1.0 OBJECTIVE

This specification defines the performance, test, quality and reliability requirements of the HPCE Cable system.

2.0 SCOPE

This specification is applicable to the termination characteristics of the HPCE Cable System which provides a separable interface for power to board connector and power to edge card applications.

3.0 GENERAL

This document is composed of the following sections:

4.0 APPLICABLE DOCUMENTS

4.1 FCI Specifications:

Applicable FCI product drawings.
GS-20-0369: Application Specification, HPCE cable System.

4.2 Other Standards and Specifications

- UL94-V0: Tests for Flammability of Plastic Materials in Devices and Appliances
- EIA 364: Electrical connector/Socket test procedures include environmental classification.
- EIA 364-1000: Environmental test methodology for assessing the performance of electrical connectors and sockets used in business office applications.
- GR-1217-CORE: Telcordia Specification “Generic Requirements for Separable Electrical Connectors”

4.3 FCI Lab Reports - Supporting Data

DL-2013-04-026: HPCE CABLE RECEPTACLE MATES TO EDGE CARD

DL-2013-04-027A: HPCE CABLE RECEPTACLE MATES TO HPCE CTB RIGHT ANGLE HEADER

4.3 UL/CSA Certifications

UL E66906

5.0 REQUIREMENTS

5.1 Current Rating

Operating temperature: -55°C~+105°C
Maximum operating voltage: 619VAC RMS/high power,
598 VAC RMS/low power,
213 VAC RMS/signal.

The temperature rise above ambient shall not exceed 30ºC at any point in the system when all contacts are powered. See table I and table II .

a) Starting at ambient: 25ºC – Still Air
b) Reference – EIA-364-70B

HPCE CABLE REC mates to HPCE CARD						
High power contact current rating (30°T-rise)						
contact type	mates to	Wire gage(AWG)	current(per contact) AMPS			
			1 Ccontact	5 Contacts	9 Contacts	
High power	mates to card	10	54	41	36	
		12	44	33	30	
Low power contact current rating (30°T-rise)						
contact type	mates to	Wire gage(AWG)	current(per contact) AMPS			
			1 Ccontact	6 Contacts	12 Contacts	
Low power	mates to card	14	35	25	22	
		16	31	21	20	
signal contact current rating(30°T-rise)						
contact type	mates to	Wire gage(AWG)	current(per contact) AMPS			
			2 contacts	8 contacts	16 contacts	24 contacts
Signal contact	mates to card	22	11	8	6	5
		24	9	6	5	4
		26	7	5	4	4

NOTES:

1. copper trace weight: multi-layers copper trace and 2 oz
2. Ambient conditions : still air at lab ambient.
3. Temperture rise 30°C Max.

TABLE I

HPCE CABLE REC mates to HPCE CTB HEADER						
High power contact current rating (30°T-rise)						
contact type	mates to	Wire gage(AWG)	current(per contact) AMPS			
			1 Ccontact	5 Contacts	9 Contacts	
High power	mates to header	10	50	40	36	
		12	40	32	30	
Low power contact current rating (30°T-rise)						
contact type	mates to	Wire gage(AWG)	current(per contact) AMPS			
			1 Ccontact	6 Contacts	12 Contacts	
Low power	mates to header	14	35	26	22	
		16	30	23	20	
signal contact current rating(30°T-rise)						
contact type	mates to	Wire gage(AWG)	current(per contact) AMPS			
			2 contacts	8 contacts	16 contacts	24 contacts
Signal contact	mates to header	22	9	6	5	5
		24	8	5	5	4
		26	7	5	4	4

NOTES:

1. copper trace weight: multi-layers copper trace and 2 oz
2. Ambient conditions : still air at lab ambient.
3. Temperture rise 30°C Max.

TABLE II

5.2. Materials

Power Contacts: Copper alloy,
Signal contacts: Copper alloy,
Housings: High temperature thermoplastic, UL94V-0 compliant.

Finish:

Contact Area (Power & Signal):

GXT plating, qualified to meet the requirements of this specification

Tails (Power & Signal):

Sn - Tin plated over Nickel (standard)
SnPb - Tin-lead plated over Nickel (for required)

5.3. Qualification

Connectors furnished under this specification shall be capable of meeting the qualification test requirements specified herein.

5.4. Design and Construction

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

5.5. Visual

Visual examinations shall be performed using 10X magnification. Parts should be free from blistering, cracks, discoloration, etc.

6.0 ELECTRICAL CHARACTERISTICS

6.1 Low Level Contact Resistance (LLCR) – Signal only tested at Low Level (LLCR) – The low level contact resistance shall not exceed 25 milliohm initial, Maximum change in contact resistance of 10 mΩ after environment measure when measured in accordance with EIA 364-23. Crimped terminal samples not to be inserted into housings when tested. The following shall apply: See figure 1

- Test Voltage Open Circuit – 20 mV DC max.
- Test Current – 100 mA DC.

