

NUMBER GS-12-1267	TYPE Product Specification	<b>Amphenol FCI</b>	
<b>PwrBlade+™ Cable Connector System</b>		PAGE 1 of 14	REVISION C
		AUTHORIZED BY Rainbow Zhan	DATE 2018-07-05
		CLASSIFICATION <b>UNRESTRICTED</b>	

## 1.0 OBJECTIVE

This specification defines the performance, test, quality, and reliability requirement of the PwrBlade+™ cable System.

## 2.0 SCOPE

This specification is applicable to the termination characteristic of separable vertical plug cable when mating with receptacle cable or board connector, receptacle cable when mating with plug board connector

## 3.0 GENERAL

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## 4.0 APPLICABLE DOCUMENTS

### 4.1 Other Standard and Specification

4.4.1 UL-94 : Flammability

4.4.2 EIA-364: Electrical Connector/Socket Test Procedure Including Environmental Classifications


### 4.2 FCI Specifications

4.2.1 EIA-364-70C Current Rating

4.2.2 GS-14-1093 Package Specification

4.2.3 GS-20-0426 Application Specification

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## 5.0 REQUIREMENTS

### 5.1 Qualification

PwrBlade+ ® cable assemblies furnished under this specification shall be capable of meeting the qualification test requirements specified herein.

#### Material

The material for each component shall be as specified herein or equivalent.

High/Low Power Contacts – High Conductivity Copper alloy.

Signal contacts – Copper alloy.

Housing Resin– Glass filled, Nylon, or other high performance resin rated flame retardant 94V-0 in accordance with UL-94.

Receptacle Latch– Glass filled, Nylon, or other high performance resin rated flame retardant 94V-0 in accordance with UL-94.

Receptacle Secondary Lock– Glass filled, Nylon, or other high performance resin rated flame retardant 94V-0 in accordance with UL-94.

Cables – Insulated Stranded Tinned or Bare Copper Conductor

### 5.2 Finish- The finish for applicable component shall be as specified herein or equivalent.

#### 5.3.1 High/Low Power Contacts

Mating Area – Precious metal Over 1.27µm (50µ”) Min. Nickel Underplate.

Crimp Area – Matte Tin Over 1.27µm (50µ”) Min. Nickel Underplate.

#### 5.3.2 Signal Contacts

Mating Area – Noble metal Over 1.27µm (50µ”) Min. Nickel Underplate.

Crimp Area – Matte Tin Over 1.27µm (50µ”) Min. Nickel Underplate.

#### 5.3.3 Signal Male Pin Contacts

Mating Area – Noble metal Over 1.27 µm (50µ”) Min. Nickel Underplate.


Crimp Area – Au Flash Over 1.27 µm (50µ”) Min. Nickel Underplate.

### 5.3 Design and Construction

Terminals, housings and cables shall be of the design, construction and physical dimensions specified on the applicable product drawings.

### 5.4 Workmanship-This includes freedom from cracks, malformed crimps, discoloration, loose wires, etc

### 5.5 Operating temperature range: -40°C~105°C

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5.6 Examination of product-EIA-364-18,SAE/USCAR-21, visual and dimensions inspection per product drawing, meet requirements of product drawing.

## 6.0 **ELECTRICAL CHARACTERISTICS**

6.1 **Low Level Contact Resistance (LLCR)** – The low level contact resistance shall not exceed  
 High Power contacts: 10 milliohm initially and 20milliohm final  
 Low Power contacts: 15 milliohm initially and 20milliohm final  
 Signal contacts: 20milliohm Initial, and after test  $\Delta$ LLCR<10 milliohm  
 after environmental exposure when measured in accordance with EIA-364-23 .The following details shall apply,

- a) Test Voltage – 20 millivolts max open circuit voltage.
- b) Test Current – Not to exceed 100 milliamps.

