LUMAWISE* Endurance S Connector Platform Qualification Testing

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity LUMAWISE Endurance S Connector Platform to determine its conformance to the requirements of Product Specification 108-133073.

1.2 Scope

This report covers the electrical, mechanical and environmental performance of the LUMAWISE Endurance S Connector Platform. Testing was performed at the Harrisburg Electrical Components Test Laboratory between January 10, 2017 and March 25, 2020. Documentation for this testing is on file at HECTL under EA20170003T, EA2017063T, EA20170176T, EA20170199T, EA20170309T, EA20180532T, EA20190152T, EA20190189T and EA20200068T.

1.3 Conclusion

All specimens from all test groups met the electrical, mechanical and environmental performance requirements as specified in Product Specification 108-133073. See Section 2 of this report for detailed results.

1.4 Product Description

The TE Connectivity LUMAWISE Endurance S Connector Platform system is used for roadway and area lighting applications.

1.5 Test Specimens

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

Table 1 – Qualification Test Specimens

Test Group	Test Set	Quantity	Part Number	Description
A	1	4	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with 16 AWG Solid Wire
		4	2213831-1, Rev 3	80mm Module PCB Assembly, LUMAWISE Endurance S with 20 AWG Stranded Wire
	2	4	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S With 20 AWG Solid Wire
		4	2213831-1, Rev 3	80mm Module PCB Assembly, LUMAWISE Endurance S with 20 AWG Stranded Wire
B	3	4	2213858-1, Rev A	Receptacle Assembly with Four UL1007 Style Solid 20 AWG Wires
		4	2213831-2, Rev 7	80mm Module Base, with Four UL1007 Style Solid 20 AWG Wires
	4	4	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with UL1007-20 AWG, Solid Wire
		4	2213831-1, Rev 3	80mm Module PCB Assembly, LUMAWISE Endurance S with 20 AWG Stranded Wire
C	5	6	2213858-1, Rev A	Receptacle Assembly with Four UL1007 Style Solid 16 AWG Wires
		6	2213831-2, Rev 7	80mm Module Base, with Four UL1007 Style Solid 16 AWG Wires
D	6	5	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with Sealing Gasket 2213830-1, Rev 6
		5	2213795-1, Rev 11	Sealing Cap, LUMAWISE Endurance S
		5	AN-1304-A	Sealed Enclosure, Flat Lid
	7	5	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with Sealing Gasket 2213830-1, Rev 8
		5	2213795-1, Rev 11	Sealing Cap, LUMAWISE Endurance S
		5	AN-1304-A	Sealed Enclosure, Flat Lid
E	8	5	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with Sealing Gasket 2213830-1, Rev 8
		5	2213795-1, Rev 11	Sealing Cap, LUMAWISE Endurance S
F	9	10	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with UL1007-16 AWG, Solid Wire
	10	10	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with UL1007-18 AWG, Solid Wire
	11	10	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with UL1007-20 AWG, Solid Wire
	12	10	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with UL1007-18 AWG, Tin Dipped Stranded Wire
	13	10	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with UL1007-20 AWG, Tin Dipped Stranded Wire

Table 1 – Qualification Test Specimens (continued)

G	14	3	2213858-1, Rev A	Receptacle Assembly
		3	2213831-2, Rev 7	80mm Vented Module Base
		3	1-2328823-1, Rev A	80mm Short Dome
		3	2213858-1, Rev A	Receptacle Assembly
		3	2213831-2, Rev 7	80mm Vented Module Base
		3	1-2328823-3, Rev A	80mm Tall Dome
	15	3	2213858-1, Rev A	Receptacle Assembly
		3	2213831-2, Rev 7	80mm Vented Module Base
		3	1-2328823-1, Rev A	80mm Short Dome
		3	2213858-1, Rev A	Receptacle Assembly
		3	2213831-2, Rev 7	80mm Vented Module Base
		3	1-2328823-3, Rev A	80mm Tall Dome
	16	3	2213858-1, Rev A	Receptacle Assembly
		3	2213837-1, Rev 5	40mm Module Base
		3	1-2329013-1, Rev D	40mm Short Dome, Clear in Color
		3	2213858-1, Rev A	Receptacle Assembly
		3	2213837-1, Rev 5	40mm Module Base
		3	2329013-2, Rev D	40mm Tall Dome, Smoke Grey Color
	17	3	2213858-1, Rev A	Receptacle Assembly
		3	2213837-1, Rev 5	40mm Module Base
		3	1-2329013-1, Rev D	40mm Short Dome, Clear in Color
		3	2213858-1, Rev A	Receptacle Assembly
		3	2213837-1, Rev 5	40mm Module Base
		3	2329013-2, Rev D	40mm Tall Dome, Smoke Grey Color
H	18	5	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with Sealing Gasket 2213830-1, Rev 8
		5	2213837-1, Rev 3	40mm Module Assembly, SR- 20.2mm ID hole
		5	AN-1304-A	Flat Mounting Lid, Bud Industries Enclosure
J	19	5	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S] with Sealing Gasket 2213830-1, Rev 6
		5	2213795-1, Rev 11	Sealing Cap, LUMAWISE Endurance S
		5	AN-1304-A	Sealed Enclosure, Flat Lid
	20	5	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S] with Sealing Gasket 2213830-1, Rev 8
		5	2213795-1, Rev 11	Sealing Cap, LUMAWISE Endurance S
		5	AN-1304-A	Sealed Enclosure, Flat Lid
K	21	5	2213858-1, Rev 3	Receptacle Assembly, LUMAWISE Endurance S with Sealing Gasket 2213830-1, Rev 8
		5	2213837-1, Rev 3	40mm Module Assembly, SR- 20.2mm ID hole
		5	AN-1304-A	Flat Mounting Lid, Bud Industries Enclosure

