Qualification Testing of LUMAWISE* Terminal Block Connectors

1. INTRODUCTION

1.1 Purpose

The purpose of this testing was to evaluate the performance of LUMAWISE Terminal Block connectors when tested to the requirements of TE Product Specification 108-160129, Revision 5.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of LUMAWISE Terminal Block connectors. Testing took place at the TE Connectivity Harrisburg Electrical Components Testing Laboratory and under test number EA20220268T between 31-August-2022 and 07-November-2022.

1.3 Conclusion

All specimens met the requirements of product specification 108-160129, Revision 5. See Section 2 of this report for detailed results.

1.4 Product Description

The LUMAWISE TB typical application is for outdoor area and roadway luminaires requiring the use of a closed back terminal block as defined within the ANSI C136.14 specification. This terminal block allows for three input wires (14-6AWG) to be clamped with a screw clamp and allow current to flow to three separate output wires (18-12AWG) for each polarity. The output wires are inserted by articulating a lever on a single polarity that will allow the three output wires, at the designed strip length, to be inserted and clamped in place after closing the lever.

1.5 Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for test see Table 1.

Table 1 – Test Specimens

Test Set	Qty	Part Number	Description
1	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 6AWG stranded IN; 18AWG solid OUT
2	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 6AWG stranded IN; 18AWG stranded OUT
3	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG solid IN; 12AWG solid OUT
4	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG stranded IN; 12AWG stranded OUT
5	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 6AWG stranded IN; 18AWG solid OUT
6	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 10AWG solid IN; 18AWG stranded OUT
7	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG stranded IN; 12AWG stranded OUT
8	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG solid IN; 12AWG solid OUT

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Table 1 – Test Specimens, continued

Test Set	Qty	Part Number	Description
9	6	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 6AWG stranded IN; 12AWG stranded OUT
10	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG stranded IN; 18AWG solid OUT
11	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; 14AWG stranded IN; 18AWG solid OUT
12	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG stranded IN; 18AWG stranded OUT
13	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; 14AWG stranded IN; 18AWG stranded OUT
14	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG solid IN; 14AWG stranded OUT
15	2	2382635-1	Terminal Block Assembly, Power Input, REAR mounting; 14AWG solid IN; 14AWG stranded OUT
16	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 16AWG stranded IN; 16AWG stranded OUT
17	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; 6AWG stranded IN; No wires OUT
18	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 8AWG stranded IN; No wires OUT
19	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 10AWG stranded IN; No wires OUT
20	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 10AWG solid IN; No wires OUT
21	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; 12AWG stranded IN; No wires OUT
22	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; 12AWG solid IN; No wires OUT
23	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG stranded IN; No wires OUT
24	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 14AWG solid IN; No wires OUT
25	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; 16AWG stranded IN; No wires OUT
26	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; 16AWG solid IN; No wires OUT
27	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; No wires IN; 12AWG stranded wires OUT
28	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; No wires IN; 12AWG solid wires OUT
29	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; No wires IN; 14AWG stranded wires OUT
30	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; No wires IN; 14AWG solid wires OUT
31	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; No wires IN; 16AWG stranded wires OUT
32	1	2382635-1	Terminal Block Assembly, Power Input, STD mounting; No wires IN; 16AWG solid wires OUT
33	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; No wires IN; 18AWG stranded wires OUT
34	1	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; No wires IN; 18AWG solid wires OUT
35	2	2382635-1	Terminal Block Assembly, Power Input, STD mounting; 6AWG stranded IN; No wires OUT
36	2	2382635-2	Terminal Block Assembly, Power Input, REAR mounting; 6AWG stranded IN; No wires OUT

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1.6 Test Sequence

The specimens listed in Table 1 were subjected to testing as outlined in Table 2.

Table 2 – Test Sequence

Test or Examination	Test Group (a)						
	A	B	C	D	E	F	G
	Test Set						
	1,2,3,4	5,6,7,8	9	10 thru16	17 thru 26	27 thru 34	35 & 36
	Test Sequence (b)						
Initial Visual Examination	1	1	1	1	1	1	1
Low Level Contact Resistance	2,5	2,5,7,9	2,7	2,5			
Insulation Resistance			3,8				
Withstanding Voltage			4,9				
Temperature Rise vs Current		3,10		3,6			
Random Vibration	3	8					
Mechanical Shock	4						
Wire Extraction Force (Input)					2		
Wire Extraction Force (Output)						3	
Current Cycling				4			
Connector Mounting Security Force							2
Durability						2	
Thermal Shock			5				
Humidity/Temperature Cycling		4	6				
Temperature Life		6					
Final Examination of Product	6	11	10	7	3	4	3

(a) See Section 4.1.A of 108-160129 Revision 5
(b) Numbers indicate sequence in which tests are 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

No damage or defects detrimental to product performance was observed on any specimen.

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2.2 Low Level Contact Resistance

All specimens met the requirement of ∆30milliohms maximum for low level contact resistance. See Tables 3 through 14 for all initial resistance measurements and Delta R. All measurements contained bulk wire resistance as well as the terminal block interface resistance.

Table 3 – Test Set 1 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Initial	After Vibration & Mechanical Shock
	Position	Measurement (mΩ)	∆R
1	L1	6.160	-0.815
	G	6.430	-0.282
	L2	6.175	-3.031
2	L1	5.988	-3.466
	G	6.223	-0.114
	L2	6.064	-0.318
Minimum:		5.988	6.337
Maximum:		6.430	9.454
Average:		6.173	7.511
Standard Deviation:		0.152	1.430
Count (Valid / Read):		6 / 6	6 / 6

Table 4 – Test Set 2 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Initial	After Vibration & Mechanical Shock
	Position	Measurement (mΩ)	∆R
1	L1	6.285	6.162
	G	6.037	0.123
	L2	6.298	-0.212
2	L1	6.383	-0.141
	G	6.487	-0.288
	L2	6.130	0.148
Minimum:		6.037	6.162
Maximum:		6.487	6.671
Average:		6.270	6.394
Standard Deviation:		0.164	0.184
Count (Valid / Read):		6 / 6	6 / 6

Table 5 – Test Set 3 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Initial	After Vibration & Mechanical Shock
	Position	Measurement (mΩ)	∆R
1	L1	3.636	4.204
	G	3.958	-0.568
	L2	3.671	0.265
2	L1	4.227	-0.069
	G	3.693	-0.620
	L2	3.805	-0.175
Minimum:		3.636	3.693
Maximum:		4.227	4.847
Average:		3.832	4.193
Standard Deviation:		0.226	0.522
Count (Valid / Read):		6 / 6	6 / 6

