154907 used for 6-2154874-2
Test fixture p/n 2154915 used for 1-2154857-3

1.6 Qualification Test Sequence

Table 2 – Test Sequence

Test or Examination	Test Groups			
	1	2	3	4
	Test Sequence (a)			
Initial Examination of Product	1	1	1	1
LLCR	3,6	2,7		
Insulation Resistance			2,6	
Withstanding Voltage			3,7	
Temperature Rise vs Current		3,8		
Sinusoidal Vibration	4	6		
Mechanical Shock	5			
Wire Insertion Force	2			
Wire Retention Force	7			
Thermal Spring Force				3
Thermal Shock			4	
Humidity/Temperature Cycling		4(b)	5	
Temperature Life		5		2
Final Examination of Product	8	9	8	4

(a) The numbers indicate sequence in which tests were performed.
(b) Precondition with 5 cycles of Durability.

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 Groups

All specimens submitted for testing were representative of normal production lots. A Certificate of Conformance was issued by Product Assurance. Where specified, specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2 Low Level Contact Resistance - Groups 1 & 2

All low level contact resistance measurements were less than 10 milliohms initially and 30 milliohms after testing.
Low level contact resistance summary data for Test Group 1 can be found below in Tables 3 and 4 and summary data for Test Group 2 can be found below in Tables 5 and 6.

Table 3 - LLCR Data Summary-Test Sets 1 through 3 (all values in milliohms with bulk wire removed)

Stats	Test Set 1 Initial	Test Set 1 Final	Stats	Test Set 2 Initial	Test Set 2 Final	Stats	Test Set 3 Initial	Test Set 3 Final
Min	2.78	2.79	Min	2.79	2.76	Min	2.74	2.73
Max	3.40	10.16	Max	3.74	4.71	Max	3.66	5.43
Avg	3.06	4.11	Avg	3.15	3.26	Avg	3.12	3.43
N	20	20	N	20	20	N	20	20

Table 4 - LLCR Data Summary Test Sets 3 through 6 (all values in milliohms with bulk wire removed)

Stats	Test Set 4 Initial	Test Set 4 Final	Stats	Test Set 5 Initial	Test Set 5 Final	Stats	Test Set 6 Initial	Test Set 6 Final
Min	2.81	2.98	Min	2.74	2.86	Min	2.29	2.38
Max	4.02	6.47	Max	4.04	4.85	Max	3.12	3.45
Avg	3.09	3.45	Avg	2.98	3.52	Avg	2.75	3.16
N	20	20	N	20	20	N	20	20

Table 5 - LLCR Data Summary Test Sets 7 through 9 (all values in milliohms with bulk wire removed)

Stats	Test Set 7 Initial	Test Set 7 Final	Stats	Test Set 8 Initial	Test Set 8 Final	Stats	Test Set 9 Initial	Test Set 9 Final
Min	3.27	3.68	Min	3.29	4.41	Min	3.28	7.24
Max	4.22	7.56	Max	4.72	17.73	Max	3.72	7.94
Avg	3.53	5.09	Avg	3.90	10.42	Avg	3.50	7.59
N	20	20	N	4	4	N	2	2

Table 6 - LLCR Data Summary Test Sets 10 through 12 (all values in milliohms with bulk wire removed)

Stats	Test Set 10 Initial	Test Set 10 Final	Stats	Test Set 11 Initial	Test Set 11 Final	Stats	Test Set 12 Initial	Test Set 12 Final
Min	3.42	6.45	Min	3.93	6.23	Min	4.20	9.88
Max	4.08	7.72	Max	4.01	6.44	Max	4.75	12.57
Avg	3.70	7.08	Avg	3.97	6.34	Avg	4.48	11.22
N	2	2	N	2	2	N	2	2

2.3 Insulation Resistance - Group 3

All insulation resistance measurements were greater than 2000 megohms initially and 1000 megohms finally.

2.4 Dielectric Withstanding Voltage - Group 3

No dielectric breakdown or flashover occurred.

2.5 Temperature Rise vs Current - Group 2

All specimens had a temperature rise of less than 30°C above ambient when tested using a current of 4.0 amperes.

Table 7 - Temperature Rise Above Ambient

	18 AWG			20 AWG		22 AWG
	Test Set 7	Test Set 8	Test Set 9	Test Set 10	Test Set 11	Test Set 12
Condition	Final-T-Rise @ 4 Amperes	Final-T-Rise @ 4 Amperes	Final-T-Rise @ 4 Amperes	Final-T-Rise @ 4 Ampere	Final-T-Rise @ 4 Ampere	Final-T-Rise @ 4 Ampere
Units	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C
Max	9.50	7.80	16.30	5.3	3.70	7.50

2.6 Vibration - Groups 1 & 2

No discontinuities were detected during vibration. Following vibration, no cracks, breaks, or loose parts on the specimens were visible.