1.6 Qualification Test Sequence

Table 2 - Test Sequence

Test or Examination	Test Sets						
	1 & 2	3 & 4	5	6	7	8	9 - 13
	Test Groups						
	A	B	C	D *(c)*		E	F
	Test Sequence *(a)*						
Initial Examination of Product	1	1	1	1	1	1	1
LLCR	2, 6	2,5,7	2,8				
Insulation Resistance			3,9				
Withstanding Voltage - Internal			4,10				
Temperature Rise vs Current		3					
Random Vibration	4						
Mechanical Shock	5						
Wire Retention Force							2
Durability	3						
Thermal Shock			6				
Humidity/Temperature Cycling		4*(b)*	7				
Temperature Life		6					
Temperature Life – IP				2	2		
Ingress Protection IP6X (Dust)				3			
Ingress Protection IPX5 (H2O)					3		
Ingress Protection IPX6 (H2O)					4		
Withstanding Voltage - External			5,11				
Salt Spray						2	
Final Examination of Product	7	8	12	4	5	3	3

Table 2 - Test Sequence (continued)

Test or Examination	Test Sets					
	14 &16	15 &17	18	19	20	21
	Test Groups					
	G *(c)*		H	J *(c)*		K
	Test Sequence *(a)*					
Initial Examination of Product	1	1	1	1	1	1
Impact	2	2				
Mating Torque			2			
Un-Mating Torque			3			
Humidity Freeze				2	2	
Ingress Protection IP6X (Dust)	3			3		
Ingress Protection IPX5 (H_2O)					3	
Ingress Protection IPX6 (H2O)		3			4	
Receptacle Mounting Torque Resistance						2
Final Examination of Product	4	4	4	4	5	3

NOTES

a) The numbers indicate sequence in which tests were performed.
b) Precondition with 2 durability cycles
c) Groups D, G and J: (5) specimens subjected to IP6X dust exposure and (5) specimens subjected to IPX5 and and/or IPX6 jet spray exposure

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 LLCR (Groups A, B and C)

All specimens had measurements that met the 25 mΩ maximum Delta R requirement specified in Product Specification 108-133073. See Tables 3, 4 and 5 for LLCR summaries for Groups A, B and C, respectively.

Table 3 – Group A LLCR Summary (mΩ)

	Initial	After Mechanical Shock
	Actual R	*Delta R*
	Test Set 1 - 16 AWG	
MIN	19.08	-0.23
MAX	19.71	0.46
AVG	19.37	0.1
STDEV	0.20	0.17
	Test Set 2 - 20 AWG	
MIN	22.32	-0.19
MAX	25.91	1.82
AVG	24.52	0.64
STDEV	1.27	0.68
DATA PTS	16	

Table 4 – Group B LLCR Summary (mΩ)

	Initial	After Temp/Hum	After Temp Life
	Actual R	*Delta R*	*Delta R*
	Test Set 3 - 20 AWG		
MIN	9.449	0.016	0.496
MAX	9.882	1.875	15.387
AVG	9.665	0.652	6.203
STDEV	0.121	0.457	5.153
	Test Set 4 - 20 AWG		
MIN	21.16	-3.36	-1.82
MAX	25.43	1.84	6.96
AVG	24.23	-0.08	1.54
STDEV	1.32	1.35	2.28
DATA PTS	16		

Table 5 – Group C LLCR Summary (mΩ)

	Initial	After Temp/Hum
	Actual R	*Delta R*
	Test Set 5 - 16 AWG	
MIN	6.711	-0.403
MAX	7.732	13.770
AVG	7.023	2.714
STDEV	0.361	2.851
DATA PTS	24	

2.3 Insulation Resistance (Group C)

All specimens met the initial 100 megaohm and final 10 megaohm minimum requirements specified in Product Specification 108-133073.

2.4 Withstanding Voltage – Internal (Group C)

With a 1600 volt AC potential applied between adjacent contacts of mated specimens for one minute, none of the specimens exhibited breakdown, flashover or exceeded 5 milliamperes leakage current.

2.5 Temperature Rise vs. Current (Group B)

All 16 AWG and 20 AWG specimens met the maximum 30°C temperature rise requirement when energized with the specified 5.0 amperes.

2.6 Random Vibration (Group A)

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

2.7 Mechanical Shock (Group A)

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

2.8 Wire Retention Force (Group F)

All specimens from all test sets met the minimum requirements specified in Product Specification 108-133073. See Table 6 for a wire retention force summary.