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Table 6 – Test Set 4 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Initial	After Vibration & Mechanical Shock
	Position	Measurement (mΩ)	Measurement (mΩ)
1	L1	4.323	ΔR
	G	4.016	4.367
	L2	4.071	-0.012
2	L1	4.168	-0.351
	G	4.129	-0.446
	L2	4.046	-0.170
Minimum:		4.016	4.196
Maximum:		4.323	4.517
Average:		4.126	4.368
Standard Deviation:		0.111	0.111
Count (Valid / Read):		6 / 6	6 / 6

Table 7 – Test Set 5 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Initial	After Humidity-Temperature Cycling	After Temperature Life	After Vibration
	Position	Measurement (mΩ)	ΔR		
1	L1	6.711	0.528	-0.140	0.703
	G	5.968	0.567	1.491	0.047
	L2	6.465	0.788	1.009	-0.174
2	L1	6.571	-0.010	-0.436	0.133
	G	5.794	1.195	0.090	0.456
	L2	6.527	0.126	2.645	-0.003
Minimum:		5.794	-0.010	-0.436	-0.174
Maximum:		6.711	1.195	2.645	0.703
Average:		6.339	0.532	0.777	0.194
Standard Deviation:		0.368	0.439	1.169	0.325
Count (Valid / Read):		6 / 6	6 / 6	6/6	6 / 6

Table 8 – Test Set 6 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Initial	After Humidity-Temperature Cycling	After Temperature Life	After Vibration
	Position	Measurement (mΩ)	ΔR		
1	L1	6.303	0.766	2.169	1.673
	G	6.907	0.601	1.530	1.048
	L2	6.517	0.421	2.597	1.855
2	L1	6.312	1.065	1.763	0.898
	G	6.321	0.813	3.288	0.942
	L2	6.300	0.288	-0.121	0.799
Minimum:		6.300	0.288	-0.121	0.799
Maximum:		6.907	1.065	3.288	1.855
Average:		6.443	0.659	1.871	1.203
Standard Deviation:		0.242	0.282	1.159	0.446
Count (Valid / Read):		6 / 6	6 / 6	6/6	6 / 6

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Table 9 – Test Set 7 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Initial	After Humidity-Temperature Cycling	After Temperature Life	After Vibration
	Position	Measurement (mΩ)	ΔR		
1	L1	4.503	0.260	0.019	0.231
	G	4.270	0.472	-0.785	-0.207
	L2	4.502	0.128	0.211	-0.381
2	L1	4.618	-0.149	0.002	-0.105
	G	4.272	-0.068	0.194	-0.528
	L2	4.152	0.042	4.213	0.475
Minimum:		4.152	-0.149	-0.785	-0.528
Maximum:		4.618	0.472	4.213	0.475
Average:		4.386	0.114	0.642	-0.086
Standard Deviation:		0.180	0.227	1.787	0.378
Count (Valid / Read):		6 / 6	6 / 6	6/6	6 / 6

Table 10 – Test Set 8 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Initial	After Humidity-Temperature Cycling	After Temperature Life	After Vibration
	Position	Measurement (mΩ)	ΔR		
1	L1	4.262	-0.094	-0.612	0.630
	G	4.364	0.382	-0.245	-0.346
	L2	4.622	-0.595	-0.697	0.591
2	L1	4.072	0.762	-0.174	2.720
	G	4.042	0.160	-0.140	0.221
	L2	4.001	1.520	-0.020	4.253
Minimum:		4.001	-0.595	-0.697	-0.346
Maximum:		4.622	1.520	-0.020	4.253
Average:		4.227	0.356	-0.315	1.345
Standard Deviation:		0.239	0.730	0.274	1.764
Count (Valid / Read):		6 / 6	6 / 6	6/6	6 / 6

Table 11 – Test Set 9 Low Level Contact Resistance Summary Data Results in Milliohms

Results	Initial (mΩ)	After Thermal Shock & Humidity	ΔR
Minimum:	2.002	2.199	-0.197
Maximum:	3.093	3.513	-0.420
Average:	2.320	2.664	-0.344
Standard Deviation:	0.176	0.305	-0.129
Count (Valid / Read):	54 / 54	54 / 54	54/54

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Table 12 – Test Set 10, 11, 12 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Test Set 10 Initial	After Current Cycling	Test Set 11 Initial	After Current Cycling	Test Set 12 Initial	After Current Cycling
	Position	(mΩ)	ΔR	mΩ	ΔR	mΩ	ΔR
1	L1	8.925	0.579	7.641	-1.066	8.768	-0.159
	G	8.498	0.496	8.057	-0.412	8.363	0.084
	L2	8.432	-0.781	8.985	0.314	8.427	-0.135
Minimum:		8.432	0.430	7.641	-0.828	8.363	0.084
Maximum:		8.925	-0.288	8.985	0.278	8.768	-0.159
Average:		8.618	0.098	8.228	-0.388	8.519	-0.070
Standard Deviation:		0.268	-0.356	0.688	0.560	0.218	-0.107
Count (Valid / Read):		3/3	3/3	3/3	3/3	3 / 3	3/3

Table 13 – Test Set 13 & 16 Low Level Contact Resistance Results in Milliohms

Specimen ID	Test Description>	Test Set 13 Initial	After Current Cycling	Test Set 16 Initial	After Current Cycling
	Position	(mΩ)	ΔR	mΩ	ΔR
1	L1	7.575	-0.203	7.927	0.904
	G	7.164	-0.818	6.873	-0.446
	L2	7.908	-0.004	6.480	-0.734
Minimum:		7.164	-0.614	6.480	-0.543
Maximum:		7.908	-0.074	7.927	0.608
Average:		7.549	-0.342	7.093	-0.092
Standard Deviation:		0.373	0.269	0.748	0.598
Count (Valid / Read):		3/3	3/3	3/3	3/3

Table 14 – Test Set 14 & 15 Low Level Contact Resistance Summary Data Results in Milliohms

Specimen ID	Test Description>	Test Set 14 Initial	After Current Cycling	Test Set 15 Initial	After Current Cycling
	Position	(mΩ)	ΔR	mΩ	ΔR
1	L1	4.740	-0.030	4.563	-0.375
	G	4.618	-0.015	4.748	-0.311
	L2	5.114	0.381	5.006	0.295
2	L1	4.126	-0.131	4.794	-0.130
	G	4.499	-0.321	5.733	0.732
	L2	4.894	0.412	4.660	-0.229
Minimum:		4.126	-0.131	4.563	-0.148
Maximum:		5.114	0.294	5.733	0.674
Average:		4.665	0.049	4.917	-0.003
Standard Deviation:		0.341	0.128	0.426	0.307
Count (Valid / Read):		6/6	6/6	6/6	6/6

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2.3 Insulation Resistance

All specimens met the requirement of 100 megohms minimum insulation resistance between adjacent contacts initially and after thermal shock and humidity/temperature cycling.

