Cluster Block Qualification Testing

1. INTRODUCTION

1.1 Purpose

Testing was performed on the Cluster Block terminals to determine its conformance to the requirements of Design Objective 108-2388, Rev. A.

1.2 Scope

This report covers the electrical and mechanical performance of the Cluster Block terminals. Testing was performed at the Harrisburg Electrical Components Test Laboratory (HETCL) between August 20, 2021 and September 2, 2021. Documentation is on file and maintained at HECTL under EA20210298T.

1.3 Conclusion

The specimens listed in paragraph 1.4 conformed to the electrical, mechanical, and environmental performance requirements of Design Objective 108-2388, Rev A

1.4 Product Description

Cluster blocks offer manufacturers of air conditioning and refrigeration products a low-cost, fully insulated, quick-connect means of electrically connecting sealed hermetic header pins on compressors. They feature high impact resistance to shock and abuse, and long-life performance in the presence of oils and refrigerants. Since the connectors accept pins from only one side, the danger of reversing polarity at the time of installation is minimized. Housings accept both lead wire and AMPLIVAR direct connect pin receptacle terminals. Our cluster blocks are precision formed and available on reels for high speed application.

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 Specimens

Test Set	Quantity	Part Number	Description
1	12	2238287-1 rev 5	Cluster Block Receptacle Terminal: Crimp on #18 awg copper stranded UL 1015 wire @ .066 CH / .120 CW
2	12	2238287-1 rev 5	Cluster Block Receptacle Terminal: Crimp on #16 awg copper stranded UL 1015 wire @ .072 CH / .120 CW
3	12	2238287-1 rev 5	Cluster Block Receptacle Terminal: Crimp on #14 awg copper stranded UL 1015 wire @ .079 CH / .120 CW
4	12	2238287-1 rev 5	Cluster Block Receptacle Terminal: Uncrimped
5	12	2238287-1 rev 5	Cluster Block Receptacle Terminal: Crimp on #18 awg copper stranded UL 1015 wire @ 066 CH / .120 CW
6	12	2238287-1 rev 5	Cluster Block Receptacle Terminal: Crimp on #16 awg copper stranded UL 1015 wire @ .072 CH / .120 CW
7	12	2238287-1 rev 5	Cluster Block Receptacle Terminal: Crimp on #14 awg copper stranded UL 1015 wire @ .079 CH / .120 CW
8	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Crimp on #14 awg copper stranded UL 1015 wire @ .077 CH / .210 CW

Table 1 – Test Specimens *(continued)*

Test Set	Quantity	Part Number	Description
9	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Crimp on #12 awg copper stranded UL 1015 wire @ .083 CH / .210 CW
10	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Crimp on #10 awg copper stranded UL 1015 wire @ .093 CH / .210 CW
11	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Crimp on # 8 awg copper stranded UL1015 wire @ .110 CH / .210 CW
12	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Uncrimped
13	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Crimp on #14 awg copper stranded UL 1015 wire @ .077 CH / .210 CW
14	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Crimp on #12 awg copper stranded UL 1015 wire @ .083 CH / .210 CW
15	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Crimp on #10 awg copper stranded UL 1015 wire @ .093 CH / .210 CW
16	12	1742539-3 rev D	Cluster Block Receptacle Terminal: Crimp on # 8 awg copper stranded UL1015 wire @ .110 CH / .210 CW

1.6 Qualification Test Sequence

The specimens in Table 1 were subjected to the testing outlined in Table 2

Table 2 – Specimen Sequence

Test or Examination	Test Set															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Test Sequence (a)															
Initial Examination	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
T-Rise vs Current	2	2	2					2	2	2	2					
Contact Engaging Force				2								2				
Contact Separating Force				3								3				
Wire Retention					2	2	2						2	2	2	2
Final Examination	3	3	3	4	3	3	3	3	3	3	3	4	3	3	3	3

***(a)** Numbers indicate the order in which testing was performed*

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 Visual Examination

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

2.2 T-Rise vs Current

Specimens were subjected to increasing current levels to create a Temperature Rise Curve. See Table 3 through Table 9 for T-Rise data and Figures 1 through 7 to see T-Rise Curves.