6.2 **Contact resistance at rated current**– The contact resistance at rated current shall not exceed 1.0 milliohm for high power contact and 1.5 milliohm for low power contact initially or after mating cycles and environmental exposure when measured in accordance with EIA 364 TP06. Test current is 30A for 12 high power contacts at 6.35mm pitch, 16A for 8 low power contacts show in Table 1A.

6.3 **Insulation Resistance** – The insulation resistance of mated connectors shall not be less than 1,000 megohms for power contacts and 500 megohms for signal initially and after environmental exposure when measured in accordance with EIA 364 TP21.

- a) Test Voltage 500 volts DC.
- b) Electrification time – 2 minutes.
- c) Points of Measurement – Between adjacent contacts.

6.4 **Dielectric Withstanding Voltage** – There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (>1 Milliampere) when mated connectors are tested in accordance with EIA-364-20. The following details apply.

- a) Test Voltage – 1000 volts, DC for signal and low power contacts.
- b) Test Voltage – 2500 volts, DC for high power contacts.
- c) Test Duration – 60 seconds.
- d) Test Condition – 760 Torr – sea level.

Points of Measurement – Between adjacent contacts

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6.5 **Current Rating** – Refer to table 1, the temperature rise above ambient shall not exceed 30°C at any point in the system at specified amperes (Table 1) when cable mated connector or cable mated cable are tested in accordance with EIA-364-70, method 1. The following detail shall apply:

- a) Ambient Conditions – Still air at 25°C
- b) Stabilize at a single current level until 3 readings at 5 minutes intervals are within 1°C.

Table 1A: Current Rating (Amperes)

Configuration of PwrBlade+ Cable Assembly mated with PwrBlade+ Board Connector

Wire Size	High Power Contact					Low Power Contact			Signal Contact		
	1P	2P	4P	8P	12P	1LP	4LP	8LP	1S	24S	48S
6AWG	70	57	52	48	45	N/A			N/A		
10AWG	58	N/A	36	33	33						
12AWG	N/A					42	26	21			
14AWG						36	26	19			
16AWG						32	21	17			
22AWG	N/A										

Configuration of PwrBlade+ Cable Assembly mated with PwrBlade+ Cable Assembly

Wire Size	High Power Contact					Low Power Contact			Signal Contact		
	1P	2P	4P	8P	12P	1LP	4LP	8LP	1S	24S	48S
8AWG	56	N/A	40	36	33	N/A			N/A		
10AWG	44	N/A	30	27	27						
22AWG	N/A										


Configuration of PwrBlade+ Cable Assembly mated with PwrBlade+ Board Connector for 8AWG

(Please pay attention to below NOTES)

Wire Size	High Power Contact					
	1P	2P	4P	6P	8P	12P
8AWG	72	65	52	50	45	40

**NOTES:**

1. Generally the pitch for 8AWG is 7.62mm, but for this special one, the pitch is 8.89mm.
2. The current rating is just the initial data before any other environment and mechanical test.

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6.6 **Crimp Resistance Low Level** – When properly crimped, the change in crimp resistance shall not exceed 1 milliohms for wire sizes 22-30 AWG for Signal and 6-16 AWG for Power. Crimp resistance shall be measured in accordance with EIA-364-23. Terminals not to be inserted into housings for this test. The following conditions shall apply:

- a Method of connection – For Signals attach current and voltage leads as shown in Figure 1 & 2  
For Power attach current and voltage leads as shown in Figure 2&3&4.and dimension X to be far away from crimped not to disturb crimp
- b Test Voltage – 20 millivolts max. open circuit
- c Test Current – Not to exceed 100 milliamperes

