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Nett Warrior Quick Disconnect Circular Plug and Receptacle Connectors
Tobyhanna Army Depot Phase III Verification Testing

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity (TE) Nett Warrior Quick Disconnect Circular Plug and Receptacle Connectors utilized in cable assemblies produced by Tobyhanna Army Depot (TYAD) to determine their conformance to the requirements of TYAD Phase III Test Plan TO-26 as defined in TE Verification Test Plans EA20140668T, Rev. C, and EA20140668T-1, Rev. A.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the TE Connectivity Nett Warrior Quick Disconnect Circular Plug and Receptacle Connectors utilized in cable assemblies produced by TYAD. Testing was performed at the Harrisburg Electrical Components Test Laboratory between 23-February-2015 and 08-May-2015. Test Group 5 environmental and basic functionality testing were performed at E-Labs, Fredericksburg, VA, between 9-April-2015 and 04-May-2015. Detailed test data is on file and maintained at the Tyco Electronics Harrisburg Electrical Components Test Laboratory.

1.3 Conclusion

All specimens of the TE Connectivity Nett Warrior Quick Disconnect Circular Plug and Receptacle Connectors utilized in cable assemblies produced by TYAD, as listed in paragraph 1.4, conformed to the electrical, mechanical, and environmental performance requirements of Tobyhanna Army Depot (TYAD) Phase III Test Plan TO-26, as defined in TE Connectivity test plans EA20140668T, Rev. C, and EA20140668T-1, Rev. A.

1.4 Test Specimens

Plug and receptacle connectors are 6-position quick-disconnect circular electrical connectors. A mated connector pair measures approximately 1.5 inches long, and 0.5 inches in diameter. Five groups of test specimens, as identified in Table 1, were submitted for testing. The double-ended production cable assemblies were prepared by TYAD and are shown in Figure 1.

Table 1 – Test Specimens

Test Group	Quantity	Plug P/N	Receptacle P/N	Assembly Length (inch)	Ferrite
1	2	2226910-1	2226920-1	20	No
2	2	2226910-1	2226920-1	20	No
3	2	2226910-1	2226920-1	20	Yes
4	2	2226910-1	2226920-1	20	No
5	2	2226910-1	2226920-1	20	No

To facilitate in-situ electrical testing and discontinuity monitoring, single-ended “pig-tail” support cable assemblies were prepared by TE and are shown in Figure 2. Extension leads were added as necessary to provide access into chambers.

Figure 1 – Test Specimen Cable Configuration

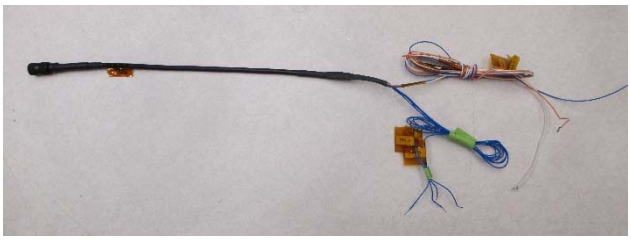

Figure 2 – Testing Support "Pig-Tail" Cables With Extension Leads

1.5 Test Sequence

The test specimens referred to in paragraph 1.4 were tested according to the test sequences listed in Table 2.

Table 2 – Test Sequence

Test or Examination	Test Group				
	1	2	3	4	5
	Test Sequence (a)				
Visual Examination	1, 5	1, 5, 9, 13, 17, 21	1, 5, 9, 13	1, 5, 9, 13,17	1, 5, 9, 13, 17
Voltage Drop @ 1 Adc	2	2, 6, 10, 14, 18, 22	2, 6, 10, 14	2, 6, 10, 14,18	2, 6, 10, 14, 18
Insulation Resistance @ 500 Vdc	3	3, 7, 11, 15, 19, 23	3, 7, 11, 15	3, 7, 11, 15,19	3, 7, 11, 15, 19
Breakaway Force	4				
Strength				16	
Altitude – Procedure I		4			
Altitude – Procedure II		8			
Vibration – Procedure I		12			
Shock		16			
Vibration – Procedure II		20			
High Temperature – Procedure II			4		
High Temperature – Procedure I			8		
Low Temperature – Procedure II			12		
Humidity – Induced Storage & Transit				4	
Humidity – Natural Environment Operational				8	
Salt Atmosphere				12	
Rain					4
Snow & Ice					8
Solar Radiation					12
Dust					16

(a) Numbers indicate the sequence in which tests were performed.

1.6 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 Visual Examination – All Groups

There was no visual evidence of physical damage. Salt deposits were observed at final examination of Test Group 4 (see Figures 3 through 6). A white residue was observed at final examination of Test Group 5 (see Figure 7 and Figure 8).

Figure 3 – Specimen 401 Plug
Post Salt Spray

Figure 4 – Specimen 401 Receptacle
Post Salt Spray

Figure 5 – Specimen 402 Plug
Post Salt Spray

Figure 6 – Specimen 402 Receptacle
Post Salt Spray

Figure 7 – White Residue on Plugs
Test Group 5

Figure 8 – White Residue on Receptacles
Test Group 5

2.2 Voltage Drop @ 1 Adc – All Groups

Voltage drop data was utilized to verify continuity at the prescribed steps in the test sequence. Measurement data for each test group is included in Appendix C of this report.

2.3 Insulation Resistance @ 500 Vdc – All Groups

All insulation resistance measurements were greater than the minimum requirement of 100 Megohms. Measurement data for each test group is included in Appendix D of this report.

2.4 Breakaway Force – Group 1

Breakaway forces met the 13 ± 3 lbf requirement. See Table 3 for data.

Table 3 – Breakaway Force Results

Specimen ID	Description	Maximum Force (lbf)
101	Overmolded Receptacle + “pig-tail” Plug	10.99
101	Overmolded Plug + “pig-tail” Receptacle	11.44
102	Overmolded Receptacle + “pig-tail” Plug	11.26
102	Overmolded Plug + “pig-tail” Receptacle	10.72

2.5 Strength – Group 4

There was no damage to the cable sheath or connector due to slippage of the cable connection.

2.6 Altitude – Procedure I – Group 2

Post altitude visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.7 Altitude – Procedure II – Group 2

No discontinuities of one microsecond or greater occurred during testing. Post altitude visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.8 Vibration – Procedure I – Group 2

No discontinuities of one microsecond or greater occurred during testing. Post vibration visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.9 Shock – Group 2

Post shock visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.10 Vibration – Procedure II – Group 2

Post vibration visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.11 High Temperature – Procedure II – Group 3

No discontinuities of one microsecond or greater occurred during testing. Voltage drop and insulation resistance were measured during the time of maximum thermal response during each of the three cycles. All visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.12 High Temperature – Procedure I – Group 3

Post high temperature exposure visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.13 Low Temperature – Procedure II – Group 3

No discontinuities of one microsecond or greater occurred during testing. Voltage drop and insulation resistance were measured at the third hour of the exposure. All visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.14 Humidity – Induced Storage & Transit – Group 4

Post humidity visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.15 Humidity – Natural Environment Operational – Group 4

No discontinuities of one microsecond or greater occurred during testing. Post humidity visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.16 Salt Atmosphere – Group 4

Post salt spray visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.17 Rain – Group 5

No discontinuities of one microsecond or greater occurred during testing. Post rain visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.18 Snow & Ice – Group 5

No discontinuities of one microsecond or greater occurred during testing. Specimens were able to be manually unmated and mated using only standard items available in the field. (Discontinuities occurring during the unmate/mate cycle were not considered a failure.) Post snow & ice visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.19 Solar Radiation – Group 5

Post solar radiation visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

2.20 Dust – Group 5

Post dust visual inspection, voltage drop and insulation resistance results are included in sections 2.1, 2.2, and 2.3, respectively.

3. TEST METHODS

3.1 Visual Examination – All Groups

Specimens were visually examined to the extent possible, using the unaided eye.

3.2 Voltage Drop @ 1 Adc – All Groups

Voltage drop measurements at 1 Adc current were made using a four terminal measuring technique (Figure 9 and Figure 10). The voltage drop across each of the six mated contact positions was measured using pre-attached probe leads. Test setup for Test Group 3 specimens measured during temperature exposures is shown in Figure 11.

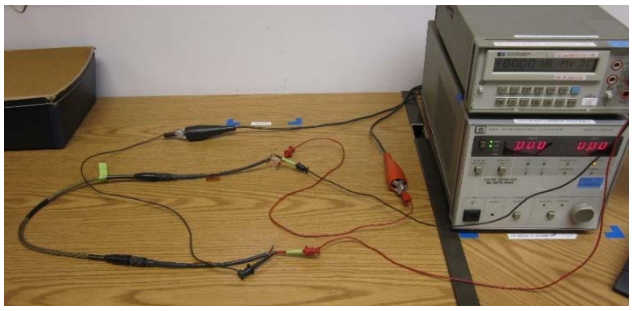

Figure 9 – Voltage Drop Test Setup
Test Group 1

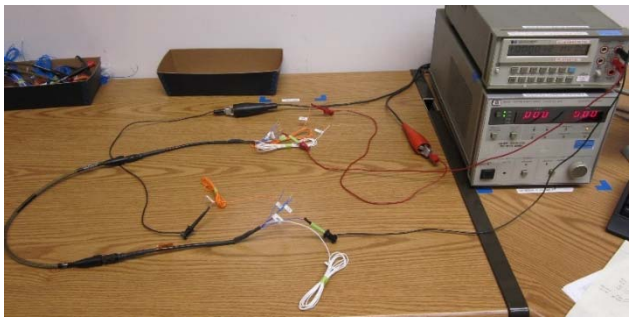

Figure 10 – Voltage Drop Test Setup
Test Groups 2, 3, 4, and 5

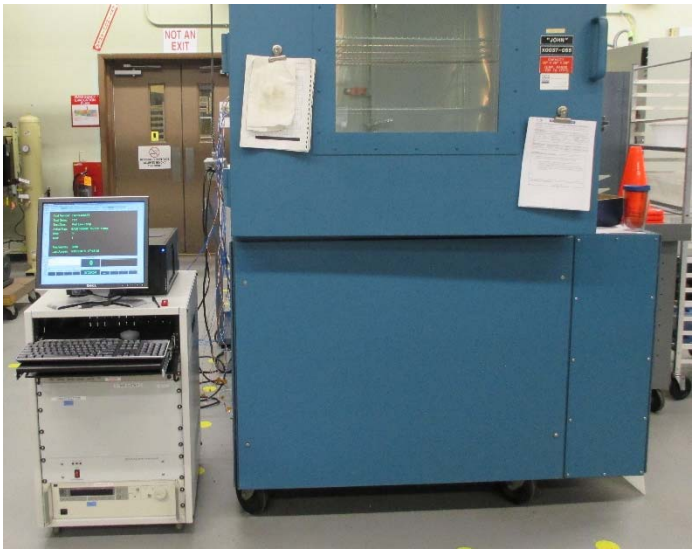

Figure 11 – Voltage Drop Measurement Setup in Chamber
Test Group 3

3.3 Insulation Resistance @ 500 Vdc – All Groups

All connector positions were combined to form one series circuit. A voltage of 500 Vdc was applied between the combined series circuit and the cable/connector shield for a minimum of 1 second, and the insulation resistance measured.

