LUMAWISE* Endurance N+ Base & Shorting Cap Assembly Qualification Testing

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1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity LUMAWISE Endurance N+ Base and Shorting Cap Assembly to determine their conformance to the requirements of TE Product Specification 108-32606 Rev. A.

1.2 Scope

This report covers the product performance of the TE Connectivity LUMAWISE Endurance N+ Base and Shorting Cap Assembly. Testing was performed at the Harrisburg Electrical Components Test Laboratory (HECTL) between June 16, 2021 and June 10, 2022. Documentation is on file and maintained at HECTL under EA20210215T, EA20210528T and EA20220174T.

1.3 Conclusion

The TE Connectivity LUMAWISE Endurance N+ Base and Shorting Cap Assembly specimens listed in paragraph 1.4 conformed to the performance requirements of Product Specification 108-32606 Rev A, Refer to Section 2 for detailed test results.

1.4 Product Description

TE Connectivity LUMAWISE Endurance N+ Bases create a platform for rapid development and manufacture of NEMA/ANSI street and outdoor lighting control solutions. These bases provide AC power switching and DC power supplies necessary for complex control node solutions. These performance features allow designers more time to focus on other features. TE Connectivity LUMAWISE Endurance N+ Bases offer organized DC power and signaling interfaces to the designer. These bases incorporate a mechanical architecture that supports design reuse and modularity across lighting control products.

1.5 Test Specimens

Specimens identified with the following part numbers were used for this test program (Refer to Table 1).

Table 1 – Specimen Identification

Test Group	Test Set	Qty	Part Number	Description
A	1	6	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE* Endurance N With Integrated Gasket
		6	2359482-2 Rev 6	Base Assembly (2359615-x), Light Controller, LUMAWISE Endurance N Gen 2 with Photocell Cover
B	2	6	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N With Integrated Gasket
		6	2359482-2 Rev 6	Base Assembly (2359615-x), Light Controller, LUMAWISE Endurance N Gen 2 with Photocell Cover

Table 1 - Specimen Identification - continued

Group	Test Set	Qty	Part Number	Description
C	3	3	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N With Integrated Gasket
		3	2359482-2 Rev 6	Base Assembly (2359615-x), Light Controller, LUMAWISE Endurance N Gen 2 with Photocell Cover
	4	3	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N With Integrated Gasket
		3	2361116-1 Rev A	Assembly, Shorting Cap LUMAWISE Endurance N+
D	5	3	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N With Integrated Gasket
		3	2361116-1 Rev A	Assembly, Shorting Cap LUMAWISE Endurance N+
	6	3	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N with Integrated Gasket
		3	2359482-1 Rev 6	Base Assembly (2359615-x), LUMAWISE Endurance N+ with light controller Cover
E	7	5	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N With Integrated Gasket
		5	2361116-1 Rev A	Assembly, Shorting Cap LUMAWISE Endurance N+
F	8	3	2359482-2 Rev 6	Base Assembly Light Controller, LUMAWISE Endurance N Gen 2
G1	9	3	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N With Integrated Gasket
		3	2359482-2 Rev 6	Base Assembly (2359615-x), Light Controller, LUMAWISE Endurance N Gen 2 with Photocell Cover
		5	2361116-1 Rev A	Assembly, Shorting Cap LUMAWISE Endurance N+
		3	2213362-2 Rev B	Receptacle Assembly, Dimmable Photocontrol
G2	10	3	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N with Integrated Gasket
		3	2359482-2 Rev 6	Base Assembly (2359615-x), Light Controller, LUMAWISE Endurance N Gen 2 with Photocell Cover
		5	2361116-1 Rev A	Endurance N+ Shorting Cap Assembly (Black Cover)
		3	2213362-2 Rev B	Receptacle Assembly, Dimmable Photocontrol
H	11	3	2361116-1 Rev. 4	Endurance N+ Shorting Cap Assembly (Black Cover)
		3	2213362-2 Rev. A27	Receptacle Assembly, Dimmable Photocontrol
	12	3	2376865-2 Rev A6	Receptacle Assembly, LUMAWISE Endurance N with Integrated Gasket
		3	2359482-2 Rev 6	Base Assembly, Light Controller, LUMAWISE Endurance N Gen 2
		3	2359615-6 Rev A	Tall Cover, LUMAWISE Endurance N+
	13	3	2376865-2 Rev A6	Receptacle Assembly, LUMAWISE Endurance N with Integrated Gasket
		3	2359482-2 Rev 6	Base Assembly, Light Controller, LUMAWISE Endurance N Gen 2
		3	2359615-5 Rev A	Short Cover, LUMAWISE Endurance N+