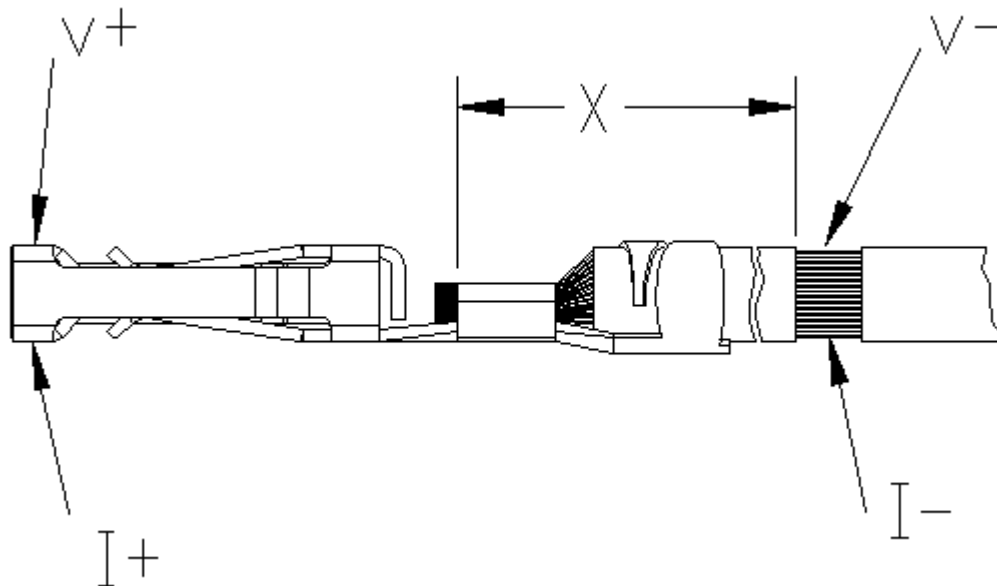



Figure 1 Receptacle signal crimped contact

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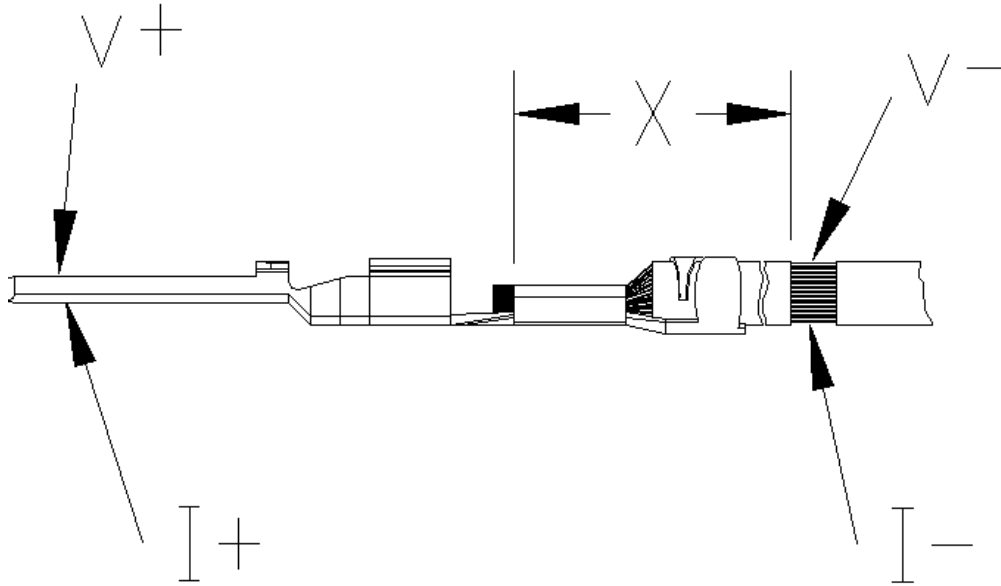