Table 3 – Test Set 1, 18 AWG Copper Stranded Wire T-Rise Data in °C

	Current (amps)				
	9.044	**11.052**	**13.028**	**15.037**	**16.025**
Minimum:	9.546	14.532	19.967	27.138	30.570
Maximum:	12.795	18.865	26.115	34.965	39.418
Average:	11.662	17.613	24.235	32.500	36.699
Standard Deviation:	0.923	1.267	1.756	2.183	2.480
Count:	12	12	12	12	12

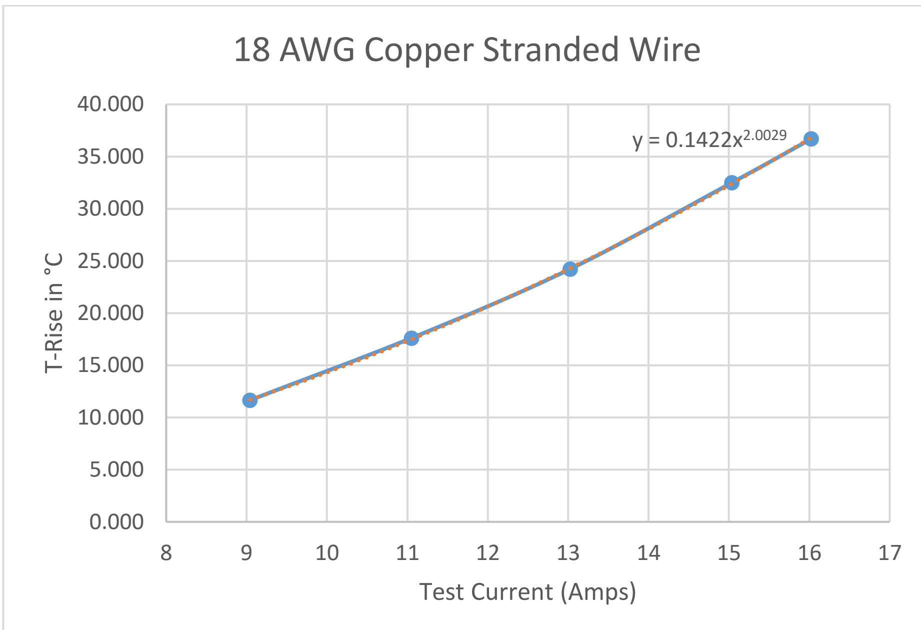

Figure 1 – Test Set 1, 18 AWG Copper Stranded Wire T-Rise Graph

Table 4 – Test Set 2, 16 AWG Copper Stranded Wire T-Rise Data in °C

	Current (amps)				
	9.038	**11.05**	**15.037**	**17.048**	**19.021**
Minimum:	6.220	9.868	18.906	25.173	30.918
Maximum:	9.858	15.044	27.858	35.586	44.288
Average:	8.171	12.721	23.965	31.107	38.562
Standard Deviation:	0.896	1.254	2.165	2.577	3.300
Count:	12	12	12	12	12

