SOLARLOK* PV Edge Solar Junction Box (V2.0)

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity SOLARLOK* PV Edge Solar Junction Box (V2.0) to determine its conformance to the requirements of Product Specification 108-32122, Rev. H.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the SOLARLOK PV Edge Solar Junction Box (V2.0). Testing was performed at the Harrisburg Electrical Components Test Laboratory between August 1, 2017 and January 22, 2018. This documentation is on file and maintained at TE Harrisburg Electrical Components Test Lab under test file EA20170495T. Additional testing was performed between February 12 and 24, 2016. This documentation is on file and maintained at TE Harrisburg Electrical Components Test Lab under test file EA20150757T.

1.3 Conclusion

The SOLARLOK PV Edge Solar Junction Box (V2.0) listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-32122, Rev. H.

1.4 Product Description

The SOLARLOK PV Edge Junction Box allows electrical connection between Photovoltaic (PV) panels. The junction box is a decentralized design with corner and middle mounting enabling savings in cross-connect foil material usage and labor in routing the foils. The shorter cross connector foils provide higher efficiency panels compared with centralized junction boxes.

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:

Table 1 – Test Specimens

Test Group	Test Set	Quantity	Part Number	Description
1	1	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3. With TIM.
	2	3 each	1-2306317-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-4 (glass-back sheet) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3. No TIM.
2	3	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
	4	3 each	3-2306317-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-4 (glass-back sheet) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
3	5	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
	6	3 each	3-2306317-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-4 (glass-back sheet) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
4	7	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
	8	3 each	3-2306317-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-4 (glass-back sheet) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
5	9	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
	10	3 each	3-2306317-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-4 (glass-back sheet) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
5a	11	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
	12	3 each	3-2306317-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-4 (glass-back sheet) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
6	13	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
	14	3 each	3-2306317-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-4 (glass-back sheet) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
7	15	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
	16	3 each	3-2306317-1,-2,-5 Rev. 4	Junction boxes secured to test panel 2213734-4 (glass-back sheet) with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
8	17	3 each	3-2306314-1,-2,-5 Rev. 4	Junction boxes secured to polycarbonate test panel with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
	18	3 each	3-2306317-1,-2,-5 Rev. 4	Junction boxes secured to polycarbonate test panel with Dow PV804 RTV. Connected to cables 2270055-3 and 2270054-3.
9	19	3 each	3-2306314-1,-2,-5 Rev. A	Junction boxes with “S” Clips, not mounted on panel.
	20	3 each	1-2306317-1,-2,-5 Rev. A	Junction boxes with Omega Clips, not mounted on panel.
10 (a)	21	3 each	8-2213674-1,-2, -5 Rev. 5	Junction boxes secured to test panel 2213734-3 (glass-glass) with Dow PV8007 RTV. Connected to cables 2270055-3 and 2270054-3. With TIM.

NOTE (a) *Specimens tested in EA20150757T contained diode part number 2213713-1 Rev. 3 and PV Edge components related to diode. Thermal interface material (TIM) was removed from specimens secured to one glass-glass panel under test.*

1.6 Test Sequence

Table 2 – Qualification Test Sequence

Test or Examination	Test Groups										
	1	2	3	4	5	5a	6	7	8	9	10
	Test Sequence (a)										
Examination of Product	1,6	1,8	1,10	1,7	1,8	1,7	1,7	1,6	1,4	1,3	1,3
Dielectric Strength		3,6	3,8	2,5	2,6	2,5					
Wet Leakage Current	5	7	9	6	7	6	6		3		
Bypass-Diode Thermal Test (IEC 62790)	3										
Bypass-Diode Thermal Test (IEC 61215)											2
Overall Resistance (DC)	2,4	2,5	2,7				2,5	2,5			
Current Carrying Capacity								3			
Foil Retention Force for Contact Rail Assembly										2	
Protection Degree (IP6x)						4					
Protection Degree (IPx7)					5						
Protection Degree (IPx5)					4						
Tension and Torque							3				
Strain Relief			6								
Cold Impact (UL)									2		
Vibration (Sinusoidal)								4			
Temperature Life					3	3					
Thermal Cycle, 50 Cycles			4								
Thermal Cycle, 200 Cycles		4									
Humidity Freeze			5								
Damp Heat				4							
Salt Mist							4				
Rapid Change of Temperature				3							

NOTE *a) Numbers indicate sequence in which tests were 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 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 Dielectric Strength – Groups 2,3,4,5,5a

No breakdown or flashover occurred.