Connector positions 1, 3, and 5 were combined to form one series circuit. Connector positions 2, 4, and 6 were combined to form another series circuit. A voltage of 500 Vdc was applied between the odd and even series circuits for a minimum of 1 second, and the insulation resistance measured. Test setup is shown in Figure 12.

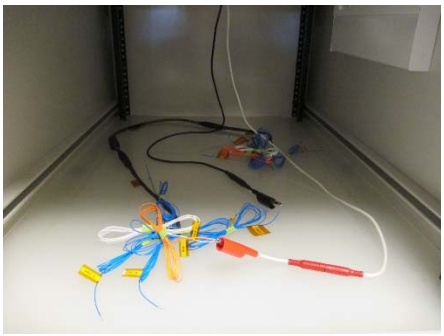

Figure 12 – Insulation Resistance Test Setup

3.4 Breakaway Force – Group 1

Each mating connector pair of an overall assembly was tested individually. The “pig-tail” assembly was secured to a floating x-y-r table on the base of the tensile/compression test system. The mating end of the production cable assembly was secured to the moveable cross-head. An axial force was applied at a rate of 15 inches per minute until the connectors unmated. The maximum force was recorded. Test setup is shown in Figure 13.

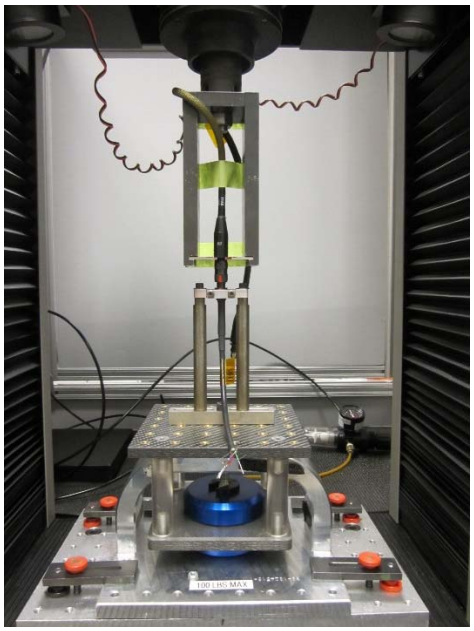

Figure 13 – Breakaway Force Test Setup

3.5 Strength – Group 4

Each mating connector pair of the double-ended production cable test assembly was tested individually. The connector was secured to the base of the tensile/compression test system using a slotted plate fixture as shown in Figure 16. The cable was secured to the moving cross-head of the system 6 to 12 inches from the connector as shown in Figure 15. A pre-load of 80 lbf was applied using a test speed of 2 inches per minute and then 100 lbf was applied using a test speed of .5 inches per minute. 100 lbf was held for 30 seconds. Test setup is shown in Figure 14.

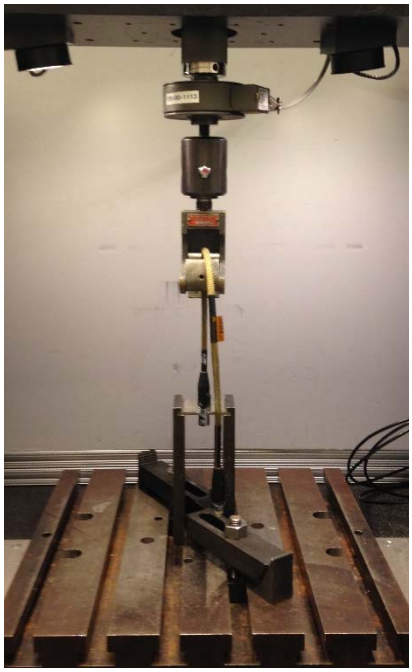

Figure 14 – Strength Test Setup

Figure 15 – Cable Clamp On Crosshead

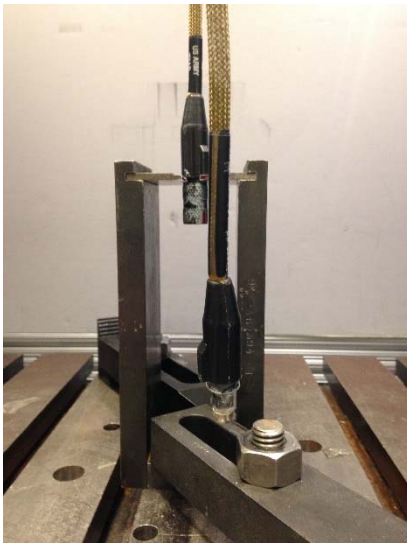

Figure 16 – Connector Secured On Base

3.6 Altitude – Procedure I – Group 2

Storage Altitude testing was performed in accordance with MIL-STD-810G, Method 500.5, Procedure I. Mated test specimens were placed in the chamber and the pressure was adjusted to a simulated altitude of 40,000 feet. Specimens were exposed to the simulated altitude for 1 hour. Test setup is shown in Figure 17.

Figure 17 – Altitude – Procedure I Test Setup

3.7 Altitude – Procedure II – Group 2

Storage Altitude testing was performed in accordance with MIL-STD-810G, Method 500.5, Procedure II. Mated test specimens were placed in the chamber and the pressure was adjusted to a simulated altitude of 32,000 feet. Specimens were exposed to the simulated altitude for 1 hour. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes. Test setup is shown in Figure 18.

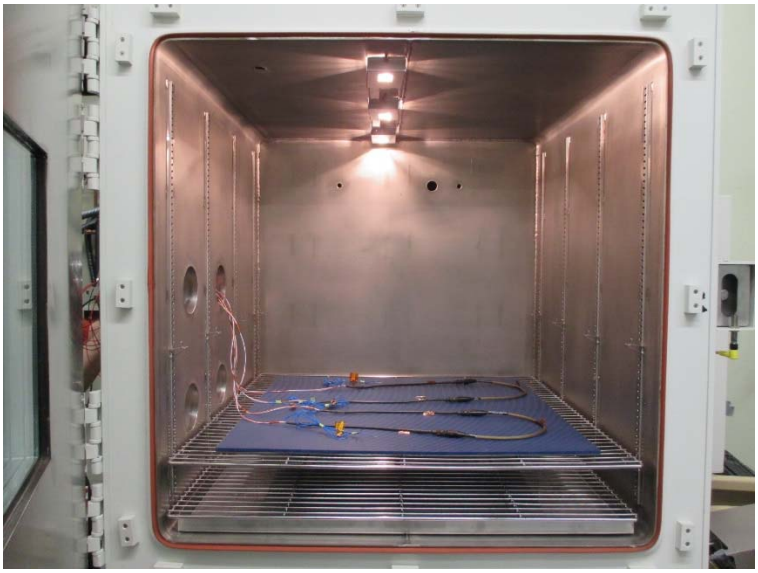

Figure 18 – Altitude – Procedure II Test Setup

3.8 Vibration – Procedure I – Group 2

The test specimens were subjected to a random vibration test in accordance with specification MIL-STD-810G, Method 514.7, Procedure I. See Figure 19 and Figure 20 for vibration setup photographs. The parameters of this test condition were specified by a random vibration spectrum with excitation frequency bounds of 20 and 2000 Hertz (Hz). The spectrum was flat at 0.04 G^2/Hz from 20 Hz to 1000 Hz. The spectrum sloped down at 6 dB per octave to a PSD of 0.01 G^2/Hz at the upper bound frequency of 2000 Hz. The root-mean square amplitude of the excitation was 7.7 GRMS. The test specimens were subjected to this test for 1 hour in two perpendicular axes. The longitudinal axis (mating axis) and one of the perpendicular planes to that axis, for a total test time of 2 hours per test specimen. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

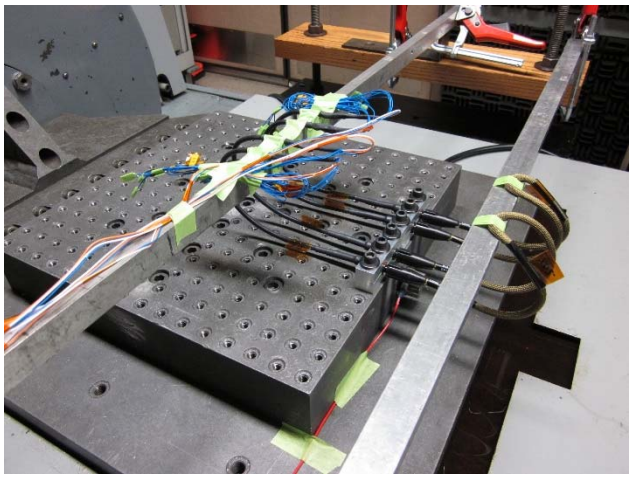

Figure 19 – Vibration Test Setup Longitudinal Axis

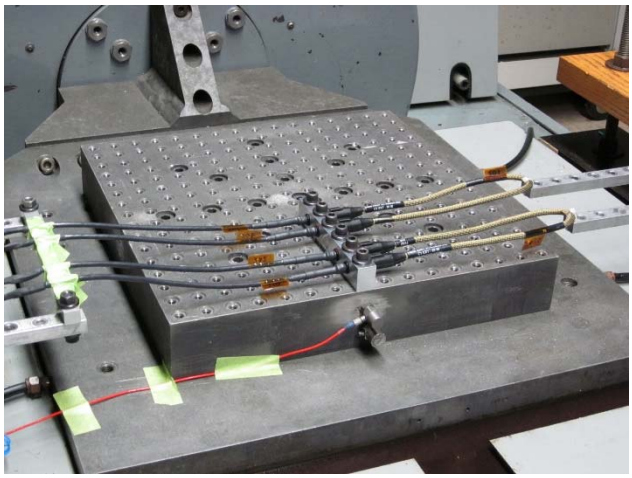

Figure 20 – Vibration Test Setup Lateral Axis

3.9 Shock – Group 2

Transit Drop Shock testing was performed in accordance with MIL-STD-810G, Method 516.6, Procedure IV. Mated test specimens were dropped from a height of 48 inches onto a concrete surface. A total of nine drops were performed on each specimen, re-orienting the assembly approximately 40 degrees from its previous orientation with each drop. Test setup is shown in Figure 21 and Figure 22.