Table 1 - Specimen Identification - continued

Group	TestSet	Qty	Part Number	Description
J1	14	3	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N with Integrated Gasket
		3	2359482-2 Rev 6	Base Assembly (2359615-x), Light Controller, LUMAWISE Endurance N Gen 2 with Photocell Cover
J2	15	3	2376865-2 Rev 11	Receptacle Assembly, LUMAWISE Endurance N with Integrated Gasket
		3	2359482-2 Rev 6	Base Assembly (2359615-x), Light Controller, LUMAWISE Endurance N Gen 2 with Photocell Cover
		3	2361116-1 Rev A	Endurance N+ Shorting Cap Assembly (Black Cover)
		3	2213362-2 Rev B	Receptacle Assembly, Dimmable Photocontrol

1.6 Test Sequence

The specimens listed in paragraph 1.4 were subjected to the test sequences outlined below in Table 2.

Table 2 – Test Sequence

Test or Examination	Test Groups										
	A	B	C	D	E	F	G1	G2	H	J1	J2
	Test Set										
	1	2	3,4	5,6	7	8	9	10	11,12,13	14	15
	Test Sequence (a)										
Initial Examination of Product	1	1	1	1	1	1	1	1	1	1	1
Low Level Contact Resistance	2,6	2,5, 7,9		2,4							
Insulation Resistance			2,7								
Dielectric Withstanding Voltage			3,6								
Current Cycling					2(b)						
Temperature Rise vs Current		3,10									
Power Contact Retention in Housing Base						2					
Vibration	4	8(c)									
Mechanical Shock	5										
Durability	3										
Salt Spray				3							
Thermal Shock			4								
Humidity		4(b)	5								
Impact									2		2
Humidity Freeze											
Temperature Life		6								2	
Temperature Life – IP							2	2			
Ingress Protection 6X (Dust)								3			3
Ingress Protection X6 (Water Spray)							3		3	3	
Final Examination of Product	7	11	8	5	3	3	4	4	4	4	4

(a) Numbers indicate the sequence in which tests are performed.
(b) Preconditioned with 5 durability cycles
(c) The mated receptacle and shorting cap were energized to an 18°C temperature rise.

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 Test Groups

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

2.2 Low Level Contact Resistance – Test Groups A, B, D

Refer to Tables 3 through 6 for summaries of the Low Level Contact Resistance data. All recorded readings were below the requirement of a delta R (ΔR) of 30 milliohms maximum.

Table 3 – Low Level Contact Resistance Test Results in Milli-Ohms for Test Set 1

Test Group A	Power Contacts		Test Group A	Signal Contacts	
	Initial	After Vibration – Final (ΔR)		Initial	After Vibration – Final (ΔR)
Minimum	4.30	-2.52	Minimum	14.27	-4.11
Maximum	7.36	0.99	Maximum	18.84	2.49
Average	5.09	-0.09	Average	16.16	-0.72