2.3 Wet Leakage Current – Groups 1,2,3,4,5,5a,6,8

Insulation resistance was greater than 400 megohms.

2.4 Bypass-Diode Thermal Test (IEC 62790) – Group 1

The diode showed no physical damage detrimental to product performance, and functioned normally following test. Calculated diode junction temperature was less than the diode manufacturer's maximum junction temperature rating following 1 hour at specified current.

2.5 Bypass-Diode Thermal Test (IEC 61215) – Group 10

The diode showed no physical damage detrimental to product performance, and functioned normally following test. Calculated diode junction temperature was less than the diode manufacturer's maximum junction temperature rating following 96 hours at specified current.

2.6 Overall Resistance – Groups 1,2,3,6,7

Overall resistance was less than 5 milliohms (Tables 3 through 12). Bulk wire resistance was removed from terminal input measurement for +PV4 and -PV4. Foil connection measurement included two foil terminations and bulk resistance of interconnecting foil.

Table 3 – Overall Resistance, TG1 Glass to Glass Panel (milliohms)

Test Group 1 Test Set 1	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.34	0.38	3.20	3.22
Max	0.42	0.43	3.43	3.31
Avg	0.38	0.40	3.27	3.25
N	6	6	6	6

Table 4 – Overall Resistance, TG1 Glass to Back Sheet Panel (milliohms)

Test Group 1 Test Set 2	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.37	0.37	1.61	1.60
Max	0.45	0.43	1.66	1.66
Avg	0.40	0.40	1.64	1.64
N	6	6	6	6

Table 5 – Overall Resistance, TG2 Glass to Glass Panel (milliohms)

Test Group 2 Test Set 3	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.38	0.37	3.19	3.20
Max	0.64	0.84	3.66	3.32
Avg	0.44	0.49	3.31	3.27
N	6	6	6	6

Table 6 – Overall Resistance, TG2 Glass to Back Sheet Panel (milliohms)

Test Group 2 Test Set 4	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.35	0.37	1.60	1.63
Max	0.42	0.46	1.65	1.71
Avg	0.40	0.41	1.63	1.68
N	6	6	6	6

2.6 Overall Resistance (cont'd)

Table 7 – Overall Resistance, TG3 Glass to Glass Panel (milliohms)

Test Group 3 Test Set 5	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.36	0.38	3.22	3.24
Max	0.44	0.49	3.36	3.35
Avg	0.39	0.44	3.28	3.30
N	6	6	6	6

Table 8 – Overall Resistance, TG3 Glass to Back Sheet Panel (milliohms)

Test Group 3 Test Set 6	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.36	0.40	1.61	1.63
Max	0.46	0.58	1.67	1.70
Avg	0.40	0.47	1.63	1.67
N	6	6	6	6

Table 9 – Overall Resistance, TG6 Glass to Glass Panel (milliohms)

Test Group 6 Test Set 13	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.39	0.25	3.19	3.18
Max	0.51	0.40	3.26	3.25
Avg	0.46	0.34	3.23	3.22
N	6	6	6	6

Table 10 – Overall Resistance, TG6 Glass to Back Sheet Panel (milliohms)

Test Group 6 Test Set 14	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.40	0.26	1.63	1.63
Max	0.49	0.41	1.66	1.65
Avg	0.45	0.32	1.64	1.64
N	6	6	6	6

2.6 Overall Resistance (cont'd)

Table 11 – Overall Resistance, TG7 Glass to Glass Panel (milliohms)

Test Group 7 Test Set 15	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.36	0.38	3.28	3.23
Max	0.42	0.41	3.51	3.41
Avg	0.39	0.39	3.37	3.34
N	6	6	6	6