2.4 Dielectric Withstanding Voltage

All specimens met the requirement of 2500VA applied to adjacent contacts initially and after thermal shock and humidity/temperature cycling, with no breakdowns, flashovers or leakage current in excess of 5mA.

2.5 Temperature Rise vs Current

All specimens met the requirement of 30°C maximum temperature rise when energized at the specified current listed in Section 3.2 of 108-160129 Rev 5, see Figure 1. See Tables 15 through 22 for the Temperature Rise vs Current test results.
NOTE: There were two measurements taken on each L1 and L2 circuits that were energized.

3.2. Ratings:

	Voltage	Current	Wire Size	Temperature
Output	480VAC	15A (12-14AWG Output) 10A (16-18AWG Output)	18-12 AWG	-40° to 105°C
Input			6-16AWG	

Figure 1 – Current Requirements per 108-160129 Rev 5

Table 15 – Test Set 5 T-Rise @ 10A

Specimen ID	Position	Initial T-Rise	Final T-Rise
		°C	°C
1	L1-1	4.48	2.67
	L1-2	4.88	3.04
	L2-1	3.97	3.15
	L2-2	4.12	3.26
2	L1-1	3.82	3.45
	L1-2	4.10	4.01
	L2-1	4.23	4.24
	L2-2	4.421	4.48
Minimum:		3.824	2.67
Maximum:		4.882	4.48
Average:		4.253	3.54
Standard Deviation:		0.334	0.637
Count:		8	8

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Table 16 - Test Set 6 T-Rise @ 10A

Specimen ID	Position	Initial T-Rise	Final T-Rise
		°C	°C
1	L1-1	4.38	4.52
	L1-2	4.70	4.97
	L2-1	4.90	5.73
	L2-2	4.34	4.87
2	L1-1	4.22	5.49
	L1-2	3.96	5.04
	L2-1	4.45	5.90
	L2-2	3.86	4.92
Minimum:		3.86	4.52
Maximum:		4.90	5.90
Average:		4.35	5.18
Standard Deviation:		0.347	0.477
Count:		8	8

Table 17 - Test Set 7 T-Rise @ 15A

Specimen ID	Position	Initial T-Rise	Final T-Rise
		°C	°C
1	L1-1	4.90	4.69
	L1-2	5.62	4.59
	L2-1	6.45	5.00
	L2-2	6.31	4.73
2	L1-1	5.46	3.87
	L1-2	5.83	4.36
	L2-1	6.82	7.49
	L2-2	7.02	7.817
Minimum:		4.90	3.87
Maximum:		7.02	7.82
Average:		6.05	5.32
Standard Deviation:		0.723	1.482
Count:		8	8

Table 18 - Test Set 8 T-Rise @ 15A

Specimen ID	Position	Initial T-Rise	Final T-Rise
		°C	°C
1	L1-1	7.29	4.86
	L1-2	8.69	6.02
	L2-1	7.25	4.77
	L2-2	7.58	4.53
2	L1-1	5.51	4.77
	L1-2	5.89	5.52
	L2-1	7.25	8.10
	L2-2	7.85	8.40
Minimum:		5.51	4.53
Maximum:		8.70	8.40
Average:		7.16	5.87
Standard Deviation:		1.026	1.548
Count:		8	8

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Table 19 – Test Set 10 & 11 T-Rise @ 10A

Specimen ID	Position	Test Set 10		Test Set 11	
		Initial T-Rise	Final T-Rise	Initial T-Rise	Final T-Rise
		°C	°C	°C	°C
1	L1-1	7.48	11.04	5.46	5.75
	L1-2	6.88	10.52	5.30	5.75
	L2-1	5.67	6.15	4.99	5.73
	L2-2	5.38	5.94	5.77	7.47
Minimum:		5.38	5.94	4.99	5.73
Maximum:		7.48	11.04	5.77	7.47
Average:		6.35	8.41	5.38	6.17
Standard Deviation:		0.991	2.743	0.324	0.863
Count:		4	4	4	4

Table 20 - Test Set 12 & 13 T-Rise @ 10A

Specimen ID	Position	Test Set 12		Test Set 13	
		Initial T-Rise	Final T-Rise	Initial T-Rise	Final T-Rise
		°C	°C	°C	°C
1	L1-1	6.93	6.17	6.24	7.05
	L1-2	5.40	4.76	6.49	7.21
	L2-1	6.93	7.14	6.22	7.46
	L2-2	6.59	6.79	5.66	6.29
Minimum:		5.36	4.76	5.66	6.29
Maximum:		6.93	7.14	6.49	7.46
Average:		6.45	6.22	6.15	7.00
Standard Deviation:		0.748	1.047	0.350	0.501
Count:		4	4	4	4

Table 21 - Test Set 14 & 15 T-Rise @ 15A

Specimen ID	Position	Test Set 14		Test Set 15	
		Initial T-Rise	Final T-Rise	Initial T-Rise	Final T-Rise
		°C	°C	°C	°C
1	L1-1	6.89	7.52	6.60	8.00
	L1-2	4.99	5.58	5.91	6.84
	L2-1	6.96	7.35	8.46	9.40
	L2-2	7.31	7.46	7.94	8.45
2	L1-1	6.74	6.73	5.44	6.03
	L1-2	5.45	5.40	7.51	8.38
	L2-1	7.39	7.69	5.58	6.83
	L2-2	6.05	6.52	6.27	7.72
Minimum:		4.99	5.40	5.437	6.03
Maximum:		7.39	7.69	8.455	9.40
Average:		6.47	6.78	6.712	7.71
Standard Deviation:		0.882	0.890	1.130	1.090
Count:		8	8	8	8

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Table 22 – Test Set 16 T-Rise @ 10A

Specimen ID	Position	Initial T-Rise	Final T-Rise
		°C	°C
1	L1-1	4.44	4.93
	L1-2	4.46	4.85
	L2-1	4.10	4.98
	L2-2	4.12	5.07
Minimum:		4.11	4.85
Maximum:		4.46	5.07
Average:		4.28	4.96
Standard Deviation:		0.194	0.094
Count:		4	4

2.6 Random Vibration

Test specimens had no apparent physical damage or discontinuities of 1 microsecond or longer occurred during vibration testing.

2.7 Mechanical Shock

Test specimens had no apparent physical damage or discontinuities of 1 microsecond or longer occurred during mechanical shock testing. The pulse velocity change was 6.64 Feet/Sec.