Table 6 – Group F Wire Retention Summary (N)

	Test Set 9 16 AWG Solid Wire	Test Set 10 18 AWG Solid Wire	Test Set 12 18 AWG Tin Dipped Stranded Wire	Test Set 11 20 AWG Solid Wire	Test Set 13 20 AWG Tin Dipped Stranded Wire
MIN	28.24	21.87	16.17	13.24	15.37
MAX	67.44	36.22	72.66	32.03	55.96
AVG	40.69	28.04	33.34	18.51	30.48
STDEV	9.47	3.79	11.99	3.38	10.80
REQ.	**25 N**	**20 N**	**15 N**	**13 N**	
DATA PTS	40				

2.9 Impact (Group G)

No physical damage detrimental to product performance was visible due to impact testing.

2.10 Connector Mating Torque (Group H)

All specimens met the 4.0 N-m maximum requirement specified in Product Specification 108-133073. See Table 7 for all mating torque force data.

2.11 Connector Un-Mating Torque (Group H)

All specimens met the 4.0 N-m maximum requirement specified in Product Specification 108-133073. See Table 7 for all un-mating torque force data.

Table 7 – Mating and Un-Mating Torque Force (N-m)

	Mating Torque	Unmating Torque
MIN	2.81	2.30
MAX	3.86	2.57
AVG	3.11	2.44
STDEV	0.43	0.12
REQ.	**4.0 N-m**	
DATA PTS	5	

2.12 Receptacle Mounting Torque Resistance (Group K)

All specimens met the maximum 30° rotation requirement, relative to the original mounting location with an applied torque of 5.0 N-m, as specified in Product Specification 108-133073. See Table 8 for all rotation measurement data.

Table 8 – Rotation Measurement Data (Degrees)

	Rotation Degrees	Applied Torque Nm
MIN	2.85	5.01
MAX	3.85	5.12
AVG	3.34	5.07
STDEV	0.42	0.05
REQ.	**30°**	**5.0 N-m**
DATA PTS	5	

2.13 Humidity Freeze (Group J)

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

2.14 Durability (Group A)

No evidence of physical damage detrimental to product performance was observed as a result of the specimens being mated and un-mated 10 times.

2.15 Thermal Shock (Groups B and C)

None of the specimens showed any signs of physical damage detrimental to product performance after being subjected to thermal shock.

2.16 Humidity/Temperature Cycling (Groups B and C)

None of the specimens showed any signs of physical damage detrimental to product performance after being subjected to humidity/temperature cycling.

2.17 Temperature Life (Group B)

None of the specimens showed any signs of physical damage detrimental to product performance after being subjected to temperature life.

2.18 Temperature Life – IP (Group D)

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

2.19 Ingress Protection IP65 (Groups D and J)

No evidence of dust ingress was visible due to exposure to IP6X testing. None of the specimens exhibited ingress of water due to exposure to IPX5 testing.

2.20 Ingress Protection IP66 (Groups D, G and J)

No evidence of dust ingress was visible due to exposure to IP6X testing. None of the specimens exhibited ingress of water due to exposure to IPX6 testing.

2.21 Withstanding Voltage – External (Group C)

With a 10,000 volt AC potential applied between all contacts and the receptacle mounting plate of mated specimens for one minute, none of the specimens exhibited breakdown, flashover or exceeded 5 milliamperes leakage current.

2.22 Salt Spray (Group E)

None of the specimens showed any signs of salt spray ingress within any sealed area of the connector.

2.23 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. Initial Examination of Product (All Groups)

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.

3.2 LLCR (Groups A, B and C)

The specimens were measured using a four terminal measurement method at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage. An unknown amount of wire bulk resistance was included in the measurements. See Figure 1 for an image of the measurement setup and probe locations. All testing was conducted in accordance with EIA-364-23C with the exception that the measurement points were at the ends of the terminated conductors.

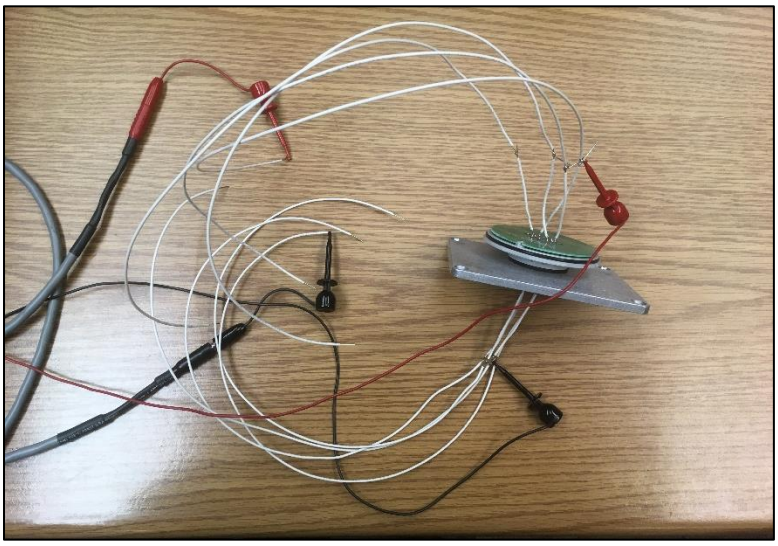

Figure 1 – Low Level Contact Resistance Test Setup

3.3 Insulation Resistance (Group C)

A test potential of 500 volts DC was applied between adjacent contacts of mated specimens for a period of 2 minutes prior to taking measurements. Testing was conducted in accordance with EIA-364-21E. See Figure 2 for test setup.