Figure 21 – Shock Test Setup

Figure 22 – Shock Test Setup

3.10 Vibration – Procedure II – Group 2

Loose cargo vibration testing was performed in accordance with MIL-STD-810G, Method 514.6, Category 5, Procedure II. Testing was performed using a package tester setup as shown in Figure 1. The length of each side was approximately 22.5 inches (based on a specimen length of approximately 20 inches and a connector diameter of approximately 0.5 inches, and using Equation (3) of MIL-STD-810G, Method 514.6, Annex C, Paragraph 2.2.c). The movement of the package tester bed was a 1.0 inch diameter orbital path at 5 Hz. Unmated double-ended production test specimens were placed in the test area in a non-uniform manner (Figure 24) and subjected to the prescribed motion for a period of 20 minutes. Test setup is shown in Figure 23.

Figure 23 – Test Setup

Figure 24 – Random Specimen Placement

3.11 High Temperature – Procedure II – Group 3

Operation High Temperature testing was performed in accordance with MIL-STD-810G, Method 501.5, Procedure II. Mated test specimens were placed in the test chamber as shown in Figure 25 and subjected to three cycles of the temperature profile defined in Table 4. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

Table 4– Operation High Temperature Profile

Hour	Temperature (Deg. C)	Hour	Temperature (Deg. C)
1	36	13	48
2	40	14	46
3	44	15	44
4	48	16	42
5	52	17	40
6	55	18	38
7	55	19	36
8	55	20	34
9	55	21	32
10	55	22	30
11	52	23	30
12	50	24	33

Figure 25 – High Temperature Test Setup

3.12 High Temperature – Procedure I – Group 3

Storage High Temperature testing was performed in accordance with MIL-STD-810G, Method 501.5, Procedure I. Mated test specimens were placed in the test chamber as shown in Figure 25 and subjected to seven cycles of the temperature profile defined in Table 5.

Table 5 – Storage High Temperature Profile

Hour	Temperature (Deg. C)	Hour	Temperature (Deg. C)
1	42	13	58
2	48	14	54
3	54	15	50
4	59	16	46
5	64	17	43
6	68	18	40
7	71	19	37
8	71	20	34
9	69	21	32
10	67	22	30
11	64	23	33
12	61	24	37

3.13 Low Temperature – Procedure II – Group 3

Operation Low Temperature testing was performed in accordance with MIL-STD-810G, Method 502.5, Procedure II. Mated test specimens were placed in the test chamber as shown in Figure 25 and subjected to a temperature of -18°C for a period of 6 hours. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.14 Humidity – Induced Storage & Transit – Group 4

Induced Storage and Transit Humidity testing was performed in accordance with MIL-STD-810G, Method 507.5, Procedure I. Mated specimens were placed in the chamber and subjected to three cycles of the Induced Storage and Transit temperature/humidity profile defined in Column B2 of Figure 26. Test setup is shown in Figure 27.

Time	Natural[1]								Induced (Storage & Transit)							
	High Humidity															
	Constant Temp. (Cycle B1)		Cyclic High RH (Cycle B2)			Hot Humid (Cycle B3)			Constant Temp. (Cycle B1)		Cyclic High RH (Cycle B2)			Hot Humid (Cycle B3)		
	Temp.	RH	Temp.		RH	Temp.		RH	Temp.	RH	Temp.		RH	Temp.		RH
		%	°F	°C	%	°F	°C	%		%	°F	°C	%	°F	°C	%
0000	Nearly constant at 24°C (75°F) throughout the 24 hours.	100[2]	80	27	100	88	31	88	Nearly constant at 27°C (80°F) throughout the 24 hours.	100[2]	91	33	68	95	35	63
0100		100	80	27	100	88	31	88		100	91	33	69	95	35	67
0200		100	79	26	100	88	31	88		100	90	32	70	94	34	72
0300		100	79	26	100	88	31	88		100	90	32	71	94	34	75
0400		100	79	26	100	88	31	88		100	88	31	72	93	34	77
0500		100	78	26	100	88	31	88		100	86	30	74	92	33	79
0600		100	78	26	100	90	32	85		100	88	31	75	91	33	80
0700		98	81	27	94	93	34	80		98	93	34	64	97	36	70
0800		97	84	29	88	96	36	76		97	101	38	54	104	40	54
0900		95	87	31	82	98	37	73		95	107	42	43	111	44	42
1000		95	89	32	79	100	38	69		95	113	45	36	124	51	31
1100		95	92	33	77	102	39	65		95	124	51	29	135	57	24
1200		95	94	34	75	104	40	62		95	134	57	22	144	62	17
1300		95	94	34	74	105	41	59		95	142	61	21	151	66	16
1400		95	95	35	74	105	41	59		95	145	63	20	156	69	15
1500		95	95	35	74	105	41	59		95	145	63	19	160	71	14
1600		95	93	34	76	105	41	59		95	144	62	20	156	69	16
1700		95	92	33	79	102	39	65		95	140	60	21	151	66	18
1800		95	90	32	82	99	37	69		95	134	57	22	145	63	21
1900		97	88	31	86	97	36	73		97	122	50	32	136	58	29
2000		98	85	29	91	94	34	79		98	111	44	43	122	50	41
2100		100	83	28	95	91	33	85		100	101	38	54	105	41	53
2200		100	82	28	96	90	32	85		100	95	35	59	103	39	58
2300		100	81	27	100	89	32	88		100	93	34	63	99	37	62
2400		100	80	27	100	88	31	88		100	91	33	68	95	35	63

Figure 26 – Temperature/Humidity Profile for Induced Storage & Transit Condition

Figure 27 - HumidityTest Setup

3.15 Humidity – Natural Environment Operational – Group 4

Natural Humidity testing was performed in accordance with MIL-STD-810G, Method 507.5, Procedure I. Mated specimens were placed in the chamber and subjected to three cycles of the Natural temperature/humidity profile defined in Column B2 of Figure 28. For chamber control purpose, 100% RH implies as close to 100% RH as possible, but not less than 95%. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes. Test setup is shown in Figure 27.

Time	Natural[1]								Induced (Storage & Transit)							
	High Humidity						Hot Humid (Cycle B3)		Constant Temp. (Cycle B1)		Cyclic High RH (Cycle B2)			Hot Humid (Cycle B3)		
	Constant Temp. (Cycle B1)		Cyclic High RH (Cycle B2)													
	Temp.	RH	Temp.		RH	Temp.		RH	Temp.	RH	Temp.		RH	Temp.		RH
		%	°F	°C	%	°F	°C	%		%	°F	°C	%	°F	°C	%
0000	Nearly constant at 24°C (75°F) throughout the 24 hours.	100[2]	80	27	100	88	31	88	Nearly constant at 27°C (80°F) throughout the 24 hours.	100[2]	91	33	68	95	35	63
0100		100	80	27	100	88	31	88		100	91	33	69	95	35	67
0200		100	79	26	100	88	31	88		100	90	32	70	94	34	72
0300		100	79	26	100	88	31	88		100	90	32	71	94	34	75
0400		100	79	26	100	88	31	88		100	88	31	72	93	34	77
0500		100	78	26	100	88	31	88		100	86	30	74	92	33	79
0600		100	78	26	100	90	32	85		100	88	31	75	91	33	80
0700		98	81	27	94	93	34	80		98	93	34	64	97	36	70
0800		97	84	29	88	96	36	76		97	101	38	54	104	40	54
0900		95	87	31	82	98	37	73		95	107	42	43	111	44	42
1000		95	89	32	79	100	38	69		95	113	45	36	124	51	31
1100		95	92	33	77	102	39	65		95	124	51	29	135	57	24
1200		95	94	34	75	104	40	62		95	134	57	22	144	62	17
1300		95	94	34	74	105	41	59		95	142	61	21	151	66	16
1400		95	95	35	74	105	41	59		95	145	63	20	156	69	15
1500		95	95	35	74	105	41	59		95	145	63	19	160	71	14
1600		95	93	34	76	105	41	59		95	144	62	20	156	69	16
1700		95	92	33	79	102	39	65		95	140	60	21	151	66	18
1800		95	90	32	82	99	37	69		95	134	57	22	145	63	21
1900		97	88	31	86	97	36	73		97	122	50	32	136	58	29
2000		98	85	29	91	94	34	79		98	111	44	43	122	50	41
2100		100	83	28	95	91	33	85		100	101	38	54	105	41	53
2200		100	82	28	96	90	32	85		100	95	35	59	103	39	58
2300		100	81	27	100	89	32	88		100	93	34	63	99	37	62
2400		100	80	27	100	88	31	88		100	91	33	68	95	35	63

Figure 28 – Temperature/Humidity Profile for Natural Condition

3.16 Salt Atmosphere – Group 4

Salt atmosphere testing was performed in accordance with MIL-STD-810G, Method 509.5. Unmated test specimens were placed in the chamber as shown in Figure 29. Specimens were exposed to the standard salt spray conditions of 5% salt concentration at 35°C for 24 hours. Specimens were removed from the chamber and allowed to dry at ambient conditions for a period of 24 hours. Specimens were then exposed the standard salt spray conditions for another 24 hours after which they were removed from the chamber and allowed to dry at ambient conditions for a period of 24 hours.