2.8 Wire Extraction Force (Input)

All specimens met the requirement for INPUT Wire Extraction Force. See Tables 23 and 24 for all measured input wire extraction force. Figure 2 shows a typical force plot recorded during testing.

Table 23 – Input Wire Extraction Force Results in Newton Force

Position ID	Test Set 17	Test Set 18	Test Set 19	Test Set 20	Test Set 21	Test Set 22
Requirements	94N	90N	80N	80N	60N	60N
L1	330.53	630.23	743.46	493.17	466.16	425.55
G	318.23	653.73	511.57	714.61	565.71	472.17
L2	441.92	577.47	390.34	435.37	561.92	559.74
Minimum	318.23	577.47	390.34	435.37	466.16	425.55
Maximum	441.92	653.73	743.46	714.61	565.71	559.74
Mean	363.56	620.47	548.46	547.72	531.26	485.82
Std. Dev.	68.14	39.06	179.42	147.40	56.41	68.13

Table 24 – Input Wire Extraction Force Results in Newton Force, continued

Position ID	Test Set 23	Test Set 24	Test Set 25	Test Set 26
Requirements	50N	50N	40N	40N
L1	463.62	495.98	244.71	313.25
G	473.85	511.13	308.72	290.01
L2	465.05	447.23	259.88	310.33
Minimum	463.62	447.23	244.71	290.01
Maximum	473.85	511.13	308.72	313.25
Mean	467.51	484.78	271.10	304.53
Std. Dev.	5.54	33.39	33.45	12.66

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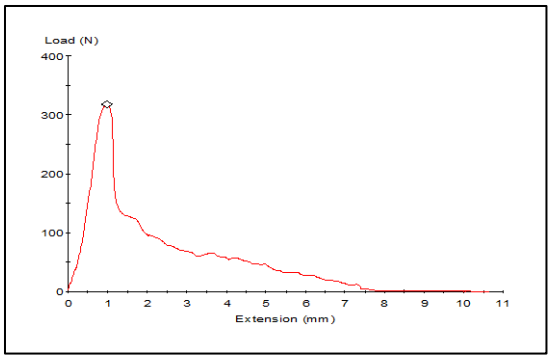

Figure 2 – Typical Input Wire Extraction Force Plot

2.9 Wire Extraction Force (Output)

All specimens met the requirement for OUTPUT Wire Extraction Force. See Tables 25 through 26 for all output wire extraction force results. Figure 3 is a typical output wire extraction force plot recorded during testing.

Table 25 – Output Wire Extraction Force Results in Newtons

Specimen ID	Test Set 27		Test Set 28	Test Set 29	Test Set 30
	Position ID	Wire Extraction Force	Wire Extraction Force	Wire Extraction Force	Wire Extraction Force
Requirement		**60N**	**60N**	**50N**	**50N**
L1	**1**	90.29	81.79	74.24	94.97
	2	114.10	78.72	69.35	70.26
	3	93.08	83.12	62.73	83.19
G	**4**	92.82	78.37	86.42	115.61
	5	125.18	76.52	82.79	103.70
	6	106.68	77.27	77.51	78.41
L2	**7**	69.93	75.46	66.74	101.18
	8	119.93	90.46	90.09	117.92
	9	107.35	66.47	58.25	86.04
Minimum		69.93	66.47	58.25	70.26
Maximum		125.18	90.46	90.09	117.92
Mean		102.15	78.69	74.24	94.59
Std. Dev.		17.27	6.46	10.28	16.47

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Table 26 – Output Wire Extraction in Newtons

Specimen ID	Position ID	Test Set 31	Test Set 32	Test Set 33	Test Set 34
		Wire Extraction Force	Wire Extraction Force	Wire Extraction Force	Wire Extraction Force
Requirements		40N	40N	30N	18N
L1	1	40.12	57.24	36.58	83.66
	2	50.05	99.85	37.21	88.41
	3	52.55	61.73	42.47	70.13
G	4	61.63	136.86	33.42	60.41
	5	61.19	72.67	41.43	55.73
	6	56.58	48.60	34.72	59.98
L2	7	54.08	92.77	39.01	62.58
	8	48.15	46.93	43.04	57.35
	9	75.64	86.60	48.38	52.77
Minimum		40.12	46.93	33.42	52.77
Maximum		75.64	136.86	48.38	88.41
Mean		55.55	78.14	39.59	65.67
Std. Dev.		10.05	29.13	4.71	12.57

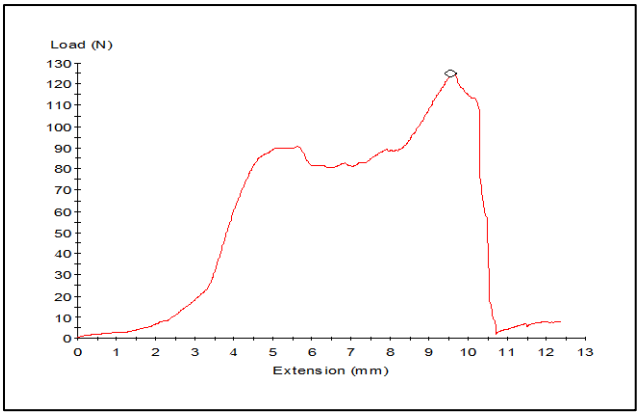

Figure 3 – Typical Output Wire Extraction Force Plot

2.10 Current Cycling

All specimens met the requirement of less than 30°C temperature rise on the “ON” cycles during current cycling. See Tables 27 and 28 for the temperature rise summary data collected on cycles 1 and 25 for each test set. All temperature rise data collected during current cycling is stored in the test file for Test Group D.

Table 27 – Current Cycling Temperature Rise Data Summary in °C

Results	Test Set 10		Test Set 11		Test Set 12	
	Cycle 1	Cycle 25	Cycle 1	Cycle 25	Cycle 1	Cycle 25
Minimum	5.27	5.44	4.87	4.92	5.70	5.72
Maximum	7.86	8.46	5.71	5.64	7.18	7.22
Average	6.46	6.83	5.40	5.41	6.52	6.49
Std Dev.	1.20	1.41	0.37	0.34	0.66	0.67

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Table 28 – Current Cycling Temperature Rise Data Summary in °C, continued

Results	Test Set 13		Test Set 14		Test Set 15		Test Set 16	
	Cycle 1	Cycle 25	Cycle 1	Cycle 25	Cycle 1	Cycle 25	Cycle 1	Cycle 25
Minimum	5.02	4.62	4.92	5.06	4.97	5.31	4.38	4.51
Maximum	5.95	5.82	7.37	7.41	8.39	8.71	4.84	4.98
Average	5.60	5.36	6.47	6.46	6.51	6.71	4.61	4.75
Std Dev.	0.40	0.53	0.91	0.88	1.24	1.24	0.23	0.24

2.11 Connector Mounting Security Force

Specimens met the 125N minimum retention force. See Table 29 for the connector mounting security force test results.