Figure 2 Plug signal crimped contact

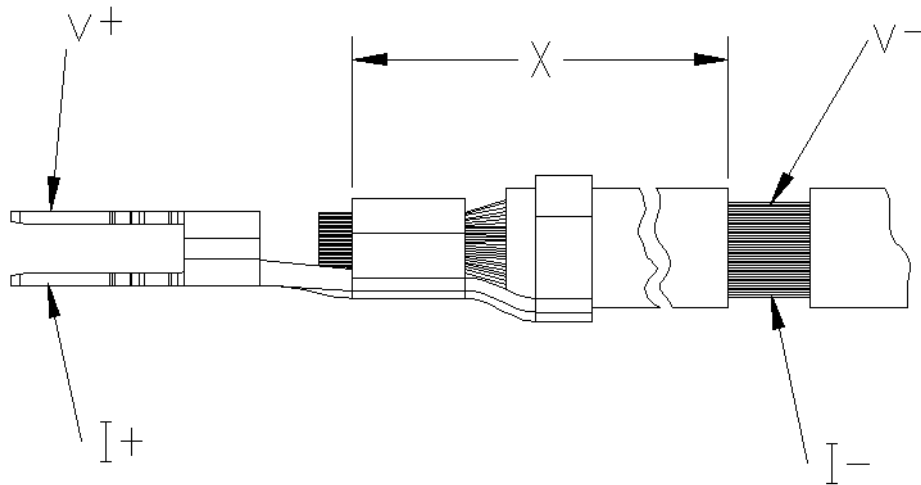



Figure 3 Receptacle high power crimped contact

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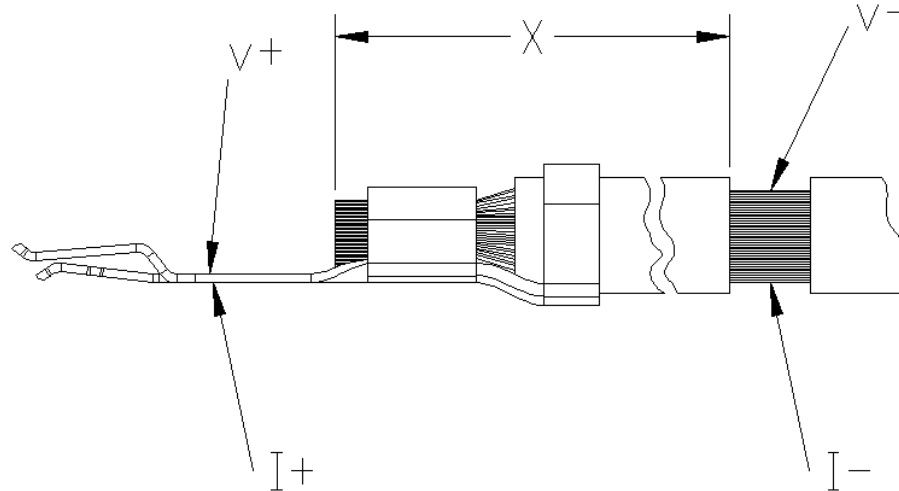


Figure 4 Receptacle low power crimped contact

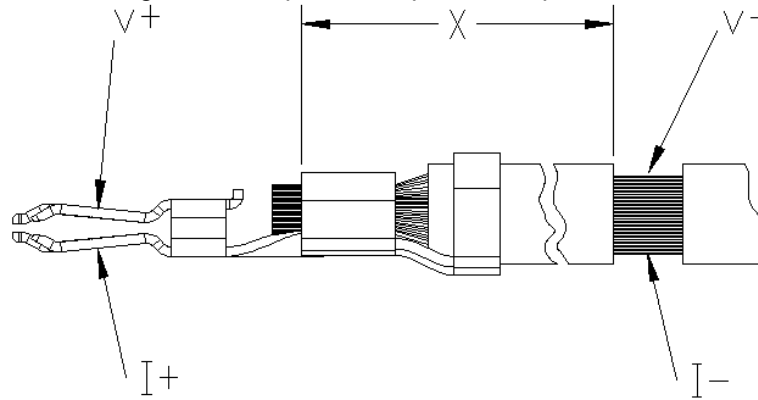


Figure 5 Plug high power crimped contact

## 7.0 MECHANICAL CHARACTERISTICS

7.1 **Mating/Unmating Force** – The force to mate/unmate a receptacle and compatible header.