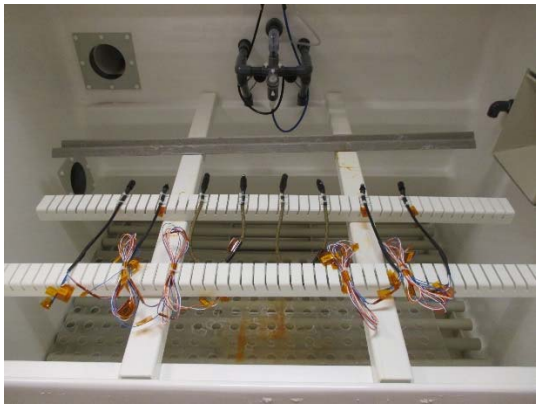

Figure 29 – Salt Spray Test Setup

3.17 Rain – Group 5

Rain testing was performed in accordance with MIL-STD-810G, Method 506.5, Procedure II (Exaggerated). Mated specimens were subjected to a water spray pattern having a droplet size predominately in the 0.45 to 0.50 mm range travelling at approximately 64 km/h (40 mph) at approximately 276 kPa (40 psig). The spray was applied to all exposed surfaces of the test specimens for 40 minutes. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.18 Snow & Ice – Group 5

Snow & Ice testing was performed in accordance with MIL-STD-810G, Method 521.3 (Glaze Ice Procedure for 6 mm Ice Thickness). Mated specimens were placed in the test chamber, and the air temperature was adjusted to 0°C (-0/+2°C) and maintained for a minimum period of 1 hour to allow the test specimens to stabilize at temperature. The specimens were then subjected to a uniform, pre-cooled (0 to 3°C) water spray at a rate of approximately 25 mm/hour for 1 hour to allow water penetration into the test specimen crevices and openings. The chamber air temperature was then adjusted to -10°C, and the water spray rate maintained until 6 millimeters of ice had accumulated on the surface of the test specimens. At that point, the chamber air temperature was maintained for a minimum period of 4 hours to allow ice to harden. The specimens were then manually unmated and mated, using only standard items available in the field. Immediately following the mating cycle, voltage drop and insulation resistance were measured in accordance with Paragraphs 3.2 and 3.3 respectively. The chamber air temperature was then adjusted to standard ambient conditions.

3.19 Solar Radiation – Group 5

Solar Radiation testing was performed in accordance with MIL-STD-810G, Method 505.5, Procedure I, Cycle A1, for three continuous cycles. Mated specimens were placed in the test chamber, and exposed to three continuous 24-hour cycles of controlled simulated radiation and dry-bub temperature as indicated for Cycle A1 of Figure 30.

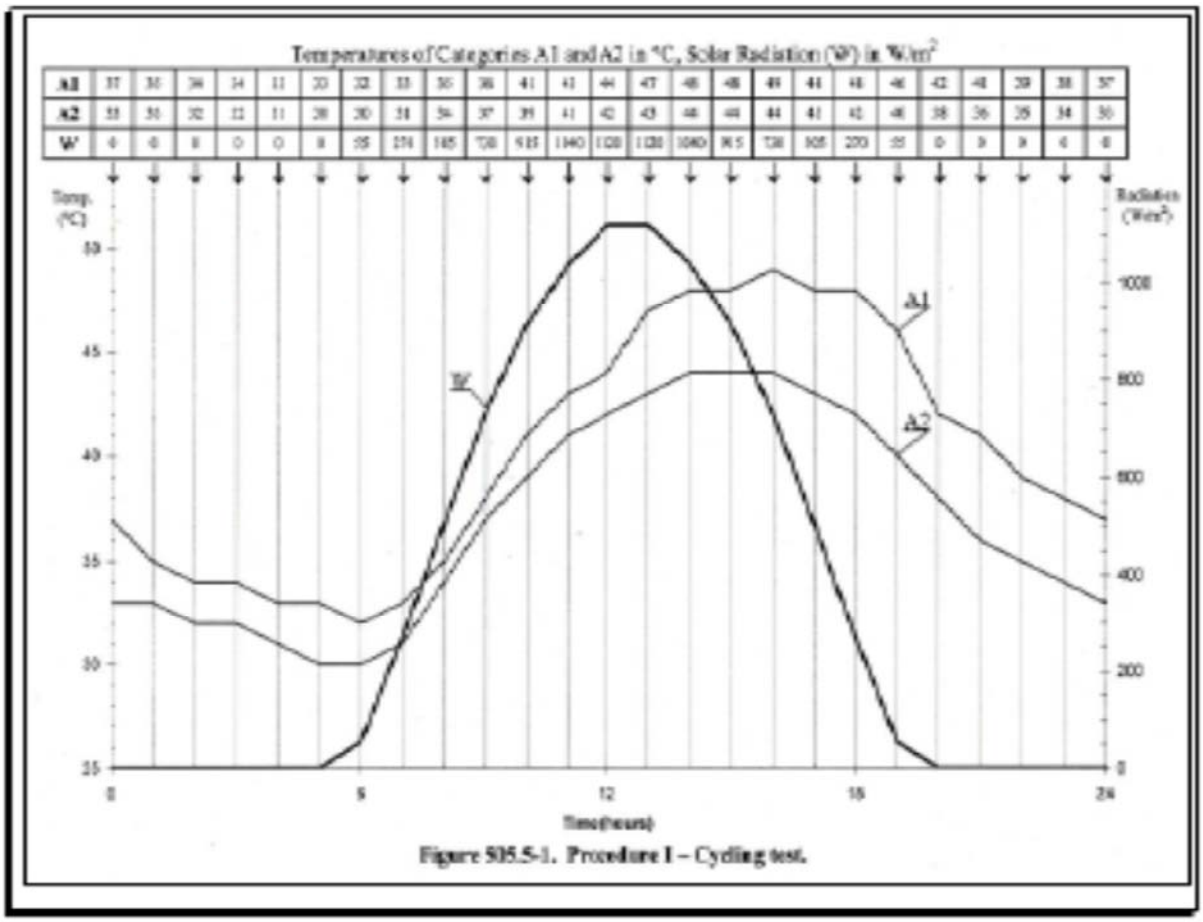

Figure 30 – Solar Radiation Exposure Curve

3.20 Dust – Group 5

Dust testing was performed in accordance with MIL-STD-810G, Method 510.5, Procedure I. Mated specimens were placed in the test chamber, and stabilized at a temperature of 55°C. The air velocity was then adjusted to 8.9 m/sec, and the dust feed control adjusted to a dust concentration of 10.6 +/- 7 g/m^3. These conditions were maintained for a period of 6 hours. The dust feed was then stopped, and the air velocity was reduced to 1.5 +/- 1 m/sec while the chamber was maintained at a temperature of 55°C. These conditions were maintained for a period of 1 hour. The air velocity was then adjusted to 8.9 m/sec, and the dust feed control adjusted to a dust concentration of 10.6 +/- 7 g/m^3. These conditions were maintained for another period of 6 hours. The dust feed was then stopped, the test chamber was allowed to return to room ambient conditions, the air flow was stopped, and the dust was allowed to settle. Accumulated dust was removed from the test specimens by shaking and brushing prior to post-test measurements.

4. EQUIPMENT

4.1 Calibration Statement

All equipment containing a calibration number is calibrated and traceable through TE Connectivity (TE) to the National Institute of Standards and Technology (NIST).

4.2 Equipment List

Equipment Name	Calibration Number	
Ambient Temperature/Humidity Monitoring System	E9100-1703	
Specified Current Station #2 Multimeter	E9100-1146	
Specified Current Station #2 Power Supply	E9100-1147	
Power Supply	E9100-1810	
Shunt 50A/25mV	E9100-0653	
Digital Multimeter	E9100-1811	
Slot 1 Acquisition Module	E9100-1823	
Slot 2 Acquisition Module	E9100-1824	
Slot 3 Acquisition Module	E9100-1825	
Load Frame	E9100-1729	
Load Cell	E9100-1730	
“Pig-Tail” Connector Fixture	39-1824440	N/A
Overmolded Connector Fixture (.300” x .082” Slotted Plate)	N/A	
Altitude Chamber	E9100-1927	
Discontinuity Event Detector	E9100-1813	
Control Accelerometer	E9100-1262	
Dytran Accel. Power Supply	E9100-1887	
Vibration Controller	E9100-1306	
Discontinuity Event Detector	E9100-1971	
Vibration Table & Amplifier EM-1104	N/A	
Base Plate 99-466854-1	N/A	
Test Fixture 39-1824540-1	N/A	
Clamping Bars	N/A	
Metal Scale, 4 Ft.	N/A	
Temperature Cycling Chamber	E9100-1310	
Temperature - Humidity Chamber	E9100-1682	
Salt Fog Corrosion Chamber	E9100-1814	
PH Meter calibrated to three buffer solution standards	E9100-1751/1752/1753	
Watlow F4 Process Controller	E9100-1866	
Cargo Fixture Bottom Plate	39-1824678-1	N/A
Cargo Fixture Side 39-1824679-1	N/A	

Appendix A

Test Plan Utilizing Outside Resources
EA20140668T, Rev. C

Verification Test Plan

EA20140668T, Rev. C

3/3/15

Prepared By: Lee W. Schaeffer

Quick Disconnect Circular Plug and Receptacle Connectors Phase III Verification Testing Utilizing Outside Resources

1. Test Protocol and Specimens

1.1 Verification Test Protocol

The test specimens shall be subjected to the verification tests in Table 1.

Table 1 – Verification Test Protocol

Test or Examination	Test Sequence[1]
Visual Examination	1, 5, 9, 13, 17
Voltage Drop @ 1 Adc	2, 6, 10, 14, 18
Insulation Resistance @ 500 Vdc	3, 7, 11, 15, 19
Rain	4
Snow & Ice[2]	8
Solar Radiation	12
Dust	16

Note 1: Numbers indicate sequence in which tests are to be performed.
Note 2: Snow & Ice test requires insitu Voltage Drop and Insulation Resistance measurements in addition to post-test measurements. See Paragraph 2.5.

1.2 Test Specimen Quantities

The test specimens shall be allocated to as indicated in Table 2.