Table 29 – Connector Mounting Security Force Results in Newtons

Specimen ID	Test Set 35-STD Mount	Test Set 36-Rear Mount
	Mounting Security Force N	Mounting Security Force N
1	374.15	164.91
2	405.52	161.13
Minimum	374.15	161.13
Maximum	405.52	164.91
Mean	389.84	163.02
Std. Dev.	22.18	2.67

2.12 Durability

No damage or defects were observed on any specimen after subjecting the specimens to 3 wire insertions and 2 wire extractions cycles before performing subsequent test.

2.13 Thermal Shock

No damage or defects were observed on any specimen after a thermal shock environmental exposure.

2.14 Humidity/Temperature Cycling

No damage or defects were observed on any specimen after a humidity/temperature cycling environmental exposure.

2.15 Temperature Life

No damage or defects were observed on any specimen after a temperature life environmental exposure.

2.16 Final Visual Examination

No damage or defects were observed on any specimen.

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3. TEST METHODS

3.1 Initial Visual Examination

All specimens were visually examined for any evidence of damage or defects detrimental to product performance. Testing was conducted in accordance with EIA 364-18B.

3.2 Low Level Contact Resistance

All specimens were measured for Low Level Contact resistance using a four-wire resistance measuring technique. The test potential was 20mV maximum open circuit voltage and 100mA maximum test current. The current probes were connected to one wire on the input side and one on the output side of each port labeled L1, G and L2. Three measurements were taken on each specimen. See Figure 4 for photographs of the measurement. Testing was conducted in accordance with EIA 364-23D.

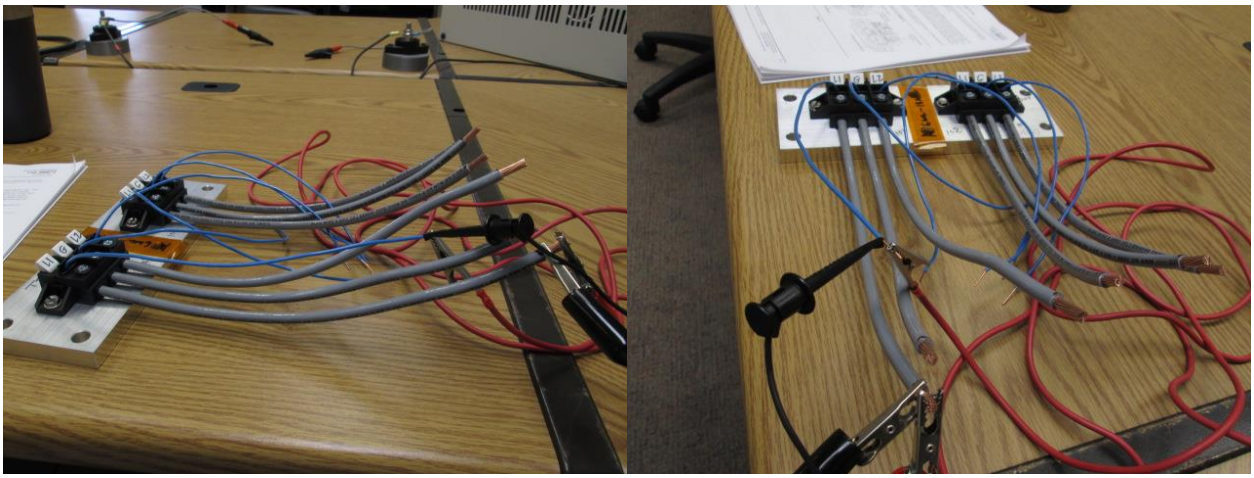

Figure 4 – Low Level Contact Resistance Measurements

3.3 Insulation Resistance

All specimens were measured for insulation resistance between circuits L1 to G and G to L2 on both the input and output sides of each terminated terminal block. A test potential of 500VDC was applied to the terminated wires in the appropriate position and monitored for two minutes or meter stabilization, and the insulation resistance was recorded. Figure 5 shows the typical test connections for insulation resistance measurements. Testing was conducted in accordance with EIA 364-21F.

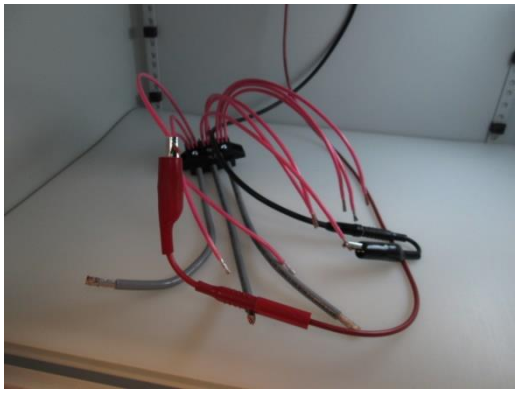

Figure 5 – Insulation Resistance Measurements

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3.4 Dielectric Withstanding Voltage

All specimens were measured for dielectric withstanding voltage between circuits L1 to G and G to L2 on both the input and output sides of each terminated terminal block. A test potential of 2500VAC was applied to the terminated wires in the appropriate position and monitored for one minute while monitoring for any breakdowns, flashover or leakage current in excess of 5Ma. The results are recorded as Pass/Fail. Testing was conducted in accordance with EIA 364-20F, Condition 1. Figure 6 shows a typical test connection.

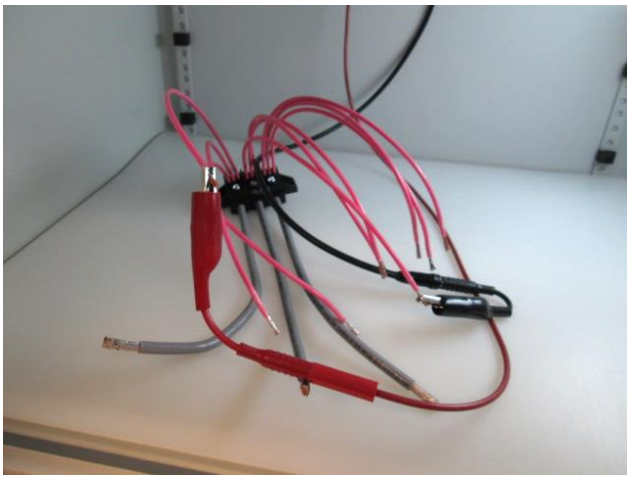

Figure 6 – DWV Typical Test Connections

3.5 Temperature Rise vs Current

The specimens in each Test Set were tested independently inside a draft free enclosure. The specimens were wired in series and connected to a power supply of an automated temperature acquisition system. The L1 and L2 positions were the positions under test on each terminal block. Type-T, 30AWG thermocouples were placed in the open cavities of each position L1 & L2, contacting the metal clamping device as well as possible, and were held in place using thermally conductive epoxy. The system was set to apply a test current of either 10A or 15A DC, as shown in Figure 1 above. The temperatures were monitored until stability occurred and the temperatures were recorded. Stability is defined as 3 consecutive measurements at 5-minute intervals did not differ by more than 1°C. A current reversing unit was utilized during measurements to minimize the possibility of temperature gradients. See Figure 7 for a photograph of the thermocouple placement and Figure 8 for specimens inside the draft free enclosure.