3.4 Withstanding Voltage – Internal (Group C)

The specimens were subjected to an internal withstanding voltage in accordance with Test Procedure EIA 364-20F and the test request. See Figure 2 for a representative image of the test setup. Test leads were connected to adjacent contacts on mated specimens with the test voltage increased from zero to 1600 VAC at a rate of 1600 volts per second. The 1600 VAC was held for one minute and the maximum leakage current recorded as well as any occurrence of breakdown or flashover.

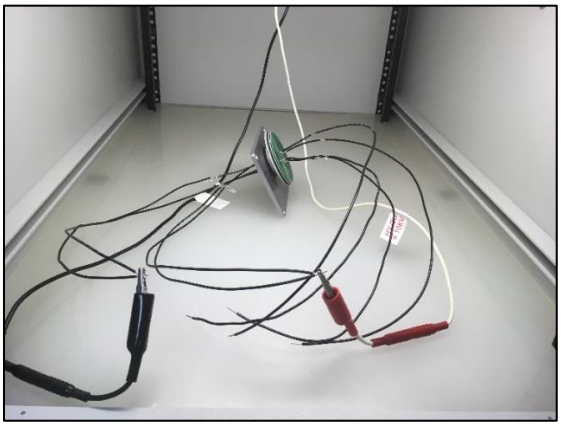

Figure 2 – Typical Insulation Resistance and Withstanding Voltage – Internal Setup

3.5 Temperature Rise vs. Current (Group B)

The specimens were subjected to a temperature rise vs current test in accordance with Test Procedure EIA 364-70C and the test request. See Figure 3 for a representative image of the test setup.

The infrared temperature measurement point, i.e. front of contact, was painted with TESTORS flat black paint, used as an emissivity correction coating. The emissivity correction coating has a known value which is 0.95. Raising and knowing the emittance value allows for accurate temperature measurements. The infrared camera was used with the 50 mm lens to image the test specimens.

ExaminIR thermal imaging processing system was used for data analysis. The area tool software feature was used to determine maximum temperature of the exposed housing. The area tool software feature allows a shape, which can be sized, to be placed on an area of interest. The pixels inside the shape are analyzed giving minimum, maximum, average, and standard deviation measurements of the target temperature.

Mated test specimens were connected in series and placed in the temperature rise enclosure. Measurements were taken after temperature stabilization at 5.0 Amps DC. The ambient temperature was subtracted from the measured temperature to obtain the temperature rise.

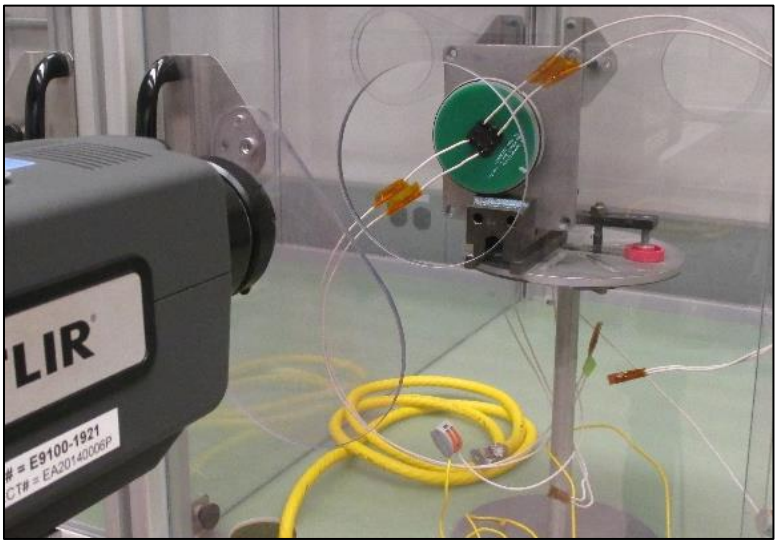

Figure 3 – Typical Temperature Rise vs. Current Test Setup

3.6 Random Vibration (Group A)

The parameters of this test condition are specified by a random vibration spectrum with excitation frequency bounds of 20 and 500 Hertz (Hz). The spectrum remains flat at 0.05 G^2/Hz from 20 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 4.9 GRMS. The test specimens were subjected to this test for 90 minutes in each of the three mutually perpendicular axes, for a total test time of 270 minutes per test specimen. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes. Testing was conducted in accordance with EIA 364-28F, Condition VII, Letter E. See Figure 4 for the vibration setup.

