Nector S Bus Bar for North American Market

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity Nector S Bus Bar to determine its conformance to the requirements of Design Objective 108-20294-1 Rev A.

1.2 Scope

This report covers the electrical, mechanical and environmental performance of the Nector S Bus Bar. Testing was performed at the Harrisburg Electrical Components Test Laboratory (HECTL) between August 11, 2015 and November 17, 2015. Detailed test data is on file and maintained at HECTL under test numbers EA20150418T and EA20150600T.

1.3 Conclusion

All specimens met the requirements as specified in TE Product Specification 108-20294-1 Rev A.

1.4 Product Description

The connector system is specifically designed for lighting industry applications and similar purposes from low voltage to 125 volts. The product mates to Nector S Plugs and terminates to UL SPT-2 type 18 AWG two conductor cable.

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	Quantity	Part Number	Description	Test Group
1	6	4-2213222-4	Nector S Bus bar	1
	6	1-2083075-2	Cable Assembly (HV-3,AC)	1
2A	6	4-2213222-1	Nector S Bus bar	2
	6	1-2083075-2	Cable Assembly (HV-3,AC)	2
2B	6	4-2213222-4	Nector S Bus bar	2
	6	2-2083075-2	Cable Assembly (LV-2,DC)	2
3A	6	4-2213222-1	Nector S Bus bar	3
	6	1-2083075-2	Cable Assembly (HV-3,AC)	3
3B	6	4-2213222-4	Nector S Bus bar	3
	6	2-2083075-2	Cable Assembly (LV-2,DC)	3
4A	3	2213222-1	Nector S Bus bar	4
	3	2-2083075-2	Cable Assembly (LV-2,DC) + 2213210-1 BOOT	4
4B	3	2-2213222-1	Nector S Bus bar	4
	3	1-2083075-2	Cable Assembly (HV-3,AC) + 2213210-1 BOOT	4

1.6 Qualification Test Sequence

The specimens listed in Table 1 were subjected to the test sequences outlined in Table 2.

Table 2 – Test Sequence

Test or Examination	Test Group			
	1	2	3	4
	Sequence (a)			
Initial Examination of Product	1	1	1	1
LLCR	3,6,8			2,6
Insulation Resistance			2,6	
Dielectric Withstanding Voltage			3,7	3,5
Temperature Rise vs. Current		2,6		
Vibration	5			
Mechanical Shock	7			
Durability	4	3		
Mating Force	2			
Un-mating force	9			
Thermal Shock			4	
Humidity/temperature cycling		4	5	
Temperature life		5		
Ingress Protection				4
Final Examination of Product	10	7	8	7

Note: (a) Numbers indicate sequence 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 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. Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2 Low Level Contact Resistance – Test Groups 1 and 4

All Low Level Contact Resistance summary results are shown in Table 3 and Table 4 (Note - wire bulk not subtracted out of initial measurements). All specimens met the requirement of 10 milliohms maximum change in resistance from initial.

Table 3 – Test Group 1 (Test Set 1) LLCR Summary in milliohms

	Initial (Actual)	After Vibration (Delta)	After Mechanical Shock (Delta)
Min	16.07	-2.07	-0.27
Max	20.06	-0.25	6.54
Average	17.58	-0.99	3.43
Std Dev	1.19	0.56	2.07
N	12	12	12

Table 4 – Test Group 4 (Test Set 4) LLCR Data Summary in milliohms

	Test Set 4A		Test Set 4B	
	Initial (Actual)	After Ingress (Delta)	Initial (Actual)	After Ingress (Delta)
Min	15.62	-2.95	13.97	-1.61
Max	17.97	0.28	16.24	1.65
Average	16.83	-0.77	14.96	0.02
Std Dev	0.95	1.04	0.71	0.99
N	6	6	6	6

2.3 Insulation Resistance – Test Group 4

All specimens met the requirement of 5 megohms minimum for insulation resistance.

2.4 Dielectric Withstanding Voltage – Test Group 4

All specimens met the requirement of no dielectric breakdown or flashover during a one minute hold at 1250 VAC.

2.5 Temperature Rise vs Current – Test Group 2

All specimens met the requirements of 45°C maximum temperature rise at the specified current levels of 6 amperes AC for Test Set 2A and 7 amperes DC for Test Set 2B.