Table 4 – Low Level Contact Resistance Test Results in Milli-Ohms for Test Set 2

Test Group B	Power Contacts				Test Group B	Signal Contacts			
	Initial	After Humidity (ΔR)	After Temp Life (ΔR)	After Vibration – Final (ΔR)		Initial	After Humidity (ΔR)	After Temp Life (ΔR)	After Vibration – Final (ΔR)
Minimum	2.02	2.03	0.78	1.71	Minimum	8.42	4.17	2.45	1.04
Maximum	3.01	7.19	5.73	7.03	Maximum	11.42	23.66	13.89	17.19
Average	2.24	2.89	2.82	3.05	Average	9.18	8.41	7.44	7.12

Table 5 – Low Level Contact Resistance Test Results in Milli-Ohms for Test Set 5

Test Group D	Initial	After Salt Spray – Final (ΔR)
Minimum	4.30	-1.26
Maximum	4.36	-0.09
Average	4.32	-0.78

Table 6 – Low Level Contact Resistance Test Results Data in Milli-Ohms for Test Set 6

Test Group D	Initial	After Salt Spray
Power Contact		
Minimum	7.840	-0.912
Maximum	8.123	2.377
Average	8.024	0.682
Signal Contact		
Minimum	26.051	-1.611
Maximum	26.530	0.507
Average	26.360	-0.270

2.3 Insulation Resistance – Test Group C

All positions on all specimens for both test sets had minimum Insulation Resistances greater than 100 Giga-Ohms, meeting the 500 Mega-Ohm minimum requirement listed in the product specification.

2.4 Dielectric Withstanding Voltage – Test Group C

There were no specimens with breakdown or flashover after subjecting specimens to 2500 VAC for 1 minute, meeting the requirements listed in the product specification.

2.5 Current Cycling – Test Group E

During the 20-hour “On” cycle, specimens had a maximum temperature rise of 13.87 °C at 15 Amps, meeting the 30 °C maximum temperature rise requirement listed in the product specification.

2.6 Temperature Rise Vs. Current – Test Group B

Specimens had a maximum initial temperature rise of 11.26 °C at 15 Amps, meeting the 30 °C maximum temperature rise requirement listed in the product specification. Only Power contacts were energized. See Table 7 for detailed test results.

Table 7 – Temperature Rise vs Current Test Results in °C

Test Group B	Initial	After Vibration – Final
Minimum	8.81	10.16
Maximum	11.26	22.03
Average	10.35	13.55

2.7 Contact Retention Housing – Test Group F

Refer to Table 8 for Power Contact Retention data in Newtons. All specimens exceeded the minimum requirement of 60 N per Product Specification.

Table 8 – Contact Retention Results in Newtons

Test Group F	Contact Retention Force
Minimum	493.01
Maximum	610.31
Average	544.77

2.8 Vibration – Test Group A, B

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

2.9 Mechanical Shock – Test Group A

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

2.10 Durability – Test Group A

After 25 cycles of durability, there were no indications of cracking, breaking or other damage which would interfere with the performance requirements of the subsequent tests on the specimens.

2.11 Salt Spray – Test Group D

After salt spray, there were no indications of cracking, breaking or other damage which would interfere with the performance requirements of the subsequent tests on the specimens.

2.12 Thermal Shock – Test Group C

After exposure to thermal shock, there were no indications of cracking, breaking or other damage which would interfere with the performance requirements of the subsequent tests on the specimens.

2.13 Humidity – Test Group B, C

After exposure to humidity, there were no indications of cracking, breaking or other damage which would interfere with the performance requirements of the subsequent tests on the specimens.

2.14 Impact – Test Group H

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

2.15 Humidity Freeze – Test Group J1, J2

No physical damage detrimental to product performance was visible due to a humidity freeze exposure.

2.16 Temperature Life – Test Group B

After exposure to temperature life, there were no indications of cracking, breaking or other damage which would interfere with the performance requirements of the subsequent tests on the specimens.

2.17 Temperature Life - IP – Test Groups G1, G2

After exposure to temperature life – IP, there were no indications of cracking, breaking or other damage which would interfere with the performance requirements of the subsequent tests on the specimens.

2.18 Ingress Protection 6X (Dust) – Test Group G2, J2

No dust ingress was observed in any specimens tested.