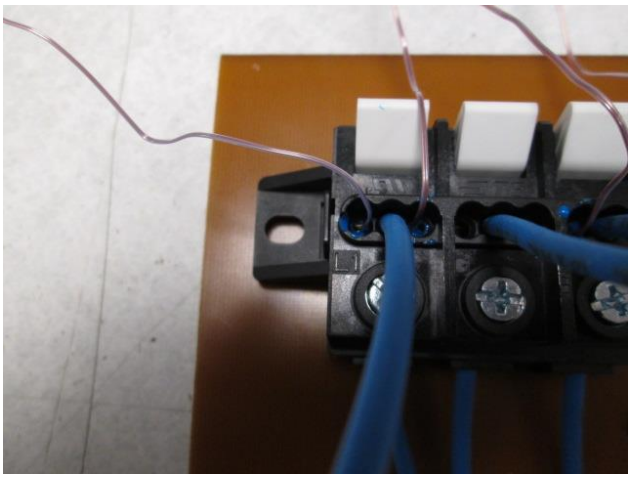

Figure 7 – Thermocouple Locations

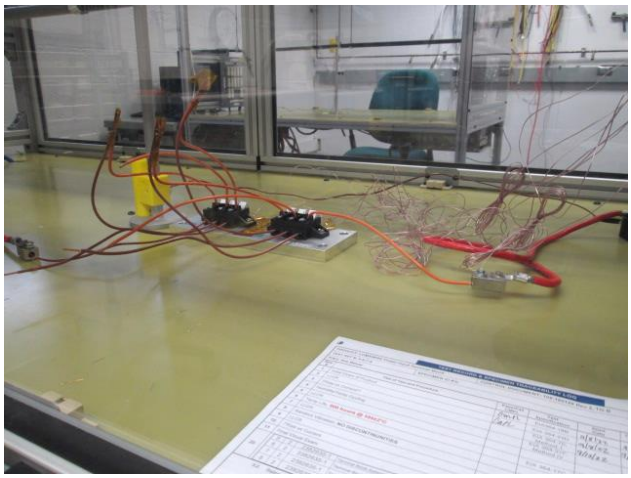

Figure 8 – Temperature Rise Measurements

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3.6 Random Vibration

Test specimens were subjected to a Sinusoidal Vibration test in accordance with TE Connectivity specification 108-160129 Rev. 5.

The parameters of this test condition are a simple harmonic motion having an amplitude of either 0.250-inch double amplitude (maximum total excursion) or 3.5 gravity unit (g's peak) whichever is less.

The vibration frequency was varied logarithmically between the approximate limits of 5 Hz to 55 Hz. The entire frequency range of 5 Hz to 55 Hz and return to 5 Hz was traversed at a rate of 1 octave/minute. This cycle was repeated for 1 hour in each of the three mutually perpendicular directions, so that the motion was applied for a total period of 3 hours on each test specimen.

The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes. Sinusoidal vibration test setups are shown in Figures 9, 10 & 11.

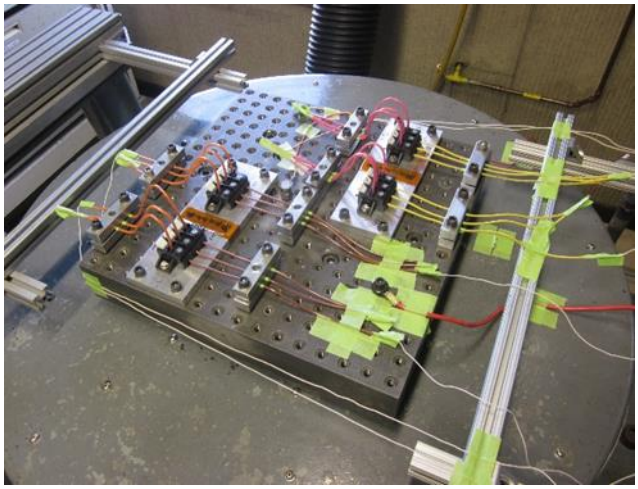

Figure 9 – Vibration Test Setup

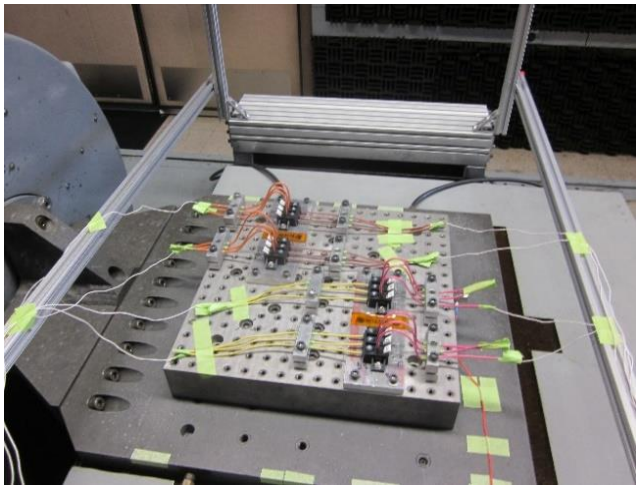

Figure 10 – Vibration Test Setup

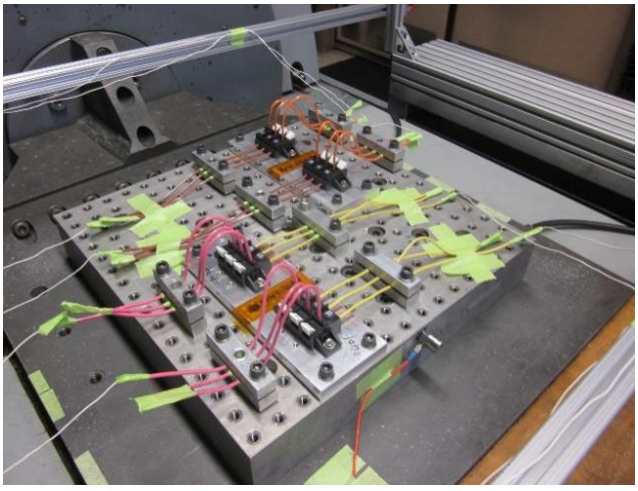

Figure 11 – Vibration Test Setup

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3.7 Mechanical Shock

The test specimens were subjected to a mechanical shock test in accordance with specification EIA-364-27C, test condition “H”.