2.6 Durability – Test Groups 1 and 2

All specimens in Group 1 and 2 did not show any signs of physical damage after Durability testing.

2.7 Vibration, Random – Test Group 1

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

2.8 Mechanical Shock – Test Group 1

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

2.9 Mating Force – Test Group 1

All mating force measurements met the maximum requirement of 57.0 N. Mating force results are shown in Table 5.

Table 5 – Mating Force Summary

	Mating Force N
Min	45.69
Max	50.25
Average	47.57
Std Dev	1.48
N	6

2.10 Unmating Force – Test Group 1

All unmating force measurements met the minimum requirement of 10.0 N on the 10th unmating cycle. Unmating force results are shown in Table 6.

Table 6 – Unmating Force Summary

	Unmating Force N
Min	30.41
Max	45.07
Average	34.05
Std Dev	5.57
N	6

2.11 Thermal Shock – Test Group 3

All specimens did not show any signs of physical damage after Thermal Shock testing.

2.12 Humidity-Temperature Cycling – Test Groups 2 and 3

No evidence of physical damage was visible as a result of exposure to Humidity/Temperature cycling.

2.13 Temperature Life – Test Group 2

No evidence of physical damage was visible as a result of exposure to Temperature Life exposure.

2.14 Ingress Protection – Test Group 4

Specimens were subjected to IPX7 water ingress testing and showed no ingress of water.

2.15 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

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.

3.2 Low Level Contact Resistance

All low level contact resistance measurements were taken using a 4 probe measurement technique on each position of the Nector S Bus Bar specimens. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage and tested in accordance with EIA 364-23C. Wire bulk was not subtracted from test measurements. Figure 1 shows the location of the probe points.

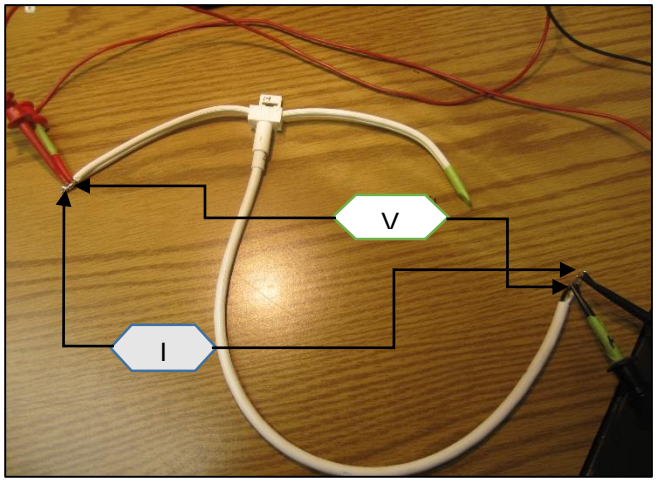

Figure 1 – LLCR Probe Locations

3.3 Insulation Resistance

Insulation resistance was measured between adjacent contacts and between contacts and the body of the specimens. A test voltage of 500 volts DC was applied for one minute before the resistance was measured. All specimens were tested in accordance with test specification EIA-364-21E. Refer to Figure 2 and Figure 3 for images of the test setup.

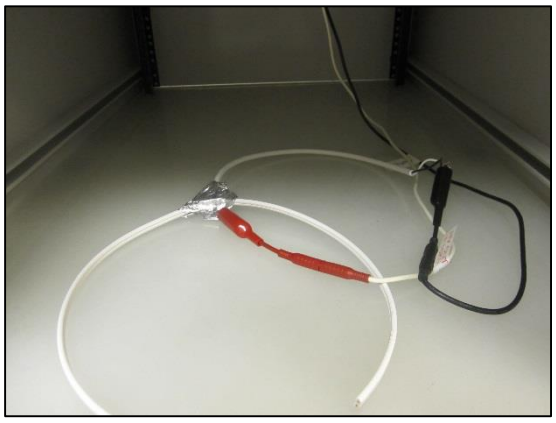

Figure 2 – IR Setup - Contacts to Shell

3.4 Dielectric Withstanding Voltage

Mated test specimens were subjected to dielectric withstanding voltage testing, conducted in accordance with EIA-364-20E. A test voltage of 1250 VAC was applied between the adjacent contacts. Test voltage was applied at a rate of 500 volts per second and maintained for 60 seconds. A photo of the test setup is shown in Figure 3.