2.19 Ingress Protection X6 (Water Spray) – Test Group G1, H, J1

No ingress of water was observed in any specimen tested.

2.20 Final Examination of Product – All Test 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

Specimens were visually examined with an unaided eye. Testing was performed in accordance with EIA-364-18B.

3.2 Low Level Contact Resistance

Low level contact resistance measurements at low level current were made using a four terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open

circuit voltage. Current and voltage was applied to each bulk wire pair as specified in 108-32606. Testing was conducted in accordance with EIA-364-23C.

3.3 Insulation Resistance

Specimens were subjected to an insulation resistance test with a dielectric analyzer in accordance with EIA 364-21F and the product specification.

Unmated receptacles were subjected to 500VDC for two minutes between adjacent power contacts; between power and signal contacts; and between all contacts and grounded mounting plate. The insulation resistance was measured and recorded at the end of the two minute application.

3.4 Dielectric Withstanding Voltage

Specimens were subjected to a dielectric withstanding voltage test with a dielectric analyzer in accordance with UL 773, Section 32 and the product specification. Unmated receptacles were subjected to 2500VAC for one minute between adjacent power contacts; between power and signal contacts; and between all contacts and grounded mounting plate. Leakage current and any breakdown or flashover occurring were recorded.

3.5 Current Cycling

Specimens were subjected to a temperature rise test in accordance with ANSI C136.10-2017 Section 11.1 and the product specification. The specimens were preconditioned with 5 cycles of durability before testing.

The specimens were suspended in an air-flow free enclosure. The Line and Load circuits were then wired in series to a power supply. The thermocouples were then connected to a data acquisition station to monitor temperature. A thermocouple for ambient temperature was placed in the center of the enclosure. The specimens were then subjected to 15 24-hour cycles of current cycling. Each cycle consisted of applying a current of 15 amps for 20 hours followed by 4 hours of zero current. The temperature was measured at the end of the 20 hour segment and the 4 hour segment of a cycle.

3.6 Temperature Rise Vs. Current

Specimens were subjected to a temperature rise test in accordance with EIA 364-70D and the product specification. Each specimen was prepared using beaded, 30 AWG, type T thermocouples placed on the PCB to monitor the Line and Load circuits during testing.

A specimen was suspended in an air-flow free enclosure. The Line and Load circuits were then wired in series to a power supply. The thermocouples were then connected to a data acquisition station to monitor temperature. A thermocouple for ambient temperature was placed in the center of the enclosure and a current of 15 amps was applied. When each temperature reached stability, 3 consecutive readings taken at 5-minute intervals not differing by more than 1°C, the temperature measurements were recorded.

3.7 Contact Retention Housing

Specimens were subjected to a contact retention test using a tensile / compression machine in accordance with Test Procedure EIA 364-29D, Method A and the product specification. A specimen was secured to a free-floating XYR alignment table attached to the base of the tensile / compression machine. A wire was axially aligned with

and gripped by air jaws attached to the load cell and crosshead of the tensile / compression machine. The crosshead was slowly raised until a maximum preload of 13.3 newtons was applied. The crosshead was then raised at a rate of 25.4 mm / min until a force of 45 Newtons was applied. The 45 Newtons was then held for 6 seconds and the crosshead was lowered to its original position. The peak force applied and the force vs time graph were recorded.

3.8 Vibration

Test specimens were subjected to a Sinusoidal Vibration test in accordance with product specification. 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.

3.8.1 Vibration – Test Set 1

An electrical load of was applied and maintained at 100 milliamperes maximum to the test specimens and was monitored for discontinuities of 1 microsecond or longer.

3.8.2 Vibration – Test Set 2

All test specimens were energized at an approximate current of 19.3 amps for an 18°C temperature rise, while being subjected to sinusoidal vibration testing.

3.9 Mechanical Shock

The test specimens were subjected to a Mechanical Shock test in accordance with Test Procedure EIA-364-27C, Test Condition H and the product specification.