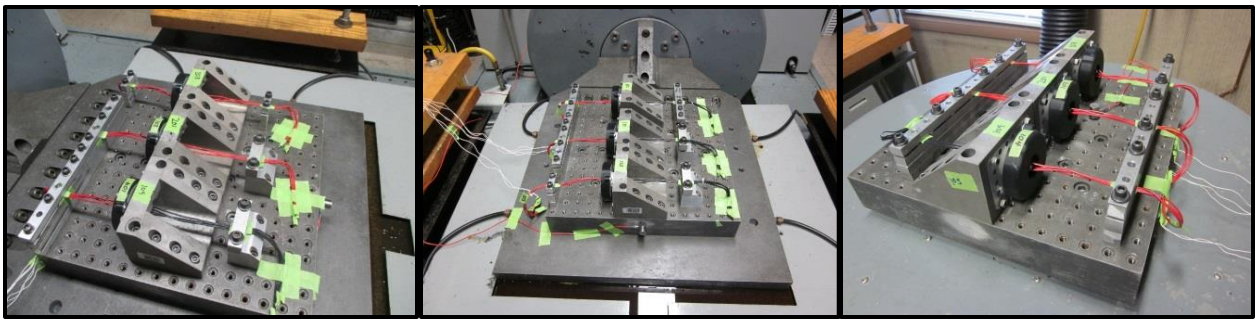

Figure 4 – Vibration Test Setup – X, Y and Z Axis

3.7 Mechanical Shock (Group A)

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. Testing was conducted in accordance with EIA 364-27C, Condition H. See Figure 5 for the mechanical shock setup.

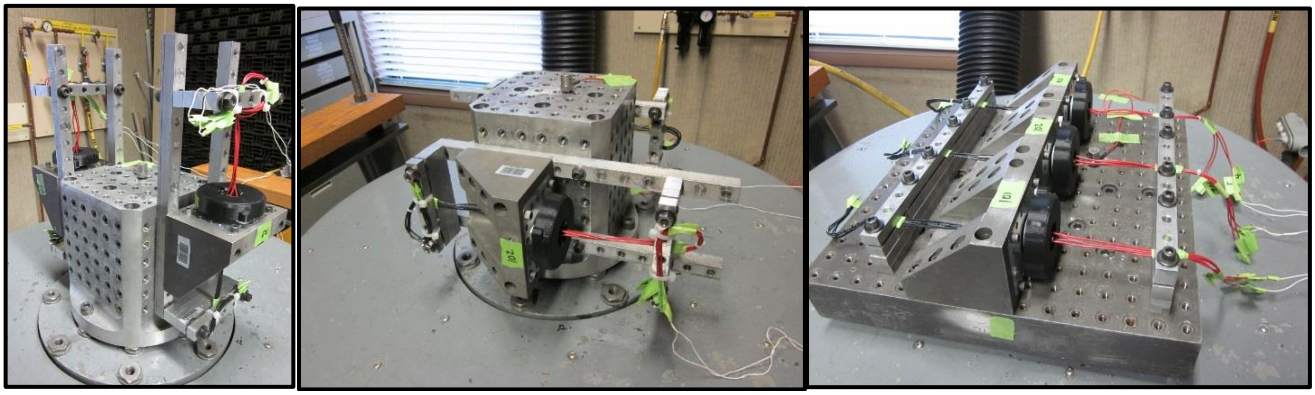

Figure 5 – Mechanical Shock Test Setup– X, Y and Z Axis

3.8 Wire Retention Force (Group F)

Prior to testing all 4 circuits of the receptacle, connectors were loaded with UL1007 solid or tin-dipped, stranded wire provided by the test requestor. The wire was held in a pneumatic jaw that was attached to the load cell and crosshead of the tensile/compression machine. The receptacle connectors were held in a slotted plate fixture that was secured to a free-floating X/Y and rotational table. The floating table was attached to the base of the tensile/compression machine. The crosshead was moved in an upward direction at a maximum rate of 12.7 mm per minute until the wire was completely removed from the receptacle connector. Maximum force prior to complete removal of the wire was picked as the wire retention force. All testing was conducted in accordance with EIA-364-8C with the exception that the forces required to remove the wires from the poke-in contacts were measured instead of crimp tensile force. See Figure 6 for an image of the test setup.

Figure 6 – Wire Retention Force Setup

3.9 Impact (Group G)

A sealing cap was secured on the receptacle supplied mounted to a BUD Industries AN-1304 enclosure. A requester supplied support fixture (Figure 7) was placed inside the enclosure to prevent the enclosure from collapsing during impact. Five 10J impacts were applied to each specimen by dropping a 5 kg mass (Figure 8) a distance of 200 mm. Refer to Figure 9 for an image of the test setup. Testing was performed in accordance with IEC 62262, First Edition, dated 2002-02.