The parameters of this test condition are a half-sine waveform with an acceleration amplitude of 30 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. See Figures 12 through 14 for photographs of the test setup.

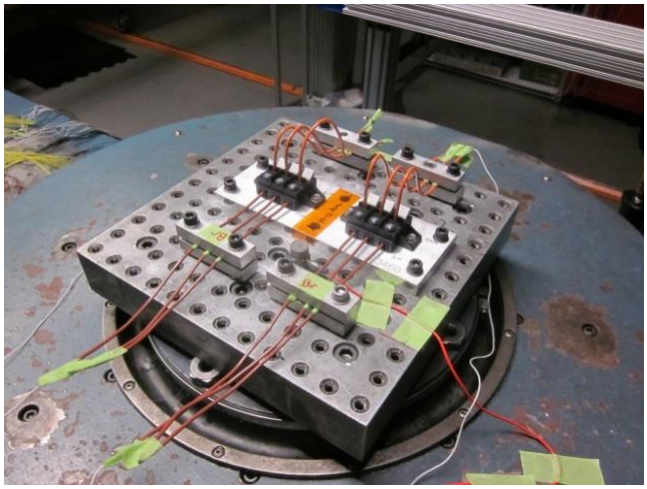

Figure 12 – Mechanical Shock Test Setup

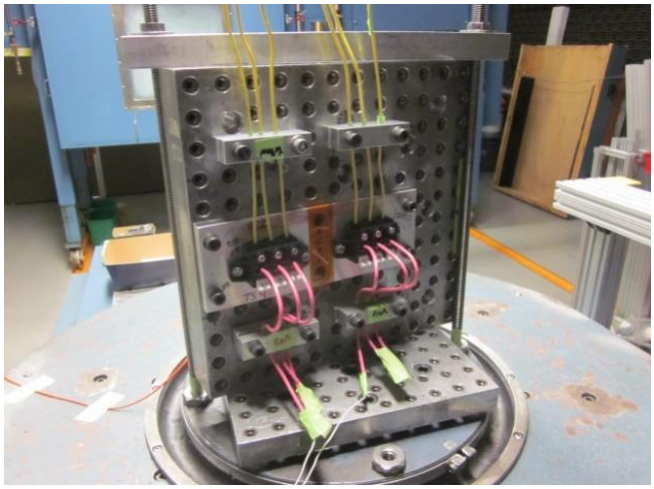

Figure 13 – Mechanical Shock Test Setup

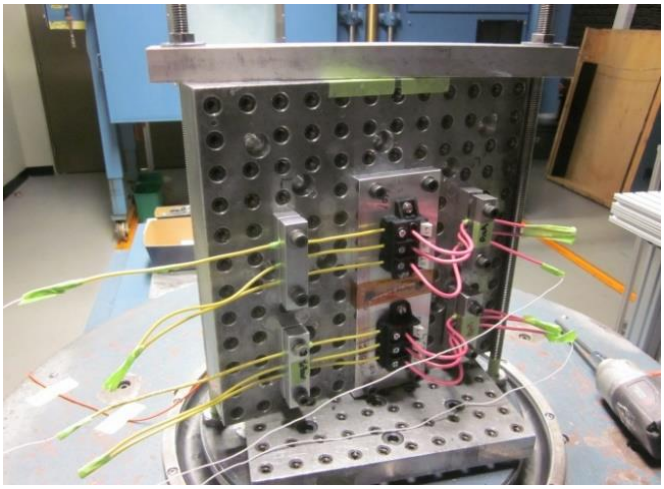

Figure 14 – Mechanical Shock Test Setup

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3.8 Wire Extraction Force (Input)

A test specimen, mounted to an aluminum block, was secured on a floating table on the base of a tensile/compression testing machine with the wires to be tested facing up. The free end of the terminated wire was grasped in pneumatic jaws that were mounted to the load cell on the cross head of the machine. The cross head was started in the tensile direction at a rate of 12.7mm/min until the wire was removed from the terminal block, and the forces were recorded. Figure 15 shows the test setup. Testing was conducted in accordance with EIA 364-8C.

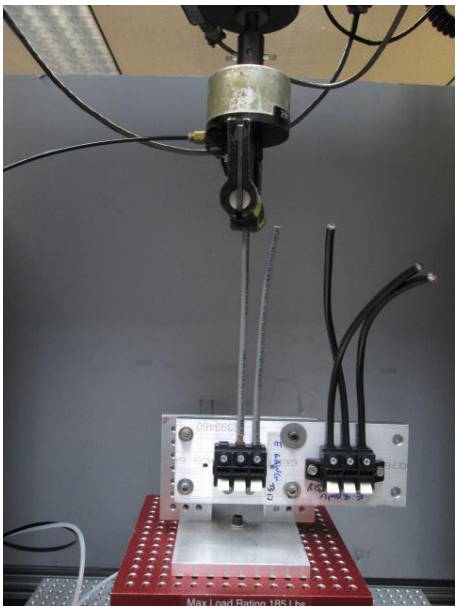

Figure 15 – Wire Extraction Force (Input) Test Setup

3.9 Wire Extraction Force (Output)

A test specimen, mounted to an aluminum block, was secured on a floating table on the base of a tensile/compression testing machine. The free end of the terminated wire was grasped in pneumatic jaws that were mounted to the load cell on the cross head of the machine. The cross head was started in the tensile direction at a rate of 12.7mm/min until the wire was removed from the terminal block, and the forces were recorded. Figure 16 shows the test setup. Testing was conducted in accordance with EIA 364-8C.