2.7 Mechanical Shock - Group 1

No discontinuities were detected during mechanical shock. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

2.8 Wire Insertion - Group 1

All wire insertion force measurements met the requirements per Product Specification 108-133005 Rev. A which are 15.6 N maximum for solid wire, and 29.0 N maximum for stranded and pre-bond wire.

2.9 Wire Retention - Group 1

All wire retention measurements met the requirements per Product Specification 108-133005 Rev. A which are 19.0 N minimum for solid wire, and 15.0 N minimum for stranded and pre-bond wire.

2.10 Thermal Spring Force - Group 4

All specimens in Test Set 16 were measured for thermal spring force after a temperature life exposure. All of the specimens met the requirements of 7.2 N minimum at 0.05 mm and 14.5 N minimum at 0.25 mm deflection as stated in Product Specification 108-133005 Rev A.

2.11 Thermal Shock - Group 3

No evidence of physical damage was visible as a result of exposure to thermal shock.

2.12 Humidity-Temperature Cycling - Group 3

No evidence of physical damage was visible as a result of exposure to humidity-temperature cycling.

2.13 Temperature Life - Groups 2 & 4

No evidence of physical damage was visible as a result of exposure to temperature life.

2.14 Final Examination of Product - All Groups

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

3. TEST METHODS

3.1 Examination of Product

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

3.2 Low Level Contact Resistance

Low level contact resistance measurements at low level current were made using a four terminal measuring technique. Refer to Figure 1 for a detailed image of the measurement locations. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage.

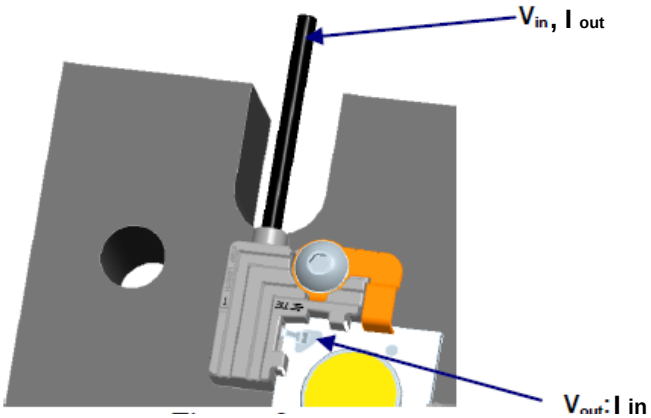


Figure 1 – Typical Low Level Contact Resistance Measurement Points

3.3 Insulation Resistance

Insulation resistance was measured between the holder wire and the heat sink mounting surface. A test voltage of 500 volts DC was applied for two minutes before the resistance was measured.

3.4 Dielectric Withstanding Voltage

A test potential of 1000 volts AC for Test Set 13 (metal substrate LEDs), 2050 volts AC for Test Set 14 (ceramic substrate LEDs), and 1500 volts AC for Test Set 15 was applied between the holder wire and the heat sink mounting surface. This potential was applied for one minute and then returned to zero while monitoring for any breakdowns or flashovers.

3.5 Temperature Rise vs Current

Each test set with the same wire gage (Test Sets 7, 8, 9 w/18AWG), (Test Sets 10 & 11 w/20AWG), and (Test Set 12 w/22AWG) were tested together in order to test all specimens of the same wire gage at the same time. The 18AWG specimens were wired in series and connected to a temperature rise acquisition station to measure T-Rise on each specimen. There was one thermocouple per specimen mounted to the pad on the LED socket as shown in Figure 2 as close to the contact as possible without interfering with the contact. Figure 3 shows an entire series chain wired for T-rise testing. All T-rise testing took place inside a draft free enclosure. The specimens were energized at 4.0 amperes and temperature measurements were taken after stability was achieved. Stability is defined as three consecutive 5 minute temperature measurements do not differ by more than 1 degree C, the specimen temperatures were recorded at that point. All wire gages were tested at 4.0 amperes in the same manner.