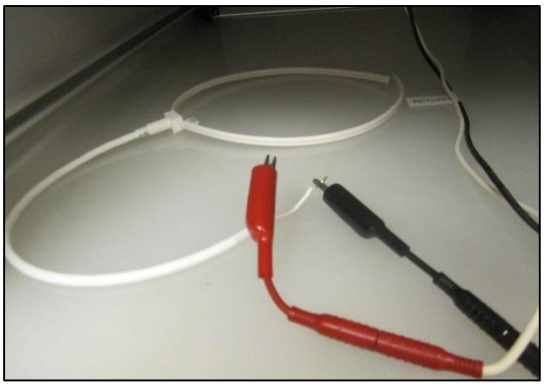

Figure 3 – IR and DWV Test Setup - Adjacent Contacts

3.5 Temperature Rise vs Current

Infrared temperature measurement point, i.e. front of specimen, was coated with Equate powder, 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 standard optics (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 contacts. 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.

The test specimens were placed in the temperature rise enclosure and measurements were taken after temperature stabilization. The specimens were connected in series. Refer to Figure 4 for images of the typical test setup. Testing was conducted in accordance with EIA 364-70C.

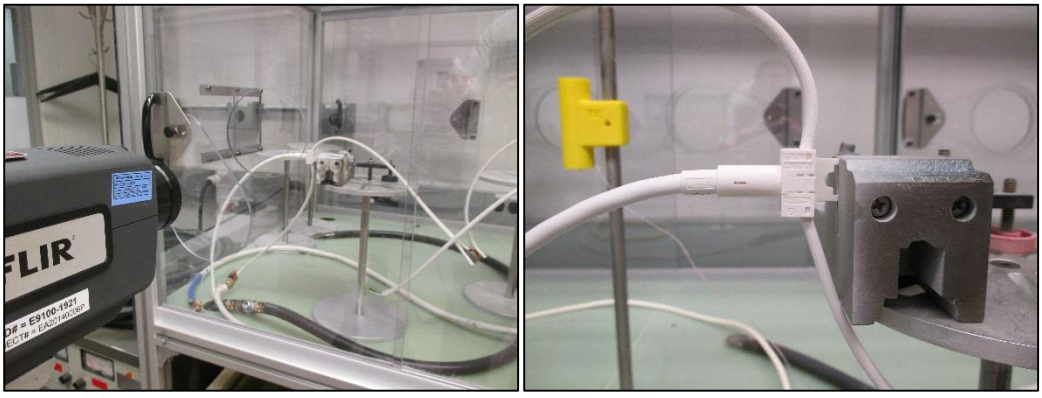

Figure 4 – Temperature Rise Test Setup

3.6 Durability

Specimens were manually mated and unmated for 10 cycles. Specimens were tested in accordance with EIA-364-9C.

3.7 Vibration, Random

The test specimens were subjected to a random vibration test in accordance with specification EIA-364-28F, test condition “VII”, test condition letter “D”. See Figure 5 below for vibration setup photograph. 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 0.02 G^2/Hz from 20 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 3.10 GRMS. The test specimens were subjected to this test for 30 minutes in each of the three mutually perpendicular axes, for a total test time of 90 minutes per test specimen.

The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

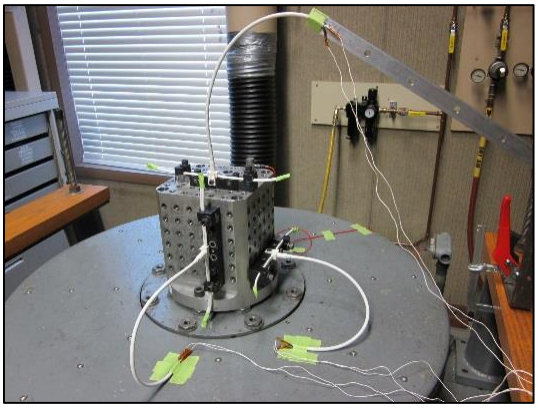

Figure 5 – Vibration Setup

3.8 Mechanical Shock

The test specimens were subjected to a mechanical shock test in accordance with specification EIA-364-27C, test condition “H”. See Figure 6 below for shock setup photograph.