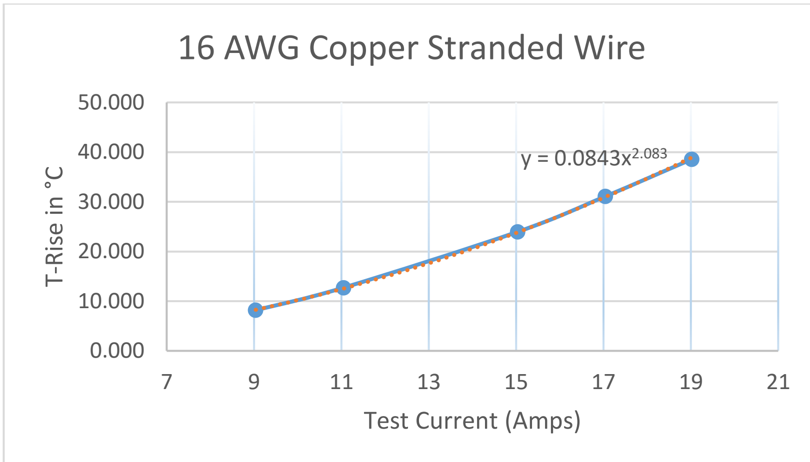

Figure 2 – Test Set 2, 16 AWG Copper Stranded Wire T-Rise Graph

Table 5 – Test Set 3, 14 AWG Copper Stranded Wire T-Rise Data in °C

	Current (amps)				
	10.033	**13.031**	**15.039**	**17.046**	**20.039**
Minimum:	7.777	14.269	18.752	24.341	34.095
Maximum:	10.012	17.454	22.828	29.359	40.602
Average:	9.158	16.101	21.226	27.413	37.870
Standard Deviation:	0.719	0.988	1.284	1.560	2.033
Count:	12	12	12	12	12

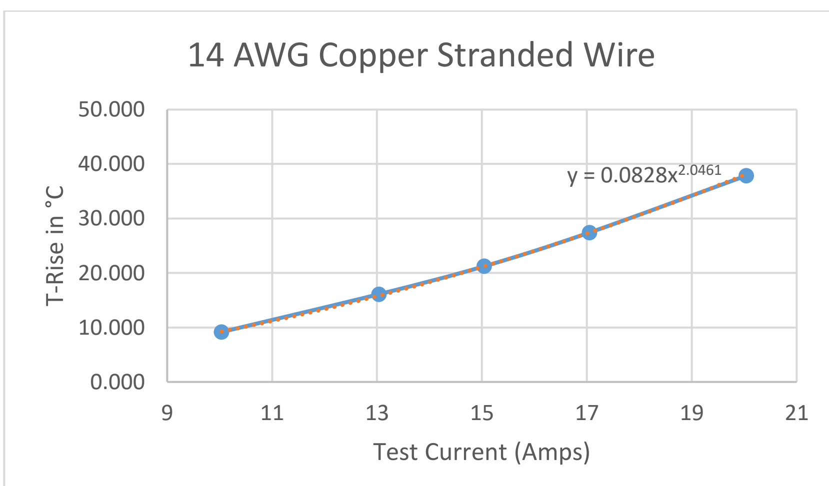

Figure 3 – Test Set 3, 14 AWG Copper Stranded Wire T-Rise Graph

Table 6 – Test Set 8, 14 AWG Copper Stranded Wire T-Rise Data in °C

	Current (amps)				
	10.031	**13.029**	**15.037**	**17.044**	**20.038**
Minimum:	6.028	11.236	15.581	20.365	28.566
Maximum:	8.927	16.129	21.675	28.047	39.079
Average:	7.740	14.179	19.303	25.106	35.041
Standard Deviation:	0.797	1.339	1.680	2.114	2.870
Count:	12	12	12	12	12