Table 3: Mating/unmating force

	Per High power Contact	Per Low power contacts	Per Signal contacts
Mating force (Max.)	5N [18 ounce]	1N [3.6ounce]	1N [3.6ounce]
Unmating force (Min.)	2.2N [8 ounce]	0.5N [1.8 ounce]	0.2N [0.64 ounces]

The following details shall apply:

7.1.1) Cross head speed – 12.7mm [0.5 in] per minute

7.1.2) Lubrication – None

7.1.3) Utilize free floating fixtures.

7.1.4) Reference EIA 364-13

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7.2 **Contact retention**– individual contacts shall withstand an axial retention load of 1360.8g(3 pounds) minimum for power contacts and 453.6g(1.0pound) minimum for signal contacts

The following details apply.

- a) Cross head speed – 12.7mm [0.5 in] per minute
- b) Lubrication – None
- c) Utilize free floating fixtures.
- d) Reference EIA 364-13

7.3 **Crimping tensile strength**– The force required to pull the properly crimped wire from the terminal shall not be less than the value specified in Table II for Power Cables and Table III for Signal Cables (CTW Male Pin and Receptacles) when tested per SAE/USCAR 21 section 4.4.5. If terminals are equipped with an insulation barrel, they should not be crimped to have an affect on this test.

	Per High power Contact		
Cable size	6	8	10
Crimping pull force(N) Min	350N	350N	290N

	Per low power Contact		
Cable size	12	14	16
Crimping pull force(N) Min	240N	180N	120N

	Per Signal Contact		
Cable size	22	24	26
Crimping pull force(N) Min	71.2N	48.9N	28.9N

7.4 **Crimp Acceptance Criteria** – General appearance as defined by SAE/USCAR21 section 4.2.5 and TA-681,TA317 and TA-211.

Cross section acceptance as defined by SAE/USCAR21section 4.3.4 and 4.3.5 Exception: Max. allowable burr width is 0.25mm.

7.5 **Bending Radius** –Cable shall accept a bending radius of 8 times its outer diameter without any cracking to the outer cable jacket or breaking of strands of copper wires.


7.6 **Vibration, random** – EIA-364-28

Test procedure – VII, test condition letter E.

- a) Subject mated specimens to 4.90G’s rms between 20-500Hz.
- b) Mounting – To eliminate relative motion, both mating halves should be rigidly fixed.
- c) Duration – 15 minutes in each of 3 mutually perpendicular planes.
- d) No evidence of physical damage, No interruptions > 1.0 microsecond

7.7 **Mechanical Shock** – EIA 364-27



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- 7.8.1) Condition A (50G, 11 millisecond half sine wave )
- 7.8.2) Shocks – 3 shocks in both directions along each of three orthogonal axes. (18 total)
- 7.8.3) Mounting – Rigidly mount assemblies.
- 7.8.4) No discontinuities of greater than 1.0 microsecond.

7.8 **Durability** – Standard laboratory procedure as applicable to the specific product EIA-364-09

- 7.9.1) Number of cycles – 500.
- 7.9.2) Maximum cycling rate – 500 cycles per hour.

## 8.0 **ENVIRONMENTAL CONDITIONS**

After exposure to the following environmental conditions in accordance with the specified test procedure and/or details, the product shall show no physical damage and shall meet the applicable electrical and mechanical requirements of paragraph 6.0 and 7.0 as detailed in Table 4 test sequences. Unless otherwise specified, assemblies shall be mated during exposure.

8.1 **Thermal Shock** – EIA-364-32

- 8.1.1) Subject mated specimens to 36 cycles.
- 8.1.2) Temperature Range – 40 to 105°C.
- 8.1.3) Time at each temperature – 30 minutes minimum.
- 8.1.4) Transfer time – 5 minutes, maximum.