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.

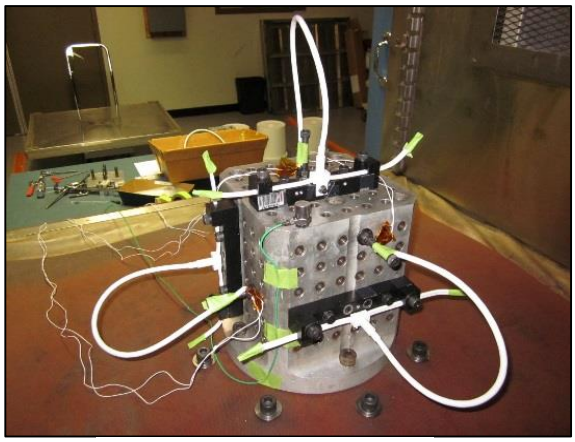

Figure 6 – Shock Setup

3.9 Mating Force

The Nector S Bus Bar connector socket was held in a vice on a XY table attached to the base of the tensile/compression machine. A PCB washer was placed onto the cable of the plug (Figure 8). A slotted plate was attached to a goal post fixture mounted to the load cell and moveable crosshead of the tensile/compression machine (Figure 7). The crosshead was moved downward at a rate of 0.50 inch/min until the connector was fully mated and the peak force was recorded. Test was conducted in accordance with EIA 364-13E.

Figure 7 – Mating Force Test Setup

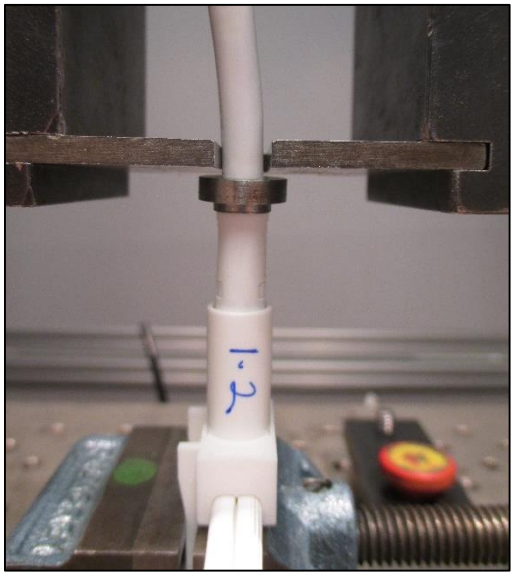

Figure 8 – Mating Force Close-up

3.10 Unmating Force

The Nector S Bus Bar connector socket was held in a vice on a floating X/Y/Rotational table attached to the base of the tensile/compression machine. A clamp fixture was attached to the load cell and moveable crosshead of the tensile/compression machine (Figure 9). The clamp was firmly secured to the plug assembly. The crosshead was moved upward at a rate of 0.50 inch/min until the connector was fully unmated and the peak unmating force was recorded. Test was conducted in accordance with EIA 364-13E.

Figure 9 – Unmating Force Test Setup

3.11 Thermal Shock

Unmated test specimens were subjected to 10 cycles between -40°C and 105°C with 30 minute dwells at temperature extremes and 1 minute transitions between temperatures. Testing was conducted in accordance with EIA-364-32G.

3.12 Humidity-Temperature Cycling

Unmated 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. Testing was conducted in accordance with EIA-364-31D.

3.13 Temperature Life

Mated specimens were exposed to a temperature of 85°C for a period of 96 hours. Testing was conducted in accordance with EIA-364-17C.

3.14 Ingress Protection

All specimens were exposed to IPX7 water ingress testing per IEC 60529. Prior to immersion testing, the exposed cable ends were sealed with dielectric wax to prevent water ingress through the wire insulation. Specimens were then subjected to immersion in 1 meter of water containing tinopal and were left in this condition for 30 minutes. After 30 minutes the specimens were removed from the immersion tube. The specimens were gently dried with paper towels and left in the open atmosphere to dry for 24 hours. After drying for 24 hours, the specimens were inspected for water ingress.

3.15 Final Examination of Product

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed in accordance with EIA 364-18B.