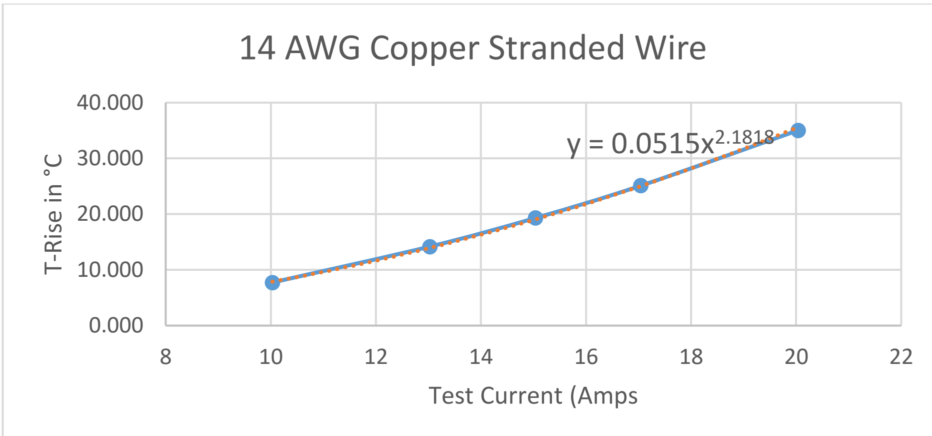

Figure 4 – Test Set 8, 14 AWG Copper Stranded Wire T-Rise Graph

Table 7 – Test Set 9, 12 AWG Copper Stranded Wire T-Rise Data in °C

	Current (amps)			
	10.023	**15.036**	**20.041**	**24.027**
Minimum:	5.735	13.403	24.082	34.212
Maximum:	7.953	17.279	30.756	43.987
Average:	7.137	15.976	28.669	40.867
Standard Deviation:	0.676	1.289	2.224	3.216
Count:	12	12	12	12

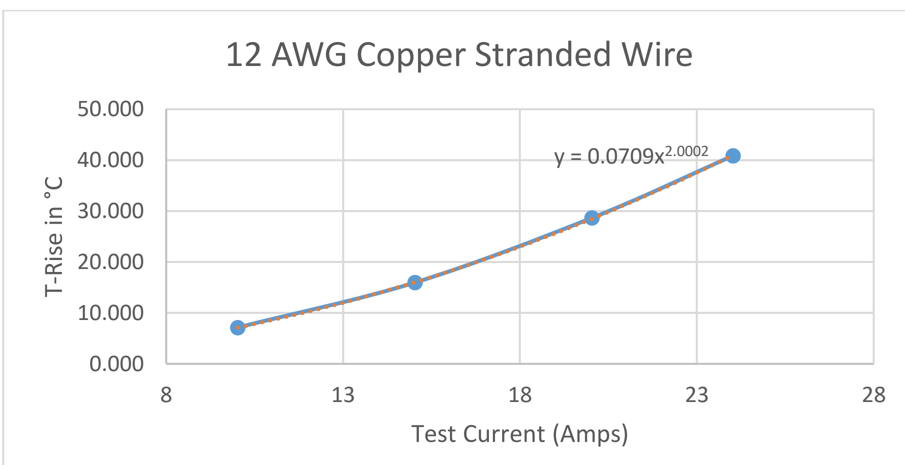

Figure 5 – Test Set 9, 12 AWG Copper Stranded Wire T-Rise Graph

Table 8 – Test Set 10, 10 AWG Copper Stranded Wire T-Rise Data in °C

	Current (amps)			
	10.036	**15.036**	**25.019**	**30.026**
Minimum:	3.186	9.611	29.760	42.166
Maximum:	4.861	13.155	38.585	55.523
Average:	4.109	11.436	34.270	48.932
Standard Deviation:	0.537	1.059	2.689	3.892
Count:	12	12	12	12