Table 12 – Overall Resistance, TG7 Glass to Back Sheet Panel (milliohms)

Test Group 7 Test Set 16	Terminal Input (+PV4 & -PV4)		Foil Connection (+ & - module to center module	
	Initial	Final	Initial	Final
Min	0.37	0.38	1.54	1.55
Max	0.42	0.41	1.64	1.64
Avg	0.39	0.39	1.60	1.60
N	6	6	6	6

2.7 Current Carrying Capacity – Group 7

The specimens had a temperature rise of less than 30°C when energized at 17.0 amperes, with the diodes removed and replaced with a 16 AWG solid wire.

2.8 Foil Retention Force for Contact Rail Assembly – Group 9

Foil retention force was greater than 4N (0.9 pound).

2.9 Protection Degree (IP6x) – Group 5a

No evidence of dust was observed in the junction box following 8 hours of dust exposure.

2.10 Protection Degree (IPx7) – Group 5

No evidence of water intrusion or damage detrimental to product performance was observed following exposure to IPX7 testing.

2.11 Protection Degree (IPx5) – Group 5

No evidence of water intrusion or damage detrimental to product performance was observed following exposure to IPX5 testing.

2.12 Tension and Torque – Group 6

There was no movement of the cable relative to the gland following the tension testing that exceeded 2 mm. There was no movement of the cable relative to the gland during or following torque testing that exceeded 45°.

2.13 Strain Relief – Group 3

No physical damage detrimental to product performance was visible following strain relief test.

2.14 Cold Impact (UL) – Group 8

No physical damage detrimental to product performance was observed following test.

2.15 Vibration (Sinusoidal) – Group 7

No physical damage or discontinuities of one microsecond or greater occurred during test.

2.16 Temperature Life – Groups 5,5a

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

2.17 Thermal Cycle, 50 Cycles – Group 3

No physical damage detrimental to product performance was observed following 50 cycles of energized thermal cycling exposure.

2.18 Thermal Cycle, 200 Cycles – Group 2

No physical damage detrimental to product performance was observed following 200 cycles of energized thermal cycling exposure.

2.19 Humidity Freeze – Group 3

No discontinuities of 1 microsecond or longer were detected during test. No physical damage was observed following exposure to humidity freeze environment.

2.20 Damp Heat – Group 4

No physical damage was observed as a result of exposure to damp heat environment.

2.21 Salt Mist – Group 6

No physical damage was observed as a result of exposure to salt mist environment.

2.22 Rapid Change of Temperature – Group 4

No physical damage was observed as a result of exposure to rapid change of temperature environment.

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. Specimens were visually examined with the unaided eye corrected to normal vision. Examination was conducted in accordance with IEC 60512-1-1 Edition 1.0 dated 2002-02, Test 1a and IEC 60512-1-2 Edition 1.0 dated 2002-02, Test 1b.

3.2 Dielectric Strength

Testing was conducted in accordance with IEC 62790 Edition 1.0 dated 2014-11, Section 5.3.6(b). Mated specimens were prepared by wrapping aluminum foil around the junction boxes. Positive lead of test equipment was connected to the short-circuited module wire ends, and the negative lead was connected to the aluminum foil. 8000 volts rms was applied at a rate of 500 volts per second. Voltage was held for 1 minute and returned to zero.

3.3 Wet Leakage Current

Testing was conducted in accordance with IEC 62790 Edition 1.0 dated 2014-11, Section 5.3.16. Mated specimens were placed in a non-corrosive water/wetting agent solution with resistivity of less than 3500 ohms per centimeter. Positive lead of test equipment was connected to short-circuited module wire ends, and the negative lead was connected to solution. 1500 volts DC potential was applied and resistance was monitored for 2 minutes. Specimens were measured after 2-minute exposure.