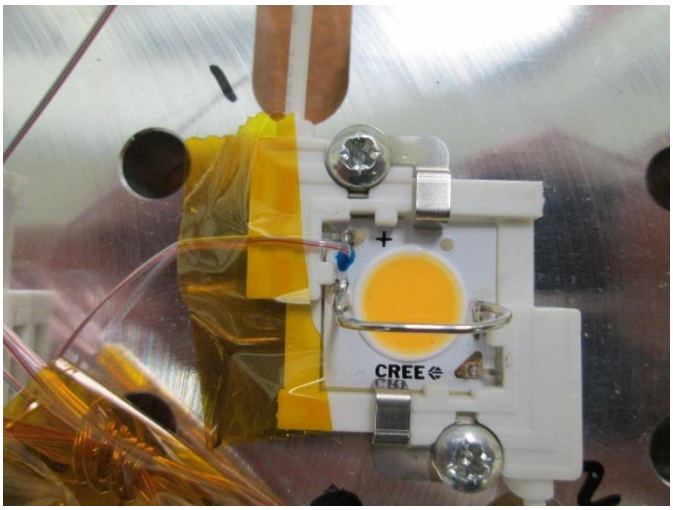


Figure 2 - Thermocouple Placement

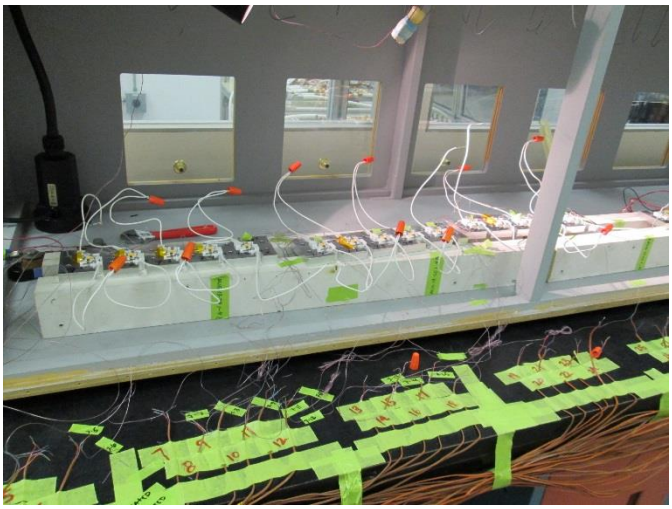


Figure 3 - Specimens wired in Series

3.6 Vibration, Sinusoidal

The test specimens were subjected to a sinusoidal vibration test in accordance with specification EIA-364-28F, test condition I. See Figures 4 and 5 below for vibration setup photographs.
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 were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

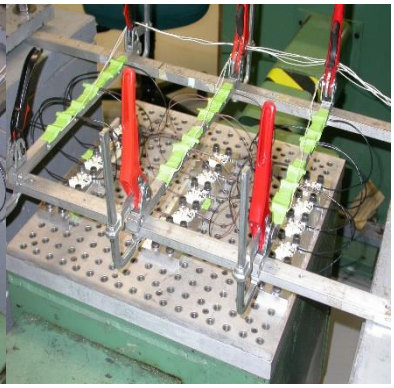
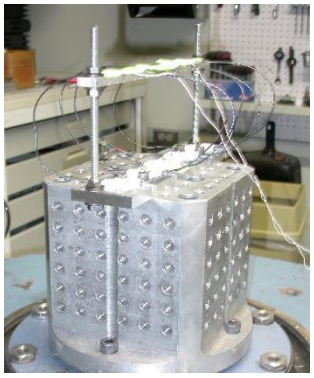
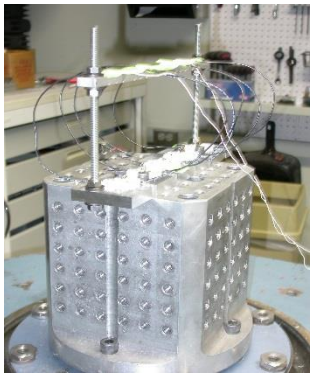


Figure 5- Vibration Setup **Figure 4- Vibration Setup**

3.7 Mechanical Shock, Half Sine

The test specimens were subjected to a mechanical shock in accordance with specification EIA-364-27C, test condition A. See Figures 6, 7, and 8 below for mechanical shock setup photographs.
The parameters of this test condition are a half-sine waveform with an acceleration amplitude of 50 gravity units (g's peak) and a 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.