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 specimen, for a total of 18 shocks.

An electrical load of was applied and maintained at 100 milliamperes maximum to the test specimens and was also monitored for discontinuities of 1 microsecond or longer.

3.10 Durability

Specimens were subjected to a durability test in accordance with EIA 364-9D and the product specification. Specimens were subjected to 25 mating and un-mating cycles at a maximum rate of 120 cycles per hour by hand.

3.11 Salt Spray

Specimens were subjected to salt spray test in accordance with IEC 60512-11-6 Edition 1.0 2002-02 and the product specification. The specimens were placed in the chamber on horizontal racks with the mating interface on a horizontal axis. The chamber was operated for a period of 240hrs.

Upon completion of the test the specimens were rinsed in warm tap water and lightly brushed as needed to remove salt deposits for 5 minutes maximum then placed in an air-circulating oven for 16hrs @ 38C to dry. The chamber operating parameters were as follows:

3.12 Thermal Shock

Specimens were subjected to a thermal shock environment in accordance with Test Procedure EIA 364-32G, Method A and the product specification. Unmated specimens were subjected to 25 cycles between -40°C and 65°C with 30-minute dwells at temperature extremes with 1 minute transitions between temperatures.

3.13 Humidity

Specimens were subjected to a humidity environment in accordance with UL 773 5th Edition, Section 23 and the product specification. Specimens from Test Set 2 were preconditioned with 5 durability cycles before testing. Mated specimens were subjected to 96 ±2% Relative Humidity at 50 ±2°C for 168 hours. Dielectric testing was done within 10 minutes from the removal of humidity chamber.

3.14 Impact

Testing was performed in accordance with IEC 62262, Edition 1.1 2021-09. The specimens were placed on a concrete floor and five IK08 (5 Joule) impacts were applied to the top of each specimen by dropping a 1.7 kg mass a distance of 300 mm.

3.15 Humidity Freeze

Specimens were subjected to 10 cycles between -40°C and 90°C at 85% relative humidity. Testing was performed in accordance with paragraph 4.12 of IEC 61215-2, Edition 2.0 2021-02.

3.16 Temperature Life

Specimens were subjected to a temperature life environment in accordance with Test Procedure EIA 364-17C, Method A and the product specification. Mated specimens were subjected to 100°C for 500 hours.

3.17 Temperature Life - IP – Test Groups G1 & G2

Specimens were subjected to a temperature life environment in accordance with Test Procedure EIA 364-17C, Method A and the product specification. Mated specimens were subjected to 65°C for 240 hours.

3.18 Ingress Protection 6X (Dust)

Mated specimens were prepared for IP6X testing by drilling a hole in the top of the shorting cap assembly cover and the enclosure box, inserting a vacuum line and sealing the line with silicone. The specimens were placed into the talcum dust chamber and the vacuum lines were attached to the vacuum manifold. A vacuum was applied to the specimens through the vacuum lines at a pressure not exceeding 2.0 kPa, maintained for the entire test. The specimens were exposed for a total duration of 8 hours. Following exposure, the specimens were allowed to rest in the dust chamber for a minimum of one hour. The specimens were then removed for inspection. Testing was performed in accordance with IP6X paragraph 13.4 of IEC 60529, Edition 2.2 2013-08.

3.19 Ingress Protection X6 (Water Spray

Mated specimens were sprayed with a stream of water from a standard test nozzle with an internal diameter of 12.5 mm positioned 2.5 to 3 meters above the test specimen for 3 minutes. The specimens were sprayed from all practicable directions with a stream of water from a standard test nozzle. The water delivery rate was 100

l/min ±5%. Testing was performed in accordance with IPX6 paragraph 14.2.6 of IEC 60529, Edition 2.2 2013-08.

3.20 Final Examination of Product

Specimens were visually examined with an unaided eye. Testing was performed in accordance with EIA-364-18B.