3.4 Bypass-Diode Thermal Test (IEC 62790)

Testing was conducted in accordance with IEC 62790 Edition 1.0 dated 2014-11, Section 5.3.18. Mated specimens were prepared by drilling a hole in the lid to pass the voltage drop and thermocouple leads. A thermocouple was epoxied to the side of the diode case using high temperature thermally conductive epoxy. A second thermocouple was placed on the junction box lid. Voltage drop wires were soldered to the diode leads to monitor voltage drop across the diode. Specimens were placed in a metal box in an oven and allowed to stabilize at 75°C. Test Set 1 was then energized in forward bias mode for 1 hour at 17.0 amperes, followed by 1 hour at 21.25 amperes. Test Set 2 was energized in forward bias mode for 1 hour at 15.0 amperes followed by 1 hour at 18.75 amperes. Temperature and voltage drop measurements at the end of first hour exposure at rated current were used to calculate the internal diode temperature using the equation:

$T_j = T_{case} + R_{THjc} * U_D * I_D$,

where,
T_j = the diode junction temperature,
T_{case} = the diode case temperature,
R_{THjc} = the manufacturer's value relating junction temperature to case temperature (SL2020A diode is 2.2°C/Watt),
U_D = the diode voltage, and
I_D = the diode current.

Following test, the diode was verified for normal operation by checking reverse bias of the diode, and the junction box and diode were visually examined.

3.5 Bypass-Diode Thermal Test (IEC 61215)

Testing was conducted in accordance with IEC 61215 Second Edition dated 2005-04, Section 10.18. Mated specimens were prepared by soldering voltage leads to each end of diode terminals and mounting thermocouples to the side of the diode shell with high temperature thermally conductive epoxy. Specimens were placed in an oven and allowed to stabilize at 75°C, and then energized at 17.0 amperes for 96 hours followed by 21.25 amperes for 1 hour. Temperature and voltage drop measurements at the end of 96 hour exposure segment at rated current were recorded and used to calculate the internal diode junction temperature using the equation:

$T_j = T_{case} + R_{THjc} * U_D * I_D$,

where,
T_j = the diode junction temperature,
T_{case} = the diode case temperature,
R_{THjc} = the manufacturer's value relating junction temperature to case temperature (SL2020A diode is 2.2°C/Watt),
U_D = the diode voltage, and
I_D = the diode current.

Following test, the diode was verified for normal operation by checking reverse bias of the diode, and the junction box and diode were visually examined.

3.6 Overall Resistance

Testing was conducted in accordance with IEC 60512-2-2 First Edition dated 2003-05, Test 2b. Mated specimen resistance was measured at 1 volt open circuit voltage and 1 ampere. Current was applied to the loose wire end of the positive and negative junction boxes. The positive terminal from the power supply was applied to the negative terminal on the junction box (Figure 1). Terminal input resistance was measured from the end of the bulk wire to the terminal end in the junction box for both +PV4 and -PV4. Bulk wire resistance was removed from terminal measurement for +PV4 and -PV4. The foil connection from positive junction box to the center junction box and the negative junction box to the center junction box were both measured. Each foil connection measurement included two foil terminations and bulk resistance of interconnecting foil.