Table 2 – Test Specimen Quantities

Test Group	Cable Assembly Qty	Component Type
5	2	Plug
	2	Receptacle

1.3 Test Specimen Configuration

Plug and receptacle connectors are 6-position quick-disconnect circular electrical connectors. A mated connector pair measures approximately 1.5 inches long, and 0.5 inches in diameter. The cabled configuration submitted for testing is as follows:

- 6-position plug and receptacle "pig-tail" specimens in Test Groups 1, 3, and 4 will be terminated with approximately 8 inches of appropriate 6-conductor cable. The "pig-tail" specimens will be mated to double-ended production cable assemblies approximately 20 inches in length. The overall assemblies will be pre-wired into two series circuits. Series circuit #1 shall consist of the three odd numbered contact positions (1, 3, and 5), wired to form one series circuit. Series circuit #2 shall consist of the three even numbered contact positions (2, 4, and 6), wired to form a second series circuit.

2. Test Methods

Tests shall be performed at a temperature of 15°C to 35°C and at 20% to 80% relative humidity, unless otherwise indicated. Tolerances on time intervals shall be +/-5% unless otherwise indicated. Tolerances on test current shall be +/- 2% unless otherwise indicated.

2.1 Visual Examination

Method

Specimens shall be visually examined to the extent possible. Document any visual evidence of physical damage.

Requirement

No visual evidence of physical damage.

2.2 Voltage Drop @ 1 Adc

Method

Series circuits #1 and #2 shall be combined to form one series circuit. The combined series circuit shall be energized at 1 Adc. The voltage drop across each of the six mated contact positions shall be measured using the pre-attached probe leads.

Requirement

No requirement defined. Provide all measured data.

2.3 Insulation Resistance @ 500 Vdc

Measurement A – All Contact Positions to Shield

Series circuits #1 and #2 shall be combined to form one series circuit. A voltage of 500 Vdc shall be applied between the combined series circuit and the cable/connector shield for a minimum of 1 second, and the insulation resistance measured.

Measurement B – Between Contact Positions

Series circuits #1 and #2 shall be separated into their two pre-wired series circuits. A voltage of 500 Vdc shall be applied between series circuits #1 and #2 for a minimum of 1 second, and the insulation resistance measured.

Requirement

Insulation Resistance measurements at 500 Vdc shall be greater than the minimum requirement of 100 Megohms. Provide all measured data.

2.4 Rain

Method

Rain testing shall be performed in accordance with MIL-STD-810G, Method 506.5, Procedure II (Exaggerated). The test procedures shall be as follows:

1. Combine series circuits #1 and #2 to form one series circuit. During testing, monitor the series circuit for discontinuities greater than 1 microsecond using a test current of 100 milliamperes. Discontinuities occurring during intentional unmating of the test item shall not be considered a failure.
2. Use a nozzle that produces a spray pattern with a droplet size predominately in the 0.45 mm to 0.5 mm range travelling at approximately 64 km/h (40 mph) at approximately 276 kPa (40 psig).
3. Spray all exposed surfaces of the test item for 40 minutes.
4. Unmate the test item, inspect the interior of the item for evidence of moisture ingress. If no moisture present, mate the test item and proceed.
5. Perform Steps 1 through 3 in two orthogonal axes perpendicular to the long axis of the connector, for a total of two cycles.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.5 Snow and Ice

Method

Snow and Ice testing shall be performed in accordance with MIL-STD-810G, Method 521.3, Glaze Ice Procedure for 6 millimeter Ice Thickness. The test procedure shall be as follows:

1. Combine series circuits #1 and #2 to form one series circuit. During testing, monitor the series circuit for discontinuities greater than 1 microsecond using a test current of 100 milliamperes. Discontinuities occurring during intentional unmating of the test item shall not be considered a failure.
2. Place the mated test specimens in the test chamber, adjust the air temperature to 0°C (-0 / +2°C), and maintain for a minimum of 1 hour to allow test specimens to stabilize at temperature.
3. Deliver a uniform, pre-cooled (0 to 3°C) water spray at a rate of approximately 25 mm/hour for 1 hour to allow water penetration into the test specimen crevices/openings.
4. Adjust the chamber air temperature to -10°C, and maintain the water spray rate until 6 millimeters of ice has accumulated on the surface of the test specimens. Wind or a side spray may be used to assist accumulation of ice on the sides of the test item.
5. Maintain the chamber air temperature for a minimum period of 4 hours to allow ice to harden.
6. Manually unmate and remate each mated test specimen. The operator may remove the amount of ice necessary to accomplish the unmate/remate cycle using only standard items available in the field. Immediately following the mating cycle, complete the following:
    a. Measure the voltage drop in accordance with Paragraph 2.2.
    b. Measure the insulation resistance in accordance with Paragraph 2.3.
7. Adjust the chamber air temperature to standard ambient conditions.

2.5 Snow and Ice (cont.)

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.6 Solar Radiation

Method

Solar Radiation testing shall be performed in accordance with MIL-STD-810G, Method 505.5, Procedure I, Cycle A1, for three continuous cycles. The test procedure shall be as follows:

1. Place the mated test specimen in the test chamber, and adjust the air temperature to the minimum value of the temperature cycle at which radiation is nonexistent.
2. Expose the test specimen to three continuous 24-hour cycles of controlled simulated radiation and dry-bulb temperature as indicated for Cycle A1 of Figure 1.
3. Adjust the chamber air temperature to standard ambient conditions.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

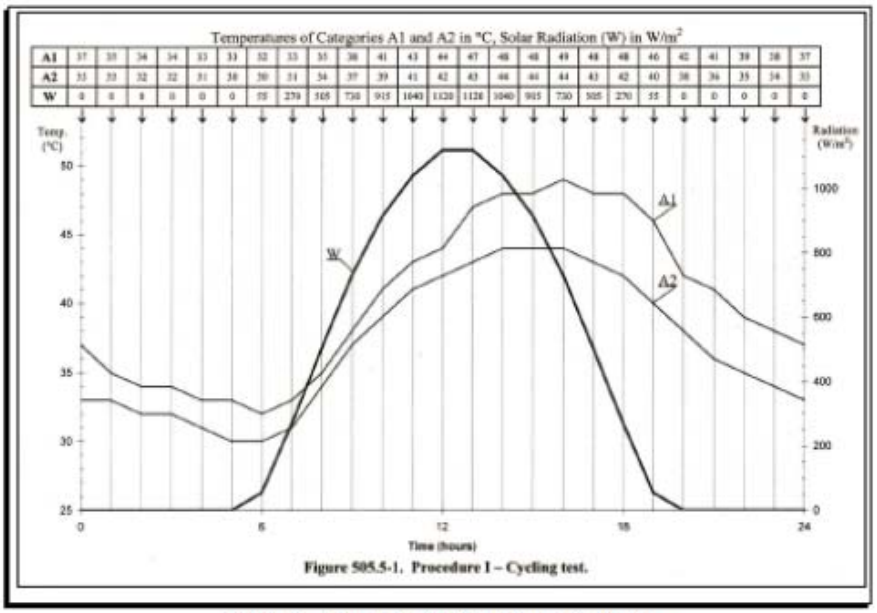

Figure 1 – Solar Radiation Exposure Curve

2.7 Dust

Method

Dust testing shall be performed in accordance with MIL-STD-810G, Method 510.5, Procedure I. The test procedures shall be as follows:

Procedure I – Blowing Dust (Red China Clay or Silicon Flour)

1. Place the mated test specimens in the chamber, and stabilize at a temperature of 55°C. Adjust the air velocity to 8.9 m/sec.
2. Adjust the dust feed control for a dust concentration of 10.6 +/- 7 g/m^3.
3. Maintain the conditions of Steps 1 and 2 for a period of 6 hours.
4. Stop the dust feed. Reduce the test section air velocity to 1.5 +/- 1 m/sec, and maintain the temperature at 55°C.
5. Maintain the conditions of Step 4 for a period of 1 hour.
6. Adjust the air velocity to 8.9 m/sec, and adjust the dust feed control for a dust concentration of 10.6 +/- 7 g/m^3.
7. Maintain the conditions of Step 6 for a period of 6 hours.
8. Stop the dust feed, and allow the test item to return to standard ambient conditions at a rate not to exceed 3°C/min. Stop any air flow, and allow the dust to settle.
9. Remove accumulated dust from the test specimens by brushing, wiping, or shaking. Do not remove dust by either air blast or vacuum cleaning.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

3. Documentation Requirements

Documentation of each test performed shall be provided, and shall include, as a minimum, the following:

1. Title of test report.
2. A unique identification number for the report, and on each page an identification in order to ensure that the page is recognized as a part of the test report.
3. The name and location of the test laboratory performing the testing.
4. The name of the person(s) issuing the report.
5. The name of the test requester (TE Connectivity).
6. Date(s) test performed.
7. Name(s) of operator(s).
8. Ambient temperature and humidity at time of test.
9. Description(s) of the item(s) tested.
10. Statement of results, including measured values (if applicable), any observations and/or anomalies, and results of final visual examination. Where damage or anomalies are observed, photographs shall be included.
11. Detailed description of test procedure, including a statement of all test parameters.
12. List of all equipment used, including manufacturer, model number, date of last calibration and calibration interval.

4. Outsourcing of Testing

Outsourcing of testing to a third party test laboratory shall not be performed without advance approval of the TE Connectivity Contact Person identified in this test plan.

5. Laboratory Certification

Testing shall be performed at an ISO 17025 and/or ISO 9001 certified laboratory unless otherwise authorized by the TE Connectivity Contact Person identified in this test plan. A copy of the laboratory's authorization certificate(s) shall be provided prior to the start of testing.