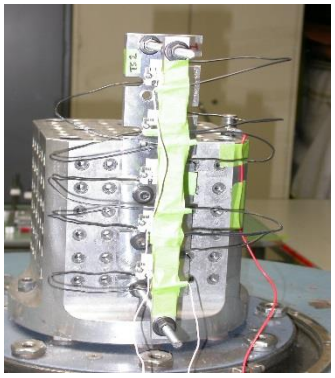


Figure 6- Shock Setup **Figure 7- Shock Setup** **Figure 8- Shock Setup**

3.8 Wire Insertion Force

The Scalable LED Socket specimens were mounted to an aluminum block prior to testing. The block was clamped in a vise attached to a free floating x-y table. The x-y table was mounted to the base of the tensile/compression machine. The wire specimens were held in a chuck and manually aligned with the connector. Force was then applied in a downward direction at a rate of 12.70 mm/min until the wire was fully inserted. See Figure 9 for a photograph of the wire insertion force test setup.

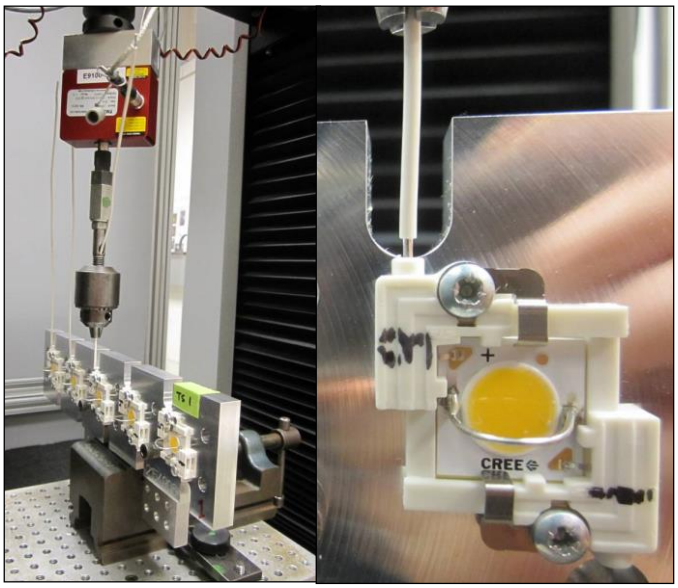


Figure 9 - Wire Insertion Force Test Setup

3.9 Wire Retention Force

The Scalable LED Socket was mounted to a plate clamped in a vise attached to a free floating x-y table. The x-y table was attached to the base of the tensile/compression machine. The wire specimen was clamped in an air jaw attached to the moveable crosshead of the tensile machine. Force was applied in an upward direction at a rate of 12.70 mm per minute until the wire was removed from the socket. Refer to Figure 10 for images of the typical test setup.