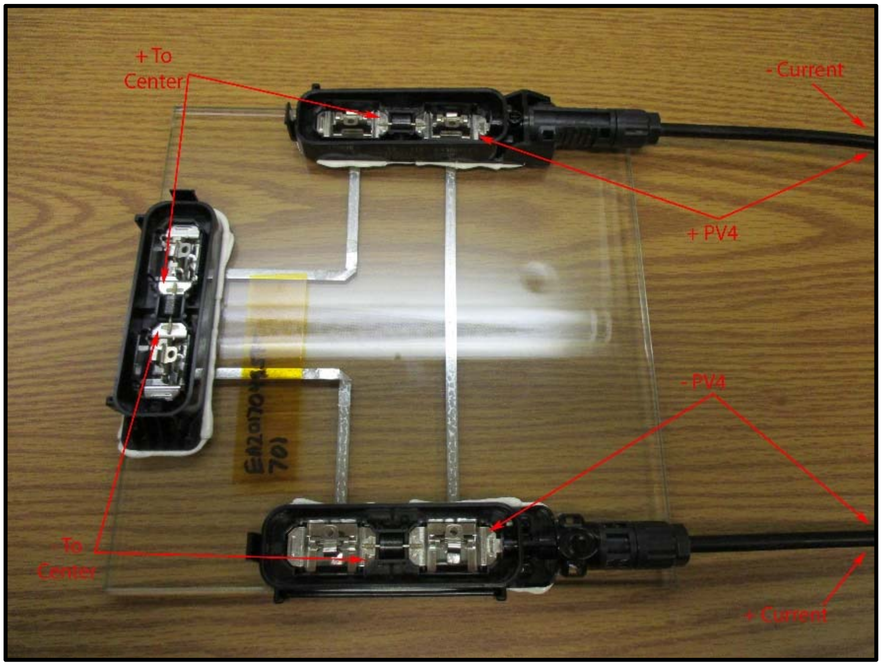

Figure 1 – Overall Resistance Measurement Locations (Typical)

3.7 Current Carrying Capacity

Testing was conducted in accordance with IEC 60512-5-1 First Edition dated 2002-02, Test 5a. Mated specimens were prepared for test by drilling a hole in the lid to pass the thermocouple leads. A thermocouple was epoxied to the foil connection point on the clip. Diodes were removed for test and replaced with a 16 AWG solid wire. Specimens were energized at 17.0 amperes until temperature stabilized, and then energized for an additional 1 hour prior to temperature measurement.

3.8 Foil Retention Force for Contact Rail Assembly

Foil retention force was measured for unmounted specimens. The junction box was held on a free floating X, Y and rotational table attached to the base of the tensile compression machine. A steel gauge approximately 5mm wide x 0.2mm thick was placed in the clip at each foil retention connection. Each foil was tested independently by holding it in a fixture attached to the moveable crosshead of the tensile compression device. The crosshead was actuated at 25mm per minute until the foil was removed. The maximum force was measured.

3.9 Protection Degree (IP6x)

Dust testing was conducted in accordance with IEC 60529 Edition 2.2 dated 2013-08, Section 13.4. Mated specimens were placed in dust chamber that was designed to maintain talcum powder in suspension during exposure. The amount of talcum powder used for test was 2 kilograms per cubic meter of the test chamber volume. Specimens were exposed to dust for 8 hours. Upon completion, specimens were subjected to dielectric strength test and then examined for signs of dust ingress by opening the lid of junction box.

3.10 Protection Degree (IPx7)

Testing was conducted in accordance with IEC 60529 Edition 2.2 dated 2013-08, Section 14.2.7. Mated specimens were prepared for test by sealing the loose cable end with wax. Specimens were immersed in one meter of water for thirty minutes, removed and subjected to dielectric strength. Specimens were dried at ambient conditions for twenty-four hours and then the lid of the junction box was opened to examine for signs of water intrusion.

3.11 Protection Degree (IPx5)

Testing was conducted in accordance with IEC 60529 Edition 2.2 dated 2013-08, Section 14.2.5. Mated specimens were prepared for test by sealing the loose cable end with wax. Specimens were subjected to a water jet test for a duration of three minutes at a distance of 2.5 to 3.0 meters. The flow rate for the 6.3mm water jet nozzle was 12.5 liters per minute ±5%. Specimens were subjected to the spray from all possible angles and continuously moved around in the spray by hand. Following test, specimens were subjected to dielectric strength. The lid of the junction box was then opened to examine for signs of water intrusion.

3.12 Tension and Torque

Testing was conducted in accordance with IEC 62790 Edition 1.0 dated 2014-11, Section 5.3.21.1.

3.12.1 Tension

Mated specimens were prepared for tension test by marking cable so that any displacement relative to gland could be detected. Test panel was held in vise in vertical orientation with loose cable end positioned up. Vise was mounted to floating X, Y and rotational table at base of tensile compression device. Loose cable end was held in pneumatic jaw assembly attached to moveable crosshead of tensile compression device. Force was applied at 0.5 inches per minute until a force of 30 Newtons was achieved. Force was held for 1 second and returned to zero. Tensile force was applied in this manner for a total of 50 cycles. Following test, the specimen was examined for displacement.