6. Contact Information

Contact Person: Lee W. Schaeffer
Manager, Test Engineering
Harrisburg Electrical Components Test Laboratory
TE Connectivity
(717) 810-3536
lwschaef@te.com

Street Address: TE Connectivity
2100 Paxton Street
Harrisburg, PA 17111

Mailing Address: TE Connectivity
M.S. 018-001
P.O. Box 3608
Harrisburg, PA 17105

7. Revision Record

Table 3 – Revision Record

Revision Level	Description of Change	Date
A	Original Release	11/20/14
B	Complete revision to test plan in accordance with revised customer requirements.	12/19/14
C	Revise Test Specimen Configuration description. Change Voltage Drop test current from 3 Adc to 1 Adc.	3/3/15

Appendix B

Test Plan Utilizing the TE Connectivity Harrisburg Electrical Components Test Laboratory (HECTL) Resources EA20140668T-1, Rev. A

Verification Test Plan

EA20140668T-1, Rev. A

3/2/15

Prepared By: Lee W. Schaeffer

Quick Disconnect Circular Plug and Receptacle Connectors Phase III Verification Testing Utilizing HECTL Resources

1. Test Protocol and Specimens

1.1 Verification Test Protocol

The test specimens shall be subjected to the verification tests in Table 1.

Table 1 – Verification Test Protocol

Test or Examination	Test Sequence[1]			
	Test Group 1	Test Group 2	Test Group 3	Test Group 4
Visual Examination	1, 5	1, 5, 9, 13, 17, 21	1, 5, 9, 13	1, 5, 9, 13, 17
Voltage Drop @ 1 Adc	2	2, 6, 10, 14, 18, 22	2, 6, 10, 14	2, 6, 10, 14, 18
Insulation Resistance @ 500 Vdc	3	3, 7, 11, 15, 19, 23	3, 7, 11, 15	3, 7, 11, 15, 19
Breakaway Force	4			16
Strength				
Altitude – Procedure I		4		
Altitude – Procedure II		8		
Vibration – Procedure I		12		
Vibration – Procedure II		16		
Shock		20		
High Temperature – Procedure II			4	
High Temperature – Procedure I			8	
Low Temperature – Procedure II			12	
Humidity – Induced Storage & Transit				4
Humidity – Natural Environment Operational				8
Salt Spray				12

Note 1: Numbers indicate sequence in which tests are to be performed.

1.2 Test Specimen Quantities

The test specimens shall be allocated to as indicated in Table 2.

Table 2 – Test Specimen Quantities

Test Group	Cable Assembly Qty	Component Type
1	2	Plug
	2	Receptacle
2	2	Plug
	2	Receptacle
3	2	Plug
	2	Receptacle
4	2	Plug
	2	Receptacle

1.3 Test Specimen Configuration

Plug and receptacle connectors are 6-position quick-disconnect circular electrical connectors. A mated connector pair measures approximately 1.5 inches long, and 0.5 inches in diameter. The cabled configuration submitted for testing is as follows:

- 6-position plug and receptacle "pig-tail" specimens in Test Groups 1, 3, and 4 will be terminated with approximately 8 inches of appropriate 6-conductor cable. The "pig-tail" specimens will be mated to double-ended production cable assemblies approximately 20 inches in length. The overall assemblies will be pre-wired into two series circuits. Series circuit #1 shall consist of the three odd numbered contact positions (1, 3, and 5), wired to form one series circuit. Series circuit #2 shall consist of the three even numbered contact positions (2, 4, and 6), wired to form a second series circuit.
- 6-position plug and receptacle "pig-tail" specimens in Test Group 2 will be terminated with approximately 12 inches of appropriate 6-conductor cable. The "pig-tail" specimens will be mated to double-ended production cable assemblies approximately 20 inches in length. The overall assemblies will be pre-wired into two series circuits. Series circuit #1 shall consist of the three odd numbered contact positions (1, 3, and 5), wired to form one series circuit. Series circuit #2 shall consist of the three even numbered contact positions (2, 4, and 6), wired to form a second series circuit.

2. Test Methods

Tests shall be performed at a temperature of 15°C to 35°C and at 20% to 80% relative humidity, unless otherwise indicated. Tolerances on time intervals shall be +/-5% unless otherwise indicated. Tolerances on test current shall be +/- 2% unless otherwise indicated.

2.1 Visual Examination

Method

Specimens shall be visually examined to the extent possible. Document any visual evidence of physical damage.

Requirement

No visual evidence of physical damage.

2.2 Voltage Drop @ 1 Adc

Method

Series circuits #1 and #2 shall be combined to form one series circuit. The combined series circuit shall be energized at 1 Adc. The voltage drop across each of the six mated contact positions shall be measured using the pre-attached probe leads.

Requirement

No requirement defined. Provide all measured data.

2.3 Insulation Resistance @ 500 Vdc

Measurement A – All Contact Positions to Shield

Series circuits #1 and #2 shall be combined to form one series circuit. A voltage of 500 Vdc shall be applied between the combined series circuit and the cable/connector shield for a minimum of 1 second, and the insulation resistance measured.

Measurement B – Between Contact Positions

Series circuits #1 and #2 shall be separated into their two pre-wired series circuits. A voltage of 500 Vdc shall be applied between series circuits #1 and #2 for a minimum of 1 second, and the insulation resistance measured.

Requirement

Insulation Resistance measurements at 500 Vdc shall be greater than the minimum requirement of 100 Megohms. Provide all measured data.

2.4 Breakaway Force

Method

1. Test each mating connector pair of an overall assembly individually.
2. Secure the "pig-tail" assembly to the base of a Tensile/Compression test system, and secure the mating end of the production cable assembly to the moving cross-head.
3. Apply an axial force to the mated assembly until the connectors unmate.
4. Record the maximum force as the Breakaway Force.

Requirement

1. The Breakaway Force shall be 13 +/- 3 pounds.

2.5 Strength

Method

1. Test each connector of a double-ended production assembly individually.
2. Secure the connector to the base of a Tensile/Compression test system, and secure the cable to the moving cross-head 6 to 12 inches from the connector.
3. Apply an axial force of 100 pounds assembly, and hold for 30 seconds.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.6 Altitude – Procedure I (Storage)

Method

Storage Altitude testing shall be performed in accordance with MIL-STD-810G, Method 500.5, Procedure I. The test procedure shall be as follows:

1. Place the mated test specimens in the test chamber, and adjust the pressure to a simulated altitude of 40,000 feet.
2. Expose the test specimen to the simulated altitude for 1 hour.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.7 Altitude – Procedure II (Operational)

Method

Operational Altitude testing shall be performed in accordance with MIL-STD-810G, Method 500.5, Procedure II. The test procedure shall be as follows:

1. Place the mated test specimens in the test chamber, and adjust the pressure to a simulated altitude of 32,000 feet.
2. Expose the test specimen to the simulated altitude for 1 hour. During the exposure, monitor for discontinuities greater than 1 microsecond.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.8 Vibration – Procedure I (General Vibration)

Method

General Vibration testing shall be performed in accordance with MIL-STD-810G, Method 514.6, Annex E, Procedure I. The test procedure shall be as follows:

1. Secure each mated end of the production cable assembly in the vibration fixture. Secure both the cable of the production cable assembly and the cables of the "pig-tail" assemblies to non-vibrating surfaces approximately 8" from the mated connectors.
2. Subject the specimens to the vibration profile illustrated in Figure 1 (20 to 2000 Hz, 7.7 grms) for 1 hour in both the lateral and longitudinal axes, for a total vibration duration of 2 hours. During the test, monitor for discontinuities greater than 1 microsecond.
3. Following the first axis, measure the Voltage Drop and Insulation Resistance, per Paragraphs 2.2 and 2.3 respectively.

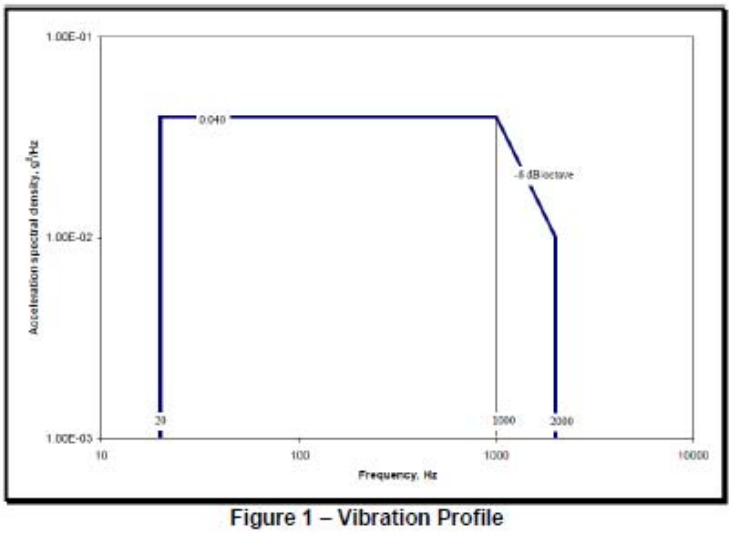

Figure 1 – Vibration Profile

2.8 Vibration – Procedure I (General Vibration) – (cont.)

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.9 Vibration – Procedure II (Loose Cargo)

Method

Loose Cargo Vibration testing shall be performed in accordance with MIL-STD-810G, Method 514.6, Category 5, Procedure II, for 20 minutes. The test procedure shall be as follows:

1. Testing shall be performed using a package tester setup in accordance with Figure 2. The length of each side of the square test area shall be approximately 21.75 inches. (Based on a production assembly test specimen length of approximately 20 inches and a connector diameter of approximately 0.5 inches, and using Equation (3) of MIL-STD-810G, Method 514.6, Annex C, Paragraph 2.2.c.) The movement of the package tester bed shall be a 1.0 inch diameter orbital path at 5 Hz.
2. Place the unmated production assembly test specimens in the test area in a non-uniform manner, and subject them to the prescribed motion for a period of 20 minutes.
3. Visually examine the mated test specimens to the extent possible. Document any evidence of physical damage.