Figure 7 – Support Fixture

Figure 8 – 5 kg Mass

Figure 9 – Typical Impact Test Setup

3.10 Connector Mating Torque (Group H)

The receptacle was supplied mounted to a BUD Industries AN-1304 enclosure. The enclosure was clamped to a plate attached to a torque load cell. The torque load cell was clamped to the base of the tensile/compression machine. A customer supplied fixture was attached to a rotational table used to apply the torque to the specimens. The rotational table was attached to the moveable crosshead of the tensile/compression machine. A module assembly was placed onto the receptacle and aligned with the fixture. The crosshead was then lowered at a rate of 0.5 in/min until a compression force of 55.6 N was achieved. The module assembly was then rotated and mated in a clockwise direction in reference to the receptacle and the peak torque force was recorded. Following the mating torque testing the crosshead of the tensile/compression machine was not moved and the specimens were rotated and unmated in the counter clockwise direction with the peak torque force value recorded. Testing was performed in accordance with EIA-364-13E. Refer to Figure 10 for images of the typical test setup.

3.11 Connector Unmating Torque (Group H)

The testing method was identical to the mating force torque method with the exception that the specimens were rotated and unmated in the counter clockwise direction with the peak torque force value recorded. Refer to Figure 10 for images of the typical test setup.

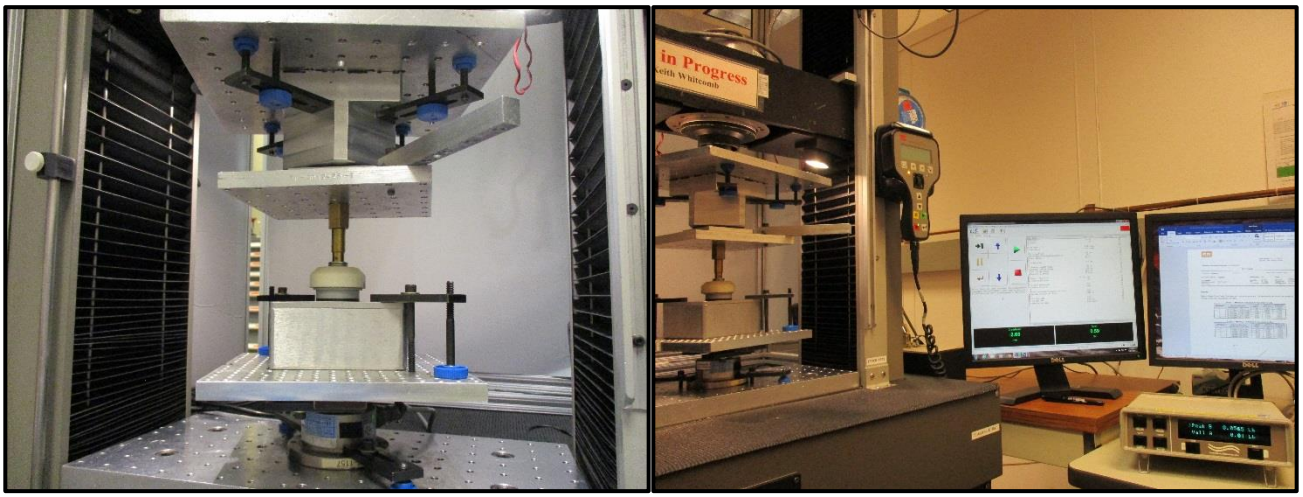

Figure 10 – Typical Mating and Un-Mating Torque Force Setu

3.12 Receptacle Mounting Torque Resistance (Group K)

The receptacle was supplied mounted to a BUD Industries AN-1304 enclosure. The enclosure was clamped to a plate attached to a torque load cell. The torque load cell was clamped to the base of the tensile/compression machine. A customer supplied fixture was attached to a rotational table used to torque the specimens. The rotational table was attached to the moveable crosshead of the tensile/compression machine. A sealing cap was placed onto the receptacle and aligned with the fixture. The crosshead was then lowered at a rate of 0.5 in/min until a compression force of 55.6 N was achieved. The sealing cap was then rotated and mated in a clockwise direction until a peak torque force of 5 N-m was achieved. The receptacle specimens and mounting plates were then inspected and measured for movement from the original mounting location with a smartscope. Prior to testing, reference lines were applied to the sealing cap and mounting plate of each specimen and the difference between the two reference lines after applying the 5 N-m torque force was measured and recorded in degrees. Testing was performed in accordance with EIA-364-13E. Refer to Figure 11 for images of the typical test setup. Refer to Figure 12 for a typical photo showing the reference lines applied to the sealing cap and mounting plate.