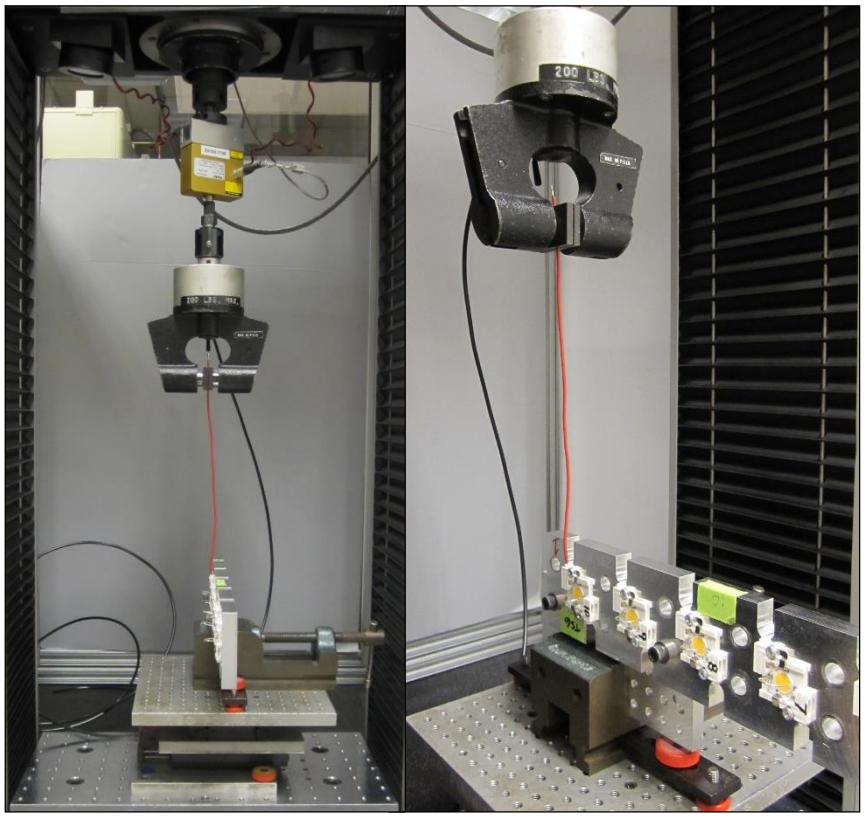


Figure 10 - Wire Retention Test Setup

3.10 Thermal Spring Force

The specimens were mounted to a plate (# 2154906) supplied by the test originator which had a hole drilled into it to access the bottom of the LED socket clamped on the opposite side. The plate was held at the base of the tensile/compression device on a movable table. A 0.24 inch gage pin was held in a drill chuck attached to the load cell and the moveable head of the tensile/compression device. The head was actuated at 3.1mm per minute. The force was recorded at 0.05 mm and 0.25 mm as the pin moved the LED socket. Figures 11 and 12 are photographs of the test setup, Figure 13 is a diagram of the test method.

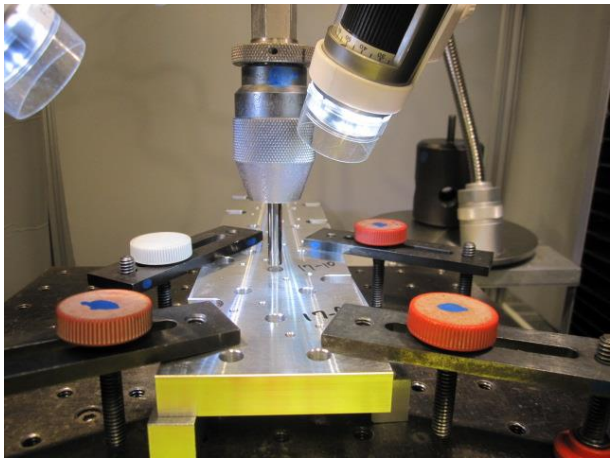


Figure 11 - Thermal Spring Force Test Setup

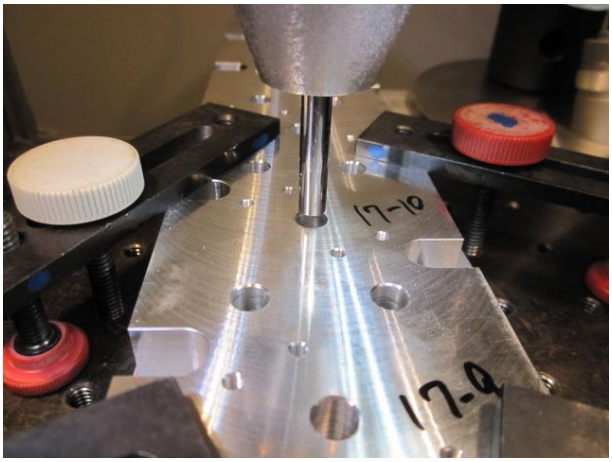


Figure 12 - Thermal Spring Force Test Setup

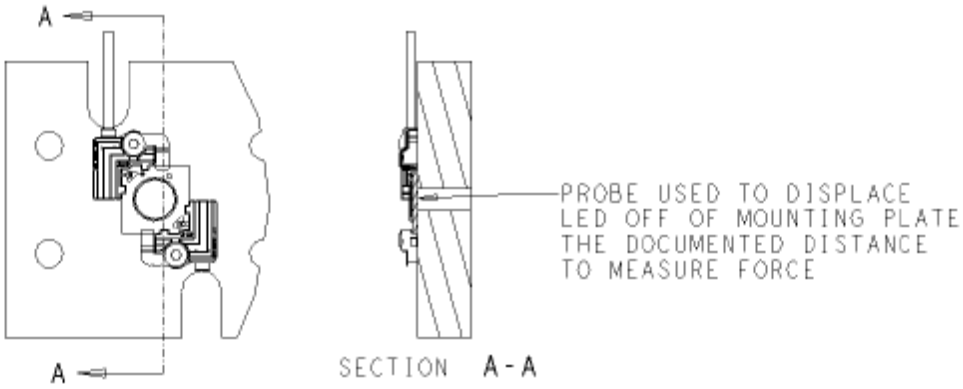


Figure 13 – Diagram of the Thermal Spring Force Testing Method

3.11 Thermal Shock

Specimens were subjected to 50 cycles of thermal shock with each cycle consisting of 30 minute dwells at -40 and 105°C. The transition between temperatures was less than one minute.

3.12 Humidity-Temperature Cycling

Specimens were exposed 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.

3.13 Temperature Life

The specimens were exposed to a temperature of 130°C for 500 hours.

3.14 Final Examination of Product

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.