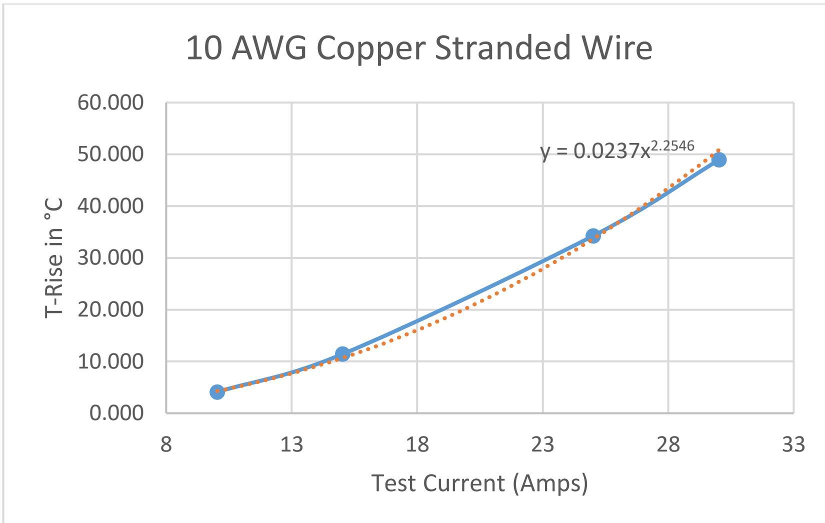

Figure 6 – Test Set 10, 10 AWG Copper Stranded Wire T-Rise Graph

Table 9 – Test Set 11, 8 AWG Copper Stranded Wire T-Rise Data in °C

	Current (amps)				
	10.025	**15.041**	**20.043**	**25.02**	**30.03**
Minimum:	1.699	6.492	13.655	22.456	33.603
Maximum:	2.760	8.639	17.267	27.970	41.180
Average:	2.200	7.600	15.495	25.263	37.404
Standard Deviation:	0.341	0.639	1.063	1.602	2.264
Count:	12	12	12	12	12

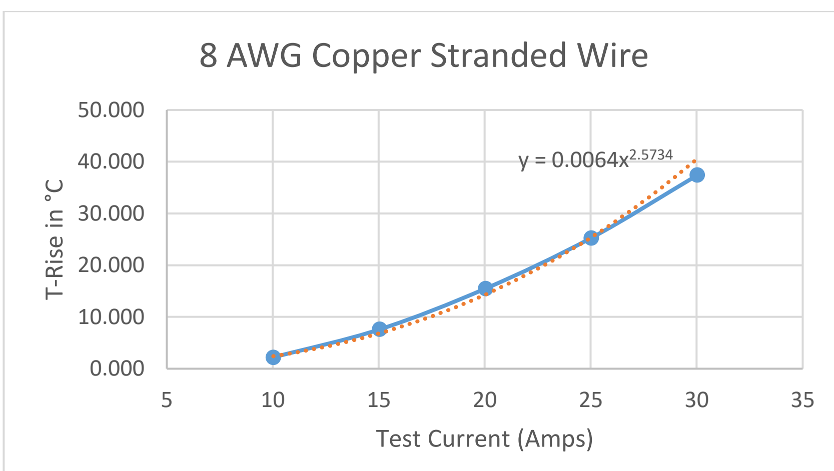

Figure 7 – Test Set 11, 8 AWG Copper Stranded Wire T-Rise Graph

2.3 Contact Engaging and Separating Force

Contact Engaging Forces did not exceed the 112 N maximum requirement called for in 108-2388 Rev O3 (Marked Up). Contact Separating Force were greater than the 30N minimum requirement called for in 108-2388 Rev O3 (Marked Up). See Tables 10 and 11 for contact engaging and separating forces. See Figure 8 for representative image of engaging and separating force graph.

Table 10 – Test Set 4 Engaging and Separating Force in Newtons

	Engaging Force N	Separating Force N
Minimum	77.39	66.15
Maximum	111.64	103.82
Mean	92.34	87.28
Std. Dev.	9.90	11.90

Table 11 – Test Set 12 Engaging and Separating Force in Newtons

	Engaging Force N	Separating Force N
Minimum	74.80	65.33
Maximum	100.37	91.84
Mean	87.93	73.95
Std. Dev.	7.35	7.91