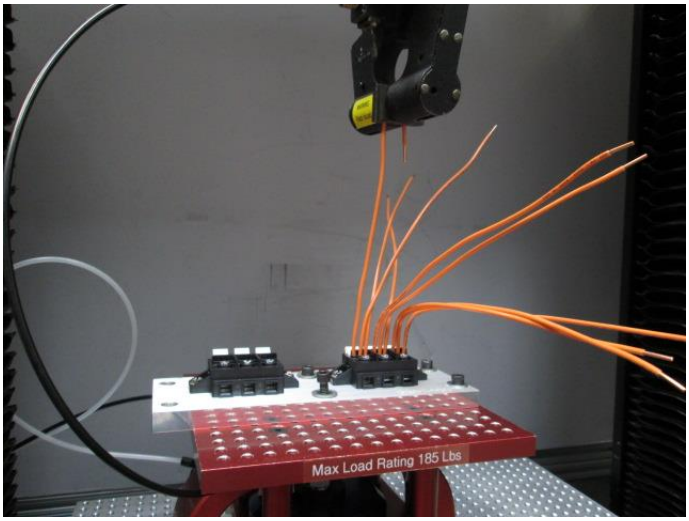

Figure 16 – Wire Extraction Force (Output) Test Setup

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3.10 Current Cycling

All specimens were tested in the same configuration as temperature rise vs current. The terminal blocks were secured to pieces of G-10 material for stability during handling and testing. The specimens were placed in a draft free enclosure for testing. The lead wires were connected to a power supply of an automated temperature acquisition system. The L1 and L2 positions were the positions under test on each terminal block. Type-T, 30AWG thermocouples were placed in the open cavities of each position L1 & L2, contacting the metal clamping device as well as possible, and were held in place using thermally conductive epoxy. The system was set to apply a test current of either 10A or 15A DC, as shown in Figure 1 above. The current was applied for 20 hours, followed by 4 hours with no current. A total of 25 cycles were performed. Temperature measurements were recorded at the end of each "ON" cycle. A current reversing unit was used during measurements to minimize the possibility of temperature gradients. See Figure 17 for a photograph of the thermocouple placement and Figure 18 for specimens inside the draft free enclosure.

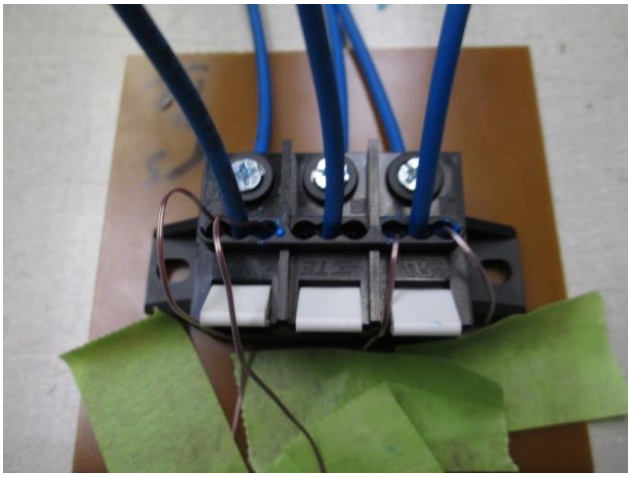

Figure 17 – Thermocouple Location

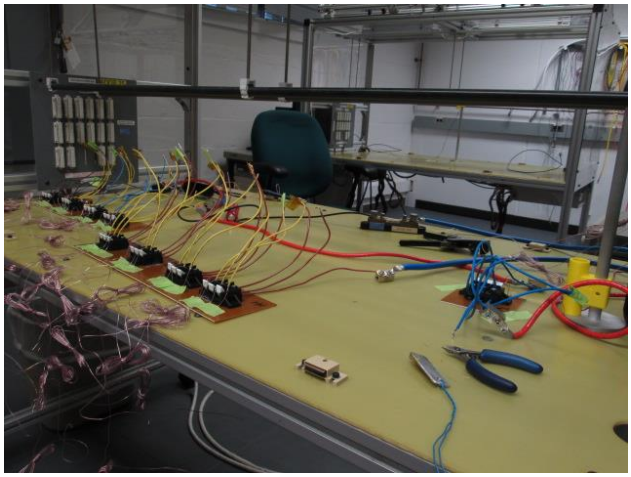

Figure 18 – Current Cycling Setup

3.11 Connector Mounting Security Force

An aluminum block with the test specimens was secured to the base of a tensile/compression testing machine. The terminated wires were secured in jaws that were mounted to the load cell on the cross head of the machine. The cross head was started in the tensile direction at a rate of 25.4 mm/min until failure occurred, and the cross head was stopped. Figure 19 shows the test setup. Testing was conducted per TE Specification 108-160129, Revision 5.

Figure 19 – Test Setup

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3.12 Durability

The specimens were subjected to 3 wire insertions and 2 wire extractions cycles before performing subsequent test. On the final insertion, a virgin wire was inserted after ensuring the stranded wire(s) were twisted. The insertion cycle consisted of actuating lever to open contact, insert wire(s) and then close the lever. The extraction cycle consisted of actuating lever to open contact and removing the wire. Testing was performed in accordance with TE 108-160129 Revision 5.

3.13 Thermal Shock

Terminated specimens were subjected to 150 cycles of thermal shock exposure. The temperature extremes were -40°C and 105°C with 30-minute dwells at each extreme. The transition time was less than 1-minute. Testing was performed in accordance with EIA 364-32G.

3.14 Humidity/Temperature Cycling

Terminated 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. Figure 20 shows the humidity-temperature cycling profile. Testing was performed in accordance with EIA 364-31F, Method IV.

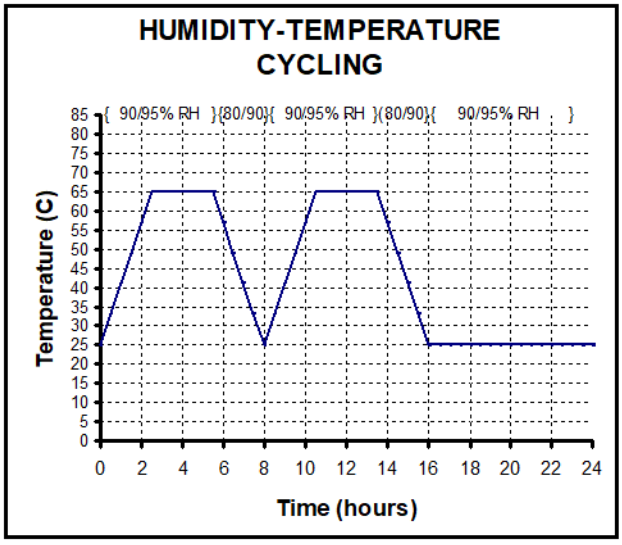

Figure 20 – One 24-Hour Cycle

3.15 Temperature Life

Terminated specimens were placed in a convection oven set to a temperature of 105°C ±2°C for a period of 500 hours. Testing was conducted in accordance with EIA 364-17C.

3.16 Final Visual Examination

All specimens were visually examined for any evidence of damage or defects detrimental to product performance. Testing was conducted in accordance with EIA 364-18B.

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