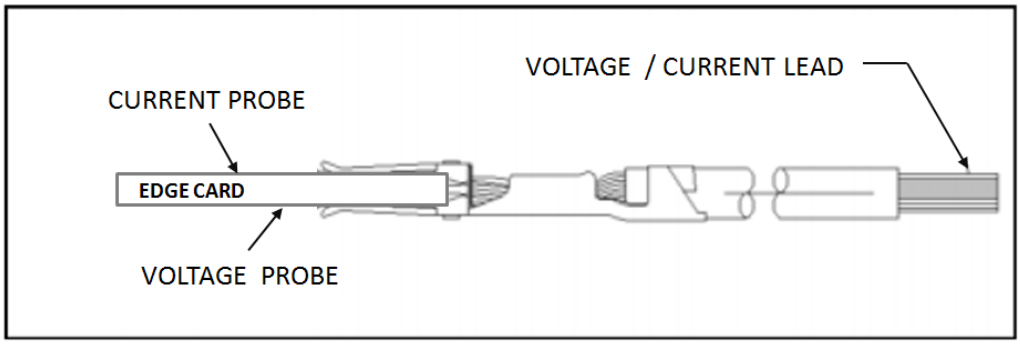


FIGURE 1

6.2. Power contact resistance tested at specified Current:

The contact resistance at a specified current shall not exceed 0.8 mΩ (milliohms) of high power and 1.5 mΩ (milliohms) of low power initially or after mating cycles and environmental exposure when measured in accordance with EIA 364-23. Figure 2

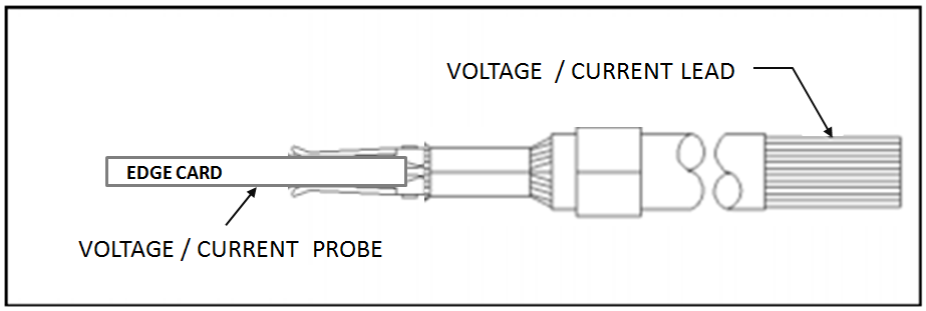


FIGURE 2

6.3. Insulation Resistance:

- Test condition: per EIA 364-21. Apply with a test voltage 500 VDC between the closest adjacent contacts under mated status.
- Requirement: the insulation resistance shall be exceed 5,000MΩ (mega ohms) minimum for power contact and 500MΩ minimum for signal contact under mated status.

6.4. Dielectric Withstanding Voltage:

- Test condition: per EIA 364-20. Apply with test voltage 1800 VDC for power contact and 500 VDC for signal contact under mated status.
- Requirement: there shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (>1 mA) under mated status.

6.5 Current Rating:

- Test condition: Energize the series of the power contacts of both upper and lower row, including signal contacts.
  a) Ambient conditions: still air at Lab ambient
  b) Reference: Per EIA 364-70
  c) Copper trace weight: multi-layers copper trace and 2oz test boards.
  d) Feed wire size: (Ref. EIA 364-70)
  e) Maximum 30°C temperature rise

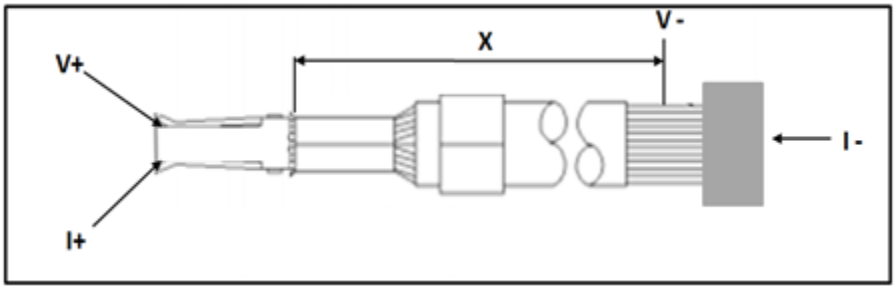
- Requirement:

  Develop temperature rise versus current curves for 36 total Power pin on upper and lower line and 24 Signal pin. Increase current level until all contacts have exceeded 30°