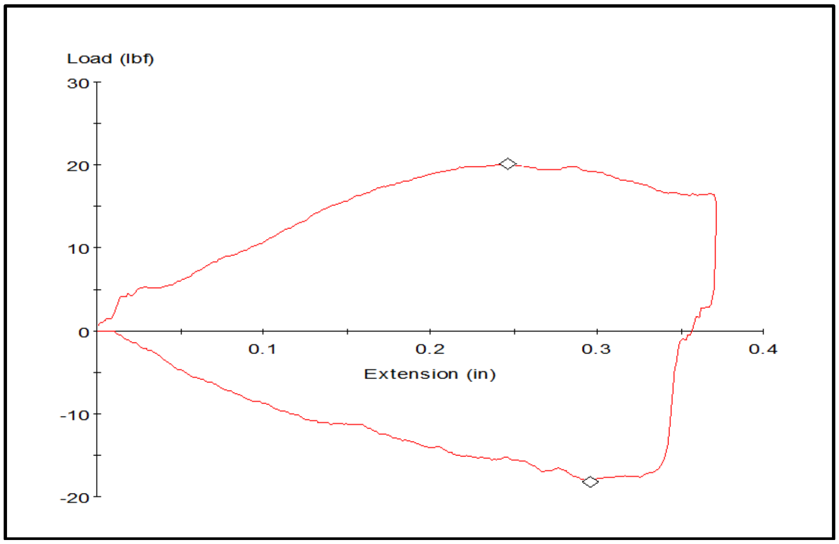

Figure 8 – Representative Graph of Engaging and Separating Force

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2.4 Wire Retention

Specimens exceeded the wire retention minimum forces called for in 108-2388 Rev O3 (Marked Up). See Table 12 for summary of wire retention results. See Figure 9 for representative graph of wire retention.

Table 12 – Wire Retention Results Summary in Newtons (N)

	Test Sets						
	TS5	**TS6**	**TS7**	**TS13**	**TS14**	**TS15**	**TS16**
Specification	**110**	**160**	**290**	**290**	**400**	**450**	**500**
Minimum	176.17	321.75	470.69	415.96	619.16	741.00	676.14
Maximum	212.17	337.86	488.67	453.81	732.36	835.45	778.48
Mean	192.12	326.05	481.10	433.70	687.46	803.10	727.24
Std. Dev.	10.62	5.29	6.47	13.57	42.72	26.53	32.17

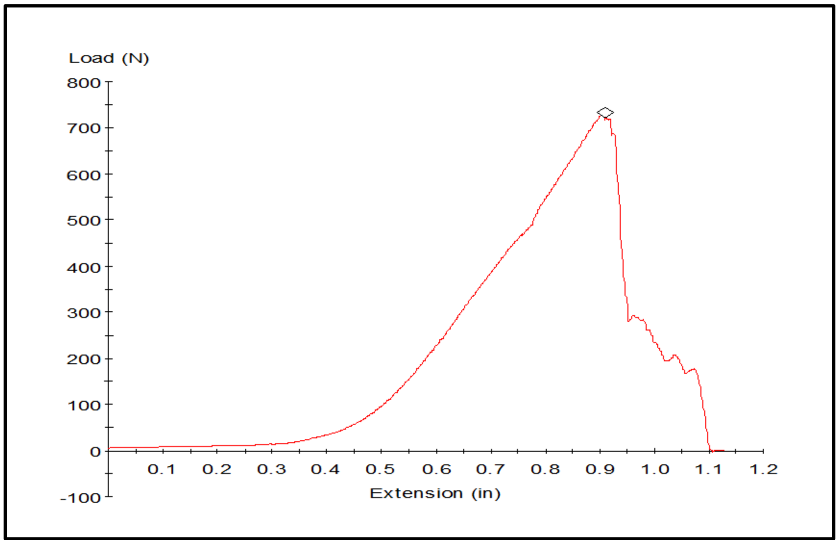

Figure 9 – Representative Graph Wire Retention

2.5 Final Visual Examination

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 C of C 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. Testing was done in accordance with EIA 364-18B.

3.2 T-Rise vs Current

Temperature rise curves were produced by measuring individual contact temperatures at 4 to 5 different current levels. These measurements were plotted to produce a temperature rise vs current curve. Thermocouples were attached to individual contacts to measure their temperatures. The ambient temperature was then subtracted from this measured temperature 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. Testing was conducted in accordance with EIA-364-70D, Method 2. See Figure 10 for Test Setup.