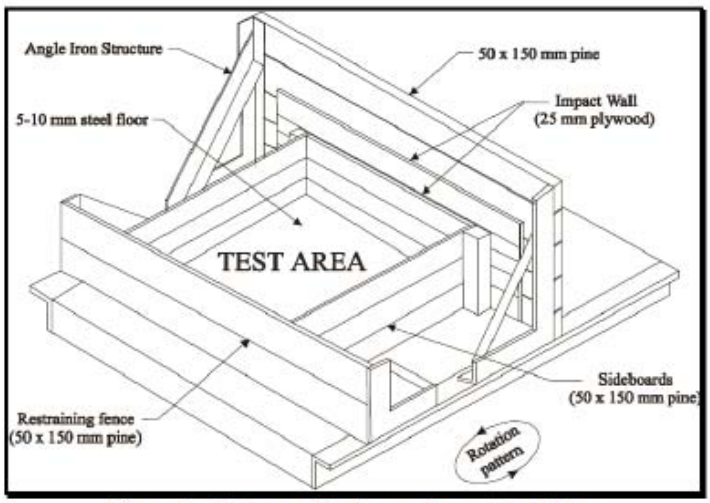

Figure 2 – Category 5 – Loose Cargo Test Setup

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.10 Shock (Transit Drop)

Method

Transit Drop Shock testing shall be performed in accordance with MIL-STD-810G, Method 516.6, Procedure IV. The test procedure shall be as follows:

1. Drop the mated test specimens from a height of 48 inches onto a concrete surface.
2. Perform a total of nine drops, re-orienting the assembly approximately 40 degrees from its previous orientation with each drop.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.11 High Temperature – Procedure II (Operation)

Method

Operation High Temperature testing shall be performed in accordance with MIL-STD-810G, Method 501.5, Procedure II. The test procedure shall be as follows:

1. Place the mated test specimens in the test chamber, and subject them to three cycles of the temperature profile defined in Table 3.
2. During the exposure, monitor for discontinuities greater than 1 microsecond.
3. During each cycle, measure the Voltage Drop and Insulation Resistance, per Paragraphs 2.2 and 2.3 respectively, during the time of maximum thermal response.

Table 3 – Operation High Temperature Profile

Hour	Temperature (Deg. C)	Hour	Temperature (Deg. C)
1	36	13	48
2	40	14	46
3	44	15	44
4	48	16	42
5	52	17	40
6	55	18	38
7	55	19	36
8	55	20	34
9	55	21	32
10	55	22	30
11	52	23	30
12	50	24	33

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.12 High Temperature – Procedure I (Storage)

Method

Storage High Temperature testing shall be performed in accordance with MIL-STD-810G, Method 501.5, Procedure I. The test procedure shall be as follows:

1. Place the mated test specimens in the test chamber, and subject them to seven cycles of the temperature profile defined in Table 4.

Table 4 – Storage High Temperature Profile

Hour	Temperature (Deg. C)	Hour	Temperature (Deg. C)
1	42	13	58
2	48	14	54
3	54	15	50
4	59	16	46
5	64	17	43
6	68	18	40
7	71	19	37
8	71	20	34
9	69	21	32
10	67	22	30
11	64	23	33
12	61	24	37

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.13 Low Temperature – Procedure II (Operation)

Method

Operation Low Temperature testing shall be performed in accordance with MIL-STD-810G, Method 502.5, Procedure II. The test procedure shall be as follows:

1. Place the mated test specimens in the test chamber, and subject them to a temperature of -18 deg. C for a period of six hours.
2. During the exposure, monitor for discontinuities greater than 1 microsecond.
3. At hour three of the six hour exposure, measure the Voltage Drop and Insulation Resistance, per Paragraphs 2.2 and 2.3 respectively, during the time of maximum thermal response.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.14 Humidity – Procedure I (Induced Storage and Transit)

Method

Induced Storage and Transit Humidity testing shall be performed in accordance with MIL-STD-810G, Method 507.5, Procedure I. The test procedure shall be as follows:

1. Place the mated test specimens in the test chamber, and subject them to three cycles of the Induced Storage and Transit temperature/humidity profile defined in Column B2 of Figure 3.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.15 Humidity – Procedure I (Natural - Operational)

Method

Natural Humidity testing shall be performed in accordance with MIL-STD-810G, Method 507.5, Procedure I. The test procedure shall be as follows:

1. Place the mated test specimens in the test chamber, and subject them to three cycles of the Natural temperature/humidity profile defined in Column B2 of Figure 3.
2. During the exposure, monitor for discontinuities greater than 1 microsecond.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

2.16 Salt Atmosphere

Method

Salt Atmosphere testing shall be performed in accordance with MIL-STD-810G, Method 509.5. The test procedure shall be as follows:

1. Place the unmated test specimens in the test chamber.
2. Expose the test specimen to the standard salt spray conditions of 5% salt concentration at 35 deg. C for 24 hours.
3. Remove the specimens from the chamber, and allow to dry at ambient conditions for a period of 24 hours.
4. Repeat steps 1 through 3.

Post-Test Requirement

1. Visual Examination in accordance with Paragraph 2.1.
2. Voltage Drop in accordance with Paragraph 2.2.
3. Insulation Resistance in accordance with Paragraph 2.3.

Time	Natural[1]								Induced (Storage & Transit)							
	High Humidity				Hot Humid (Cycle B3)				Constant Temp. (Cycle B1)		Cyclic High RH (Cycle B2)			Hot Humid (Cycle B3)		
	Constant Temp. (Cycle B1)		Cyclic High RH (Cycle B2)													
	Temp.	RH	Temp.		RH	Temp.		RH	Temp.	RH	Temp.		RH	Temp.		RH
		%	°F	°C	%	°F	°C	%		%	°F	°C	%	°F	°C	%
0000	Nearly constant at 24°C (75°F) throughout the 24 hours.	100[2]	80	27	100	88	31	88	Nearly constant at 27°C (80°F) throughout the 24 hours.	100[2]	91	33	68	95	35	63
0100		100	80	27	100	88	31	88		100	91	33	69	95	35	67
0200		100	79	26	100	88	31	88		100	90	32	70	94	34	72
0300		100	79	26	100	88	31	88		100	90	32	71	94	34	75
0400		100	79	26	100	88	31	88		100	88	31	72	93	34	77
0500		100	78	26	100	88	31	88		100	86	30	74	92	33	79
0600		100	78	26	100	90	32	85		100	88	31	75	91	33	80
0700		98	81	27	94	93	34	80		98	93	34	64	97	36	70
0800		97	84	29	88	96	36	76		97	101	38	54	104	40	54
0900		95	87	31	82	98	37	73		95	107	42	43	111	44	42
1000		95	89	32	79	100	38	69		95	113	45	36	124	51	31
1100		95	92	33	77	102	39	65		95	124	51	29	135	57	24
1200		95	94	34	75	104	40	62		95	134	57	22	144	62	17
1300		95	94	34	74	105	41	59		95	142	61	21	151	66	16
1400		95	95	35	74	105	41	59		95	145	63	20	156	69	15
1500		95	95	35	74	105	41	59		95	145	63	19	160	71	14
1600		95	93	34	76	105	41	59		95	144	62	20	156	69	16
1700		95	92	33	79	102	39	65		95	140	60	21	151	66	18
1800		95	90	32	82	99	37	69		95	134	57	22	145	63	21
1900		97	88	31	86	97	36	73		97	122	50	32	136	58	29
2000		98	85	29	91	94	34	79		98	111	44	43	122	50	41
2100		100	83	28	95	91	33	85		100	101	38	54	105	41	53
2200		100	82	28	96	90	32	85		100	95	35	59	103	39	58
2300		100	81	27	100	89	32	88		100	93	34	63	99	37	62
2400		100	80	27	100	88	31	88		100	91	33	68	95	35	63

Figure 3 – Temperature/Humidity Profile for Natural and Induced (Storage & Transit) Conditions

3. Documentation Requirements

Documentation of each test performed shall be provided, and shall include, as a minimum, the following:

1. Title of test report.
2. A unique identification number for the report, and on each page an identification in order to ensure that the page is recognized as a part of the test report.
3. The name and location of the test laboratory performing the testing.
4. The name of the person(s) issuing the report.
5. The name of the test requester (TE Connectivity).
6. Date(s) test performed.
7. Name(s) of operator(s).
8. Ambient temperature and humidity at time of test.
9. Description(s) of the item(s) tested.
10. Statement of results, including measured values (if applicable), any observations and/or anomalies, and results of final visual examination. Where damage or anomalies are observed, photographs shall be included.
11. Detailed description of test procedure, including a statement of all test parameters.
12. List of all equipment used, including manufacturer, model number, date of last calibration and calibration interval.

4. Outsourcing of Testing

Outsourcing of testing to a third party test laboratory shall not be performed without advance approval of the TE Connectivity Contact Person identified in this test plan.

5. Laboratory Certification

Testing shall be performed at an ISO 17025 and/or ISO 9001 certified laboratory unless otherwise authorized by the TE Connectivity Contact Person identified in this test plan. A copy of the laboratory's authorization certificate(s) shall be provided prior to the start of testing.

6. Contact Information

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TE Connectivity
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lwschaef@te.com

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Mailing Address: TE Connectivity
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Harrisburg, PA 17105

7. Revision Record

Table 3 – Revision Record

Revision Level	Description of Change	Date
A	Original Release	3/2/15

Appendix C

Voltage Drop @ 1 Adc
Test Results

Appendix C – Voltage Drop @ 1 Adc

Table C.1 – Test Group 1, Voltage Drop at 1 Adc (Units: millivolts)

Connector Position	Initial	
	101	102
1	59	58
2	56	56
3	57	56
4	127	127
5	132	131
6	56	56

Table C.2 – Test Group 2, Voltage Drop at 1 Adc (Units: millivolts)

Connector Position	Initial		Post Altitude Procedure I		Post Altitude Procedure II	
	201	202	201	202	201	202
1	69	69	69	69	69	69
2	70	70	70	70	70	70
3	68	68	68	68	68	68
4	154	154	153	154	154	154
5	160	160	159	159	159	160
6	69	69	69	69	69	69
Connector Position	**Post Vibration Procedure I**		**Post Shock**		**Post Vibration Procedure II**	
	201	202	201	202	201	202
1	69	69	69	69	69	69
2	70	70	70	70	70	70
3	68	68	68	68	68	68
4	153	154	154	155	154	154
5	159	160	160	160	159	160
6	69	69	69	69	69	69

Table C.3 – Test Group 3, Voltage Drop at 1 Adc (Units: millivolts)

Connector Position	Initial		Post High Temp Procedure II		Post High Temp Procedure I		Post Low Temp Procedure II	
	301	302	301	302	301	302	301	302
1	58	58	58	58	57	58	58	58
2	59	60	59	60	59	59	59	60
3	58	57	58	58	57	57	58	58
4	128	129	129	129	127	128	128	129
5	132	133	132	134	131	132	132	134
6	57	58	57	58	57	57	57	58