8.2 **Humidity-temperature cycling**– EIA-364-31, Method III.

- 8.2.1) Subject mated specimens to 10 cycles(10 days)
- 8.2.2) Relative Humidity – 80~100%
- 8.2.3) Temperature 25°C~65°C


8.3 **Temperature Life** – EIA-364-17, Method A.

- 8.3.1) Test condition 5.
- 8.3.2) Test duration – 504 Hours.
- 8.3.3) Temperature 105°C.

8.4 **Mixed Flowing Gas (MFG)** – EIA 364-65

- 8.4.1) Class – IIA
- 8.4.2) Duration – 14 days. (7 days mated, 7 days unmated)

8.5 **Environmental Sequence:**

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8.5.1 Phase I –Visual inspection – SAE/USCAR21 section 4.2

8.5.2 . Phase II –For wire size<5 mm<sup>2</sup>, dry circuit resistance – SAE/USCAR21 section 4.5.3  
For wire size>5 mm<sup>2</sup>, Voltage drop – SAE/USCAR21 section 4.5.6

8.5.3. Phase III –Thermal Shock – – SAE/USCAR21 section 4.5.5

- a. Test Duration – 72, 1 hour cycles
- b. Temperature Range – Between -40°C to +105°C
- c. Time at Each Temperature – 30 minutes
- d. Transfer Time – 5 minutes maximum

8.5.4. Phase IV –For wire size<5 mm<sup>2</sup>, dry circuit resistance – SAE/USCAR21 section 4.5.3  
For wire size>5 mm<sup>2</sup>, Voltage drop – SAE/USCAR21 section 4.5.6

8.5.5.Phase V –Temperature Humidity – – SAE/USCAR21 section 4.5.4

Cycles– 4 cycles,

- a. Relative Humidity – 95%-98%  
Temperature– +65°C ± 3 °C  
Test Duration–16hrs ± 5min.
- b. Relative Humidity – not controlled  
Temperature– -40°C ± 3 °C  
Test Duration–2hrs ± 5min.
- c. Relative Humidity – not controlled  
Temperature– +85°C ± 3 °C  
Test Duration–2hrs ± 5min.
- d. Relative Humidity – not controlled  
Temperature– +23°C ± 3 °C  
Test Duration–4hrs ± 5min.

8.5.6. Phase VI –For wire size<5 mm<sup>2</sup>, dry circuit resistance – SAE/USCAR21 section 4.5.3  
For wire size>5 mm<sup>2</sup>, Voltage drop – SAE/USCAR21 section 4.5.6

8.5.7. Phase VII –Visual inspection – SAE/USCAR21 section 4.2

## 9.0 QUALITY ASSURANCE PROVISIONS

### 9.1 Equipment Calibration

All test equipment and inspection facilities used in the performance of any test shall be maintained in a calibration system in accordance with QS9000.

### 9.2 Inspection Conditions

Unless otherwise specified, all inspections shall be performed under the following conditions:

- a) Temperature: 25+/- 5°C
- b) Relative Humidity: 30% to 60%

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c) Barometric Pressure: Local ambient

### 9.3 **Acceptance**

9.3.1 Electrical and Mechanical requirements shall be as indicated in Paragraphs 6.0 and 7.0 using test data and appropriate statistical techniques.

9.3.2 Failures attributed to equipment, test setup or operator error shall not disqualify the product.

### 9.4 **Qualification Testing**

9.4.1 Specimen selection  
Specimens shall be prepared in accordance with applicable instruction sheets and shall be selected at random from current production.

9.4.2 Test Sequence-as specified in Table 4.

### 9.5 **Re-qualification Testing**

9.5.1 If any of the following conditions occur, the responsible product engineer shall initiate re-qualification testing consisting of the applicable parts of the test matrix, Table 4.