3.12.2 Torque

Mated specimens were prepared for torque test by marking cable so that any displacement relative to gland could be detected. Test panel was held flat on table and torque gauge was connected to loose cable end. Torsion force of 21 ounce-inch was applied and held for 1 minute. The torque was returned to zero. During test, the mated specimen was examined for any torsion relative to the gland.

3.13 Strain Relief

Testing was conducted in accordance with UL 3730 First Edition dated March 27, 2017, Section 25. Test panel was protected with a silicon mat and was lightly clamped in a vise with loose cable end facing down. A straight cable pull was initiated by slowly applying a 20-pound load to loose cable of mated specimen. The load was held for 1 minute and removed.

3.14 Cold Impact (UL)

Testing was conducted in accordance with UL 3730 First Edition dated March 27, 2017, Section 28. Cold impact was performed at room ambient temperature after the mated specimen had been subjected to 0°C for 3 hours. Specimen was mounted in a manner representative of its intended use, and was subjected to a 5 foot-pound (6.78 joules) impact normal to the surface resulting from a 2 inch (51 millimeter) diameter smooth steel sphere weighing 1.18 pounds falling a distance of 51 inches.

3.15 Vibration (Sinusoidal)

Mated specimens were subjected to a sinusoidal vibration test in accordance with IEC 60512-6-4 First Edition dated 2002-02, Test 6d. The parameters of this test condition are a simple harmonic motion having an amplitude of 0.7 mm double amplitude (maximum total excursion) between 10Hz and 60 Hz, and with an acceleration of 5 gravity units (g's peak) between 60Hz and 500 Hz. The vibration frequency was varied logarithmically between the approximate limits of 10 to 500 Hertz (Hz). The entire frequency range of 10 to 500 Hz and return to 10 Hz was traversed at 1 octave per minute for 2.5 hours in all three mutually perpendicular axes so that the motion was applied for a total period of approximately 7.5 hours (Figures 2 through 4). Specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