Table C.4 – Test Group 3, Voltage Drop at 1 Adc During Exposure (Units: millivolts)

Connector Position	Cycle 1 High Temp Procedure II		Cycle 2 High Temp Procedure II		Cycle 3 High Temp Procedure II		Hour 3 Low Temp Procedure II	
	301	302	301	302	301	302	301	302
1	64	64	64	64	64	64	49	50
2	65	66	65	66	65	66	50	51
3	64	63	64	64	64	64	49	49
4	142	143	142	143	143	143	108	108
5	146	148	147	148	147	148	111	112
6	63	64	63	64	63	64	49	49

Appendix C – Voltage Drop @ 1 Adc *(continued)*

Table C.5 – Test Group 4, Voltage Drop at 1 Adc (Units: millivolts)

Connector Position	Initial		Post Humidity Storage		Post Humidity Operational		Post Salt Spray		Post Strength Test	
	401	402	401	402	401	402	401	402	401	402
1	58	57	58	57	58	57	58	57	58	57
2	58	58	58	58	61	58	59	58	59	59
3	57	56	57	56	57	56	57	56	57	57
4	127	127	126	127	127	127	127	127	128	128
5	131	131	131	131	131	131	131	131	132	132
6	57	57	57	57	57	57	57	57	57	57

Table C.6 – Test Group 5, Voltage Drop at 1 Adc (Units: millivolts)

Connector Position	Initial @ TE Connectivity		Initial @ E-Labs, Inc.		Post Rain		Post Snow & Ice	
	501	502	501	502	501	502	501	502
1	56	57	56	56	57	57	57	54
2	56	58	56	57	56	58	56	56
3	56	56	58	56	56	56	57	56
4	124	126	123	124	127	125	130	130
5	126	130	125	128	127	129	129	129
6	56	57	55	55	55	56	58	58

Connector Position	Post Solar Radiation		Post Dust		Final @ TE Connectivity			
	501	502	501	502	501	502		
1	55	211	56	114	56	56		
2	58	82	56	86	57	58		
3	56	100	56	3	56	56		
4	116	99	123	95	124	126		
5	125	127	125	127	125	130		
6	56	56	55	151	56	56		

Note: Specimen 502 began to exhibit erratic voltage drop results following the Solar Radiation testing. It was suspected that water ingress into the unsealed single-ended “pig-tail” support cable assemblies (see Figure C.1) compromised the integrity of the wire terminations of those assemblies. Upon return of the test specimens from E-Labs to TE Connectivity, the TYAD production cable assemblies were mated to unconditioned single-ended “pig-tail” support cable assemblies, and voltage drop measurements were taken. The results were in line with the initial measurements, confirming that the unsealed single-ended “pig-tail” support cable assemblies were the root cause of the erratic results.

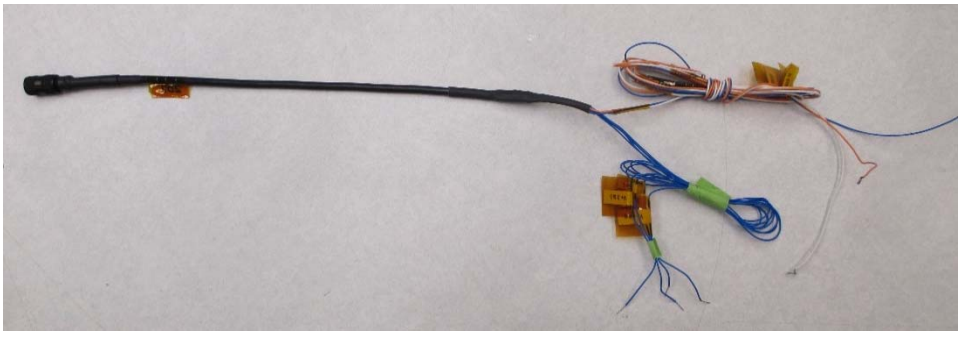

Figure C.1 – Unsealed Single-Ended “Pig-Tail” Support Cable Assembly

Appendix D

Insulation Resistance Test Results

Appendix D – Insulation Resistance

Table D.1 – Test Group 1, Insulation Resistance (Units: Megohms)

Measurement ID	Initial	
	101	102
Odd – Even	7.4×10^4	9.9×10^4
All – Sheild	5.8×10^4	8.2×10^4

Table D.2 – Test Group 2, Insulation Resistance (Units: Megohms)

Measurement ID	Initial		Post Altitude Procedure I		Post Altitude Procedure II	
	201	202	201	202	201	202
Odd – Even	5.6×10^4	4.4×10^4	4.4×10^4	4.2×10^4	3.3×10^4	4.0×10^4
All – Sheild	2.4×10^4	2.3×10^4	1.9×10^4	2.1×10^4	1.7×10^4	2.5×10^4
Measurement ID	**Post Vibration Procedure I**		**Post Shock**		**Post Vibration Procedure II**	
	201	202	201	202	201	202
Odd – Even	4.3×10^4	4.4×10^4	3.4×10^4	2.7×10^4	2.7×10^4	2.5×10^4
All – Sheild	2.0×10^4	2.1×10^4	1.6×10^4	1.5×10^4	1.4×10^4	1.2×10^4

Table D.3 – Test Group 3, Insulation Resistance (Units: Megohms)

Measurement ID	Initial		Post High Temp Procedure II		Post High Temp Procedure I		Post Low Temp Procedure II	
	301	302	301	302	301	302	301	302
Odd – Even	7.8×10^4	$> 1.0 \times 10^5$	7.6×10^4	$> 1.0 \times 10^5$	$> 1.0 \times 10^5$	$> 1.0 \times 10^5$	7.5×10^4	$> 1.0 \times 10^5$
All – Sheild	5.0×10^4	7.2×10^4	3.9×10^4	2.2×10^4	6.2×10^4	2.5×10^4	4.5×10^4	2.1×10^4

Table D.4 – Test Group 3, Insulation Resistance During Exposure (Units: Megohms)

Measurement ID	Cycle 1 High Temp Procedure II		Cycle 2 High Temp Procedure II		Cycle 3 High Temp Procedure II		Hour 3 Low Temp Procedure II	
	301	302	301	302	301	302	301	302
Odd – Even	1.0×10^4	1.6×10^4	1.2×10^4	1.9×10^4	1.7×10^4	2.1×10^4	$> 1.0 \times 10^5$	$> 1.0 \times 10^5$
All – Sheild	5.8×10^3	8.7×10^3	6.3×10^3	9.4×10^3	6.7×10^3	9.8×10^3	$> 1.0 \times 10^5$	$> 1.0 \times 10^5$

Table D.5 – Test Group 4, Insulation Resistance During Exposure (Units: Megohms)

Measurement ID	Initial		Post Humidity Storage		Post Humidity Operational		Post Salt Spray		Post Strength Test	
	401	402	401	402	401	402	401	402	401	402
Odd – Even	7.4×10^4	2.6×10^4	4.4×10^4	1.4×10^4	3.4×10^4	1.3×10^4	2.2×10^4	1.4×10^4	3.4×10^4	5.6×10^3
All – Sheild	3.6×10^4	1.1×10^4	2.3×10^4	5.4×10^3	1.7×10^4	4.9×10^3	1.6×10^2	6.3×10^3	1.9×10^4	4.5×10^3

Appendix D – Insulation Resistance

Table D.6 – Test Group 5, Insulation Resistance During Exposure (Units: Megohms)

Measurement ID	Initial @ TE Connectivity		Initial @ E-Labs, Inc.		Post Rain		Post Snow & Ice	
	501	502	501	502	501	502	501	502
Odd – Even	7.3×10^4	7.2×10^4	5.8×10^4	5.5×10^4	2.4×10^2	5.5×10^3	3.1×10^4	3.0×10^4
All – Sheild	7.0×10^4	4.7×10^4	4.7×10^4	4.1×10^4	1.0×10^2	8.0×10^2	3.2×10^4	3.3×10^4
Measurement ID	**Post Solar Radiation**		**Post Dust**		**Final @ TE Connectivity**			
	501	**502**	**501**	**502**	**501**	**502**		
Odd – Even	5.3×10^4	$> 1.0 \times 10^5$	2.0×10^4	3.8×10^4	2.7×10^4	$> 1.0 \times 10^5$		
All – Sheild	3.0×10^4	$> 1.0 \times 10^5$	2.8×10^4	1.7×10^4	2.3×10^4	6.0×10^4		

Note: Insulation resistance values decreased following the Rain test exposure. It was suspected that water ingress into the unsealed single-ended “pig-tail” support cable assemblies (see Figure D.1) was compromising the measurements. The support cable assemblies were unmated from the TYAD production cable assemblies under test, dried in an oven at 50°C, then remated to the test cable assemblies. Subsequent spot checks of the insulation resistance values found the results to be in line with initial measurements, confirming that the unsealed single-ended “pig-tail” support cable assemblies were the root cause of the low insulation resistance values.

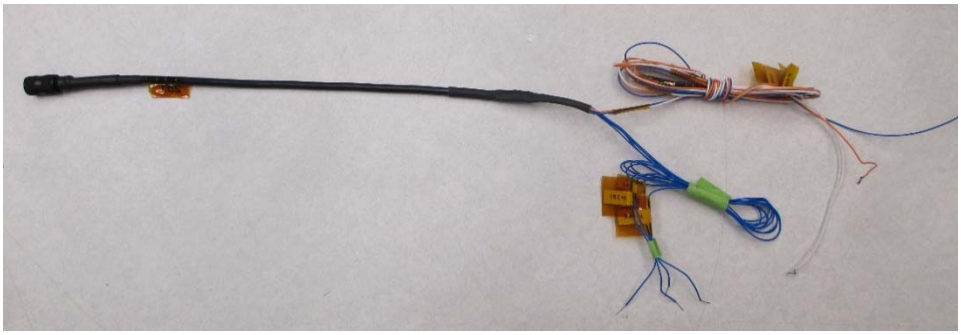

Figure D.1 – Unsealed Single-Ended “Pig-Tail” Support Cable Assembly