- a) A significant design change is made to the existing product that impacts the product form, fit or function. Example of significant changes shall include, but not be limited to, changes in the plating material composition or thickness, contact force or contact surface geometry, insulator design, contact base material or contact lubrication requirements.
- b) A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.
- c) A significant change is made to the manufacturing process that impacts the product form, fit or function.


### 9.6 **Sample Quantity and Description**

a Connector Assemblies (CTW Receptacle and CTW Headers ) – Sixteen (16) connector assemblies consisting of the largest sizes with wires crimped of largest and smallest AWG wire size and thirteen (13) of the smallest sizes with wires crimped of largest and smallest AWG wire size to be populated and subjected to the qualification inspection. Assemblies to have three 76.2 mm (3) inches long wire leads crimped .

b. A separate group of 60 crimped to wire sub-assemblies each of signal terminals (CTW Receptacle and CTW Male Pins) and power terminals for each AWG size to be crimped at Minimum and Maximum height and supplied for qualification testing. Wire leads to be three 76.2 mm (3) inches long minimum. No housings required for these samples

Test Group Table IV	Description	Qty. Conn. Assemblies	Number of Term. Tested
1	3 largest & populated connectors with wires crimped of largest and smallest AWG wire size.	3	ALL

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2	3 largest populated connectors with wires crimped of largest and smallest AWG wire size.	3	ALL
3	3 largest populated connector with wires crimped of largest and smallest AWG wire size.	3	ALL
4	3 largest populated connectors with wires crimped of largest and smallest AWG wire size.	3	ALL
5	3largest populated connectors with wires crimped of largest and smallest AWG wire size.	2	ALL
6	Individual Contacts Crimped to each wire size (Power Only)	0	15 each
7	Individual Contacts Crimped to each wire size (Power & Signal Receptacle and Male Pin)	0	30each
8	Individual Contacts Crimped to each wire size (Power & Signal Receptacle and Male Pin)	0	15each

**TABLE 4: QUALIFICATION TESTING SEQUENCE**

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TEST	PARA	Test Group(a)								
		1	2	3	4	5	6	7	8	9
		Test Sequence (c)								
Examination of Product	5.5	1,6	1,10	1,8	1,5	1,13	1	1,9	1	1,3
Low Level Contact Resistance Signal, High/Low power contacts	6.1	2,5	3,5,8		2,4					
Low Level Contact Resistance High/Low power contacts only						2,6 8,10				
Contact Resistance at Specified Current	6.2					12				
Insulation Resistance	6.3			2,6						
Dielectric Withstanding Voltage	6.4			3,7						
Current Rating	6.5					4,11				
Mating Force	7.1		2							
Un-mating Force			9							
Contact Retention	7.2									2
Crimp Tensile Strength	7.3								2	
Crimp Resistance								2,4 6,8		
Crimp & Cross Section Accept	7.4, 7.5						2			
Thermal Shock	8.1			4				3		
Humidity-temperature-cycling	8.2			5				5		
High Temperature Life	8.3				3	7		7		
Vibration	7.6		6			9				
Mechanical Shock	7.7		7							
Durability	7.8	3(e)	4			3(f)				
Mix Flowing Gas	8.4	4				5				

**NOTE:**

- (a) See paragraph 9.4.
- (b) Split into subgroups as needed for on and off board tests.
- (c) Numbers indicate sequence in which tests are performed.
- (d) Energize at current for 18°C temperature rise.
- (e) Precondition specimens with 5 durability cycles.
- (f) Precondition specimens with 25 durability cycles.

**REVISION RECORD**

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REV	PAGE	DESCRIPTION	ECN#	DATE
A	All	Initial release	-	2015-12-30
B	2	Correct section "5.1" to "4.2"	ELX-DG-25192	2016-10-12
C	4	Add the initial current rating for 8AWG per wire to board type	ELX-DG-30634	2018-07-05

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