Figure 10 – T-Rise vs Current Test Setup

3.3 Contact Engaging and Separating Force

A cluster block with .125 gage posts was secured to a floating table that was attached to the base of a tensile / compression machine. Air jaws holding the contact was attached to the movable crosshead of the tensile / compression machine. Force applied in a compression direction at a rate of 25.4 mm per minute until the specimen was fully mated to the .125 gage post of the cluster block. After mating the contact to the post, the crosshead continued in tensile direction separating the contact from the cluster block. Testing was conducted in accordance with EIA-364-37C. See Figure 11 for Test Setup.

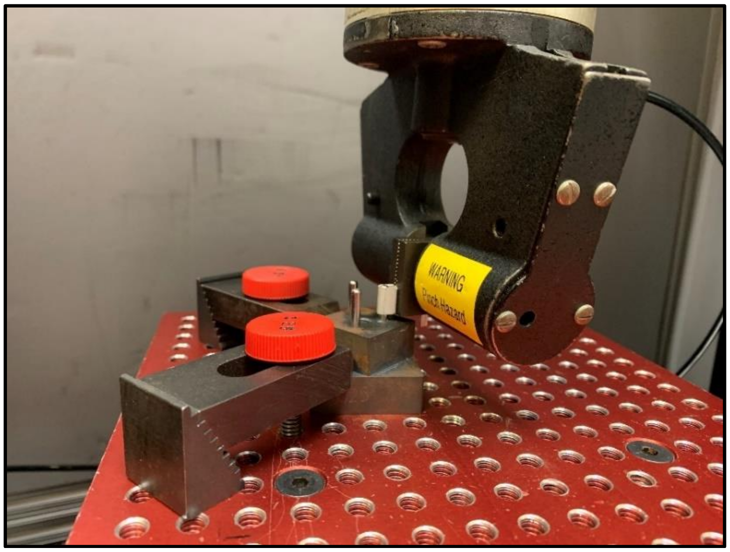

Figure 11 – Contact Engaging and Separating Test Setup

3.4 Wire Retention

The wires of the specimens were secured in a wire retention grip that was secured to the movable crosshead of the tensile / compression machine. The contacts were secured in a slotted vice that was secured to a floating table that was attached to the base of a tensile / compression machine. The specimens were then pulled in an upwards direction to the point of failure. Testing was conducted in accordance with EIA-364-8C. See Figure 12 for Test Setup.

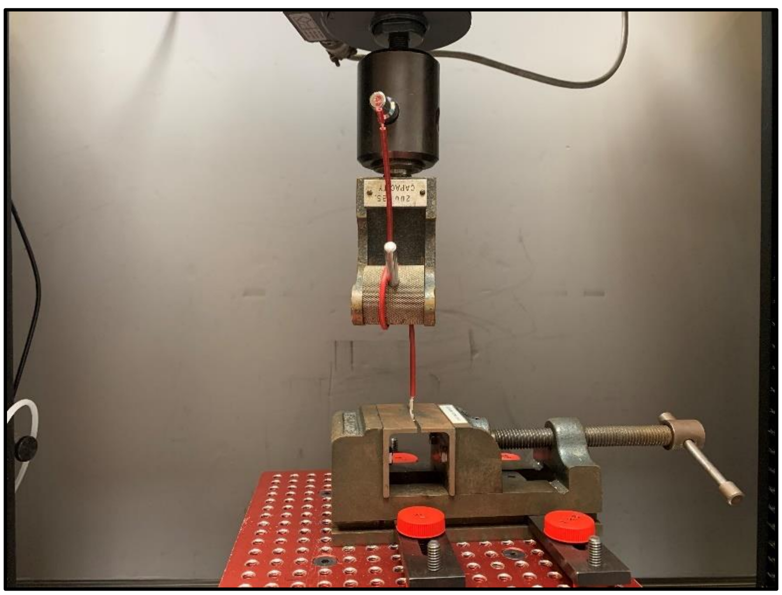

Figure 12 – Wire Retention Test Setup

3.5 Final Visual Examination

Specimens were visually examined for evidence of physical damage that would be detrimental to product performance. Testing was done in accordance with EIA 364-18B.