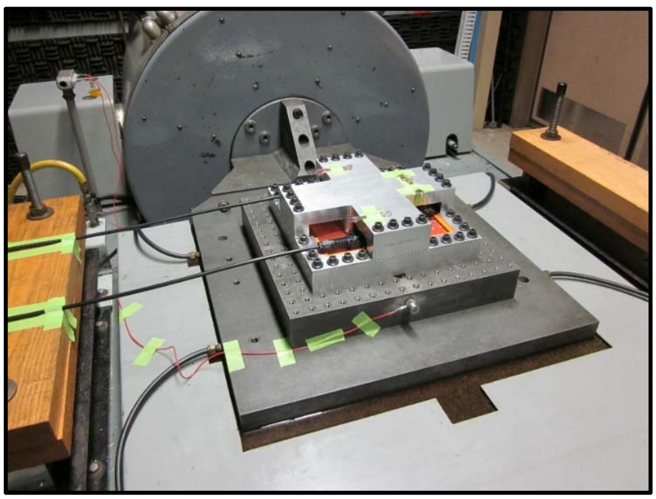

Figure 2 – Vibration Test Setup

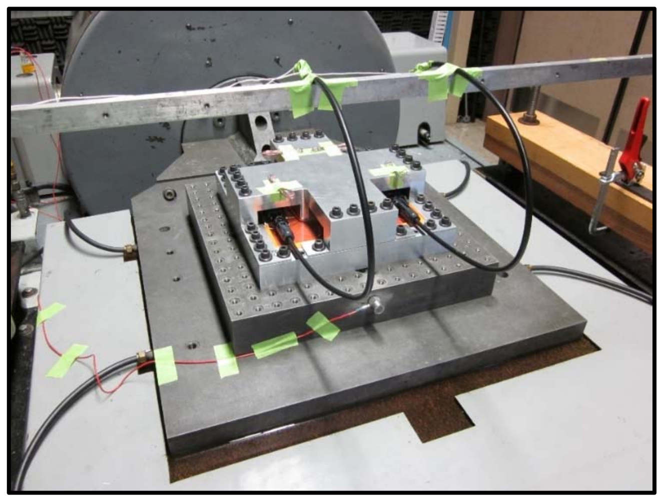

Figure 3 – Vibration Test Setup

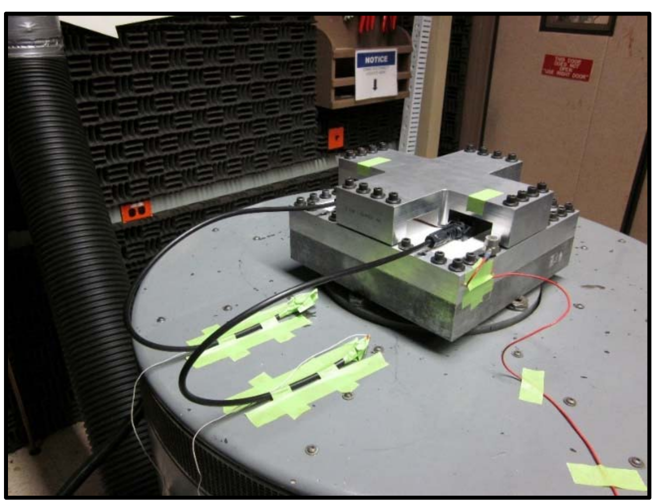

Figure 4 – Vibration Test Setup

3.16 Temperature Life

Testing was conducted in accordance with EIA 364-17C, Method A. Mated specimens in Group 5 were exposed to a temperature of 85°C for 240 hours. Mated specimens in Group 5a were exposed to a temperature of 115°C for 240 hours.

3.17 Thermal Cycle (50 Cycles)

Testing was conducted in accordance with IEC 62790 First Edition dated 2014-11, Section 5.3.9. Mated specimens were subjected to 50 cycles of thermal cycling, with each cycle consisting of a minimum of 10 minute dwells at -40 and 85°C. The transition between temperatures was at a maximum rate of 100°C per hour. Specimens were energized at 17.0 Amperes during test.

3.18 Thermal Cycle (200 Cycles)

Testing was conducted in accordance with IEC 62790 First Edition dated 2014-11, Section 5.3.9. Mated specimens were subjected to 200 cycles of thermal cycling with each cycle consisting of a minimum of 10 minute dwells at -40 and 85°C. The transition between temperatures was at a maximum rate of 100°C per hour. Specimens were energized at 17.0 Amperes during test.

3.19 Humidity Freeze

Testing was conducted in accordance with IEC 62790 Edition 1.0 dated 2014-11, Section 5.3.17. Mated specimens were placed in a humidity chamber for 10 cycles of humidity-freezing. Specimens were mounted in the chamber as to provide for free circulation of the surrounding air. Each cycle consisted of a transition in the test chamber from 25°C to 85°C, with a dwell at 85°C for 20 hours minimum. This was followed by a transition from 85°C to -40°C, with a dwell at -40°C for 30 minutes. Chamber humidity at 85°C was maintained at 85 ±2.5 %. During all temperature transitions, the chamber air was isolated from outside air to allow condensing water vapor to freeze in the module or panel. Specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.20 Damp Heat

Testing was conducted in accordance with IEC 60068-2-78 Edition 2.0 dated 2012-10. Mated specimens were exposed to 1000 hours of damp heat at 85°C and 85% relative humidity.

3.21 Salt Mist

Testing was conducted in accordance with IEC 60068-2-11 Third Edition dated 1981, Test Ka. Mated specimens were placed in the salt mist chamber on horizontal bars mounted on a rig which tilted the specimens at an angle similar to that of an actual field installation. The chamber was operated for a total of 14 days (336hrs). Upon completion of test, specimens were not rinsed, and were dried at room ambient conditions.

3.22 Rapid Change of Temperature

Testing was conducted in accordance with IEC 60512-11-4 First Edition dated 2002-02, Test 11d. Mated specimens were subjected to 100 cycles of thermal shock with each cycle consisting of 15 minute dwells at -40°C and 85°C. The transition between temperatures was less than one minute.