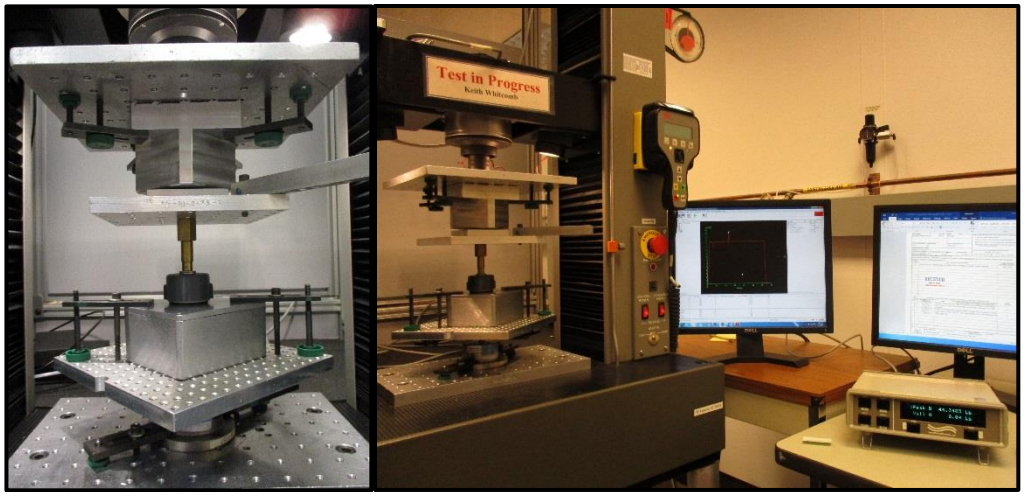

Figure 11 – Typical Receptacle Mounting Torque Test Setup

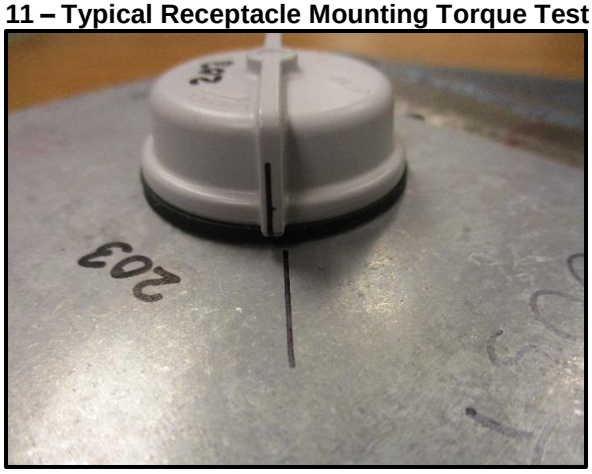

Figure 12 – Typical Specimen Sealing Cap and Mounting Plate Reference Lines

3.13 Humidity Freeze (Group J)

Receptacle specimens with sealing caps installed and mounted to a flat plate were subjected to 10 cycles between -40°C and 90°C at 85% relative humidity. Refer to Figure 13 for an illustration of the chamber profile. Testing was performed in accordance with IEC 61215, Second Edition, dated 2005-04.

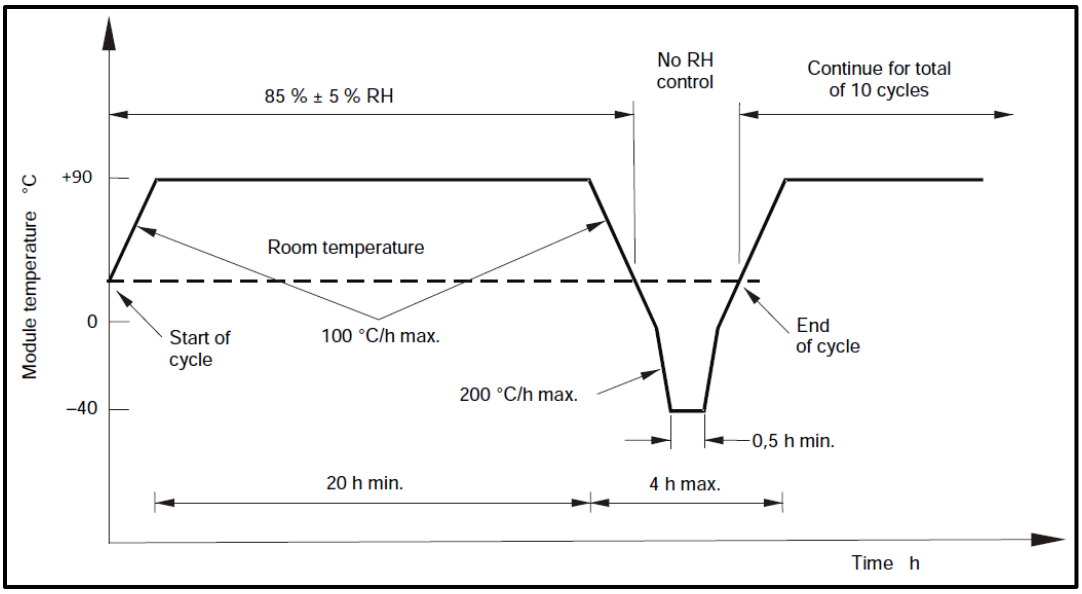

Figure 13 – Typical Humidity Freeze Chamber Profile

3.14 Durability (Group A)

The specimens were manually mated and unmated for 10 cycles at a maximum rate of 360 cycles per hour as specified in Product Specification 108-133073. All testing was conducted in accordance with EIA-364- 9C.

3.15 Thermal Shock (Groups B and C)

The mated specimens were subjected to 150 cycles between -40 and 90°C with 30-minute dwells at temperature extremes and 1-minute transition between temperatures. Testing was conducted in accordance with EIA-364-32G.

3.16 Humidity/Temperature Cycling (Groups B and C)

The specimens were subjected to humidity / temperature cycling in accordance with Test Procedure EIA 364-31F and the test request. Specimens were subjected to 10 cycles (24-hours per cycle) between 25°C and 65°C at 80 to 100%RH.

3.17 Temperature Life (Group B)

The specimens were subjected to temperature life in accordance with Test Procedure EIA 364-17C, Method A and the test request. Mated specimens were exposed to a temperature of 100°C for 500 hours.

3.18 Temperature Life – IP (Group D)

Receptacle specimens with sealing caps installed and mounted to a flat plate were subjected to 90°C for a duration of 240 hours. Testing was performed in accordance with EIA-364-17C, Method A.

3.19 Ingress Protection IP65 (Groups D and J)

Specimens were subjected to IP-6X testing in accordance with test specification IEC-60529 Edition 2.2, 2013-08. A sealing cap was secured on the receptacle that was supplied mounted to a BUD Industries AN-1304 enclosure. A hole was drilled in each enclosure and a 1/8" OD tube was inserted and sealed with a silicone sealant. The tubing was connected to a vacuum manifold. A vacuum was applied through the tubing not exceeding 2 KPa. The amount of talcum powder used was 2 kg per cubic meter of the test chamber volume. The dust chamber was designed to maintain the talcum powder in suspension during the exposure. Specimens were exposed for a period of 8 hours. Refer to Figure 14 for an image of the typical test setup.

Specimens were subjected to IPX5 testing in accordance with test specification IEC-60529 Edition 2.2, 2013-08. A sealing cap was secured on the receptacle that was supplied mounted to a BUD Industries AN-1304 enclosure. Each specimen was tested independently by placing it in an enclosure and spraying it with water. The size of the nozzle was 6.3mm and the delivery rate was 12.5 liters/minute ±5%. The distance from the nozzle to the test specimen was 2.5-3.0 meters. The water spray was applied to the enclosure from all practicable directions for a period of 3 minutes. Upon completion, the outside of each specimen was dried using paper towels. The sealing cap was then removed and inspected for water intrusion. The box was then opened and inspected for any evidence of water intrusion. Refer to Figure 15 for an image of the typical test setup.

Figure 14 – Typical IP6X Test Setup

Figure 15 – Typical Ingress Protection IPX5 and IPX6Test Setup

3.20 Ingress Protection IP66 (Groups D, G and J)

The dust testing portion was conducted identical to the method described in paragraph 3.19. See Figure 14. The water jet spray testing portion was conducted identical to the method described in paragraph 3.19 with the exception that the size of the nozzle was 12.5 mm and the delivery rate was 100 liters/minute ±5%. See Figure 15.

3.21 Withstanding Voltage – External (Group C)

The specimens were subjected to an external withstanding voltage in accordance with Test Procedure EIA 364-20F and the test request. See Figure 16 for a representative image of the test setup.

Test leads were connected to the contacts and the receptacle mounting plate of mated specimens with the test voltage increased from zero to 10,000 VAC at a rate of 10,000 volts per second. The 10,000 VAC was held for one minute and the maximum leakage current recorded as well as any occurrence of breakdown or flashover.

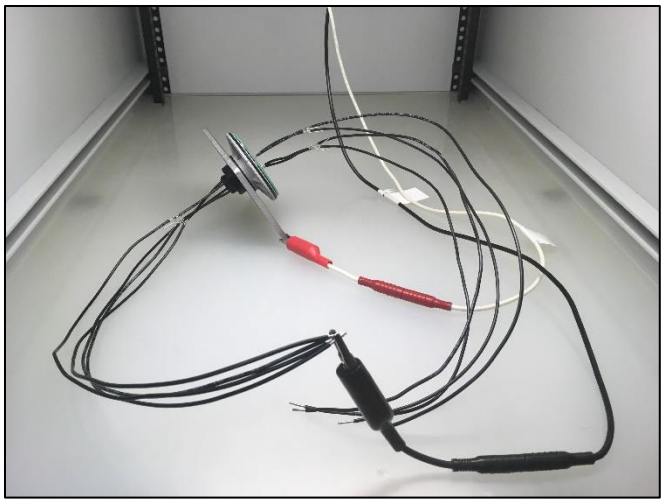

Figure 16 – Typical Withstanding Voltage – External Setup

3.22 Salt Spray (Group E)

The specimens were placed in the chamber on horizontal racks with the caps facing upwards. The chamber was operated for a total of 240 hrs. Upon completion of the test the specimens were dried (as removed/no rinsing) at room ambient conditions. The specimens were lightly brushed with a toothbrush in order to remove excess salt deposits on the outside of the enclosure box. Testing was conducted in accordance with IEC 60512-11-6, First Edition 2002-02. The chamber operating parameters were as follows:

Salt Fog Chamber Operating Parameters:

- Chamber Temperature: 35°C.
- Aeration Tower temperature: 48°C.
- 5% Brine Solution Purity: Sodium Chloride with no more than .3% impurities.
- Aeration Tower Pressure: 15 PSI.
- Brine Solution pH Range: 6.5 to 7.2.
- Specific Gravity Range: 1.031 to 1.037.
- Collection rate: .5 to 3ml per hour.

3.23 Final Examination of Product (All Groups)

The specimens were visually examined without magnification for physical damage or defects that would affect product performance. The examination was conducted per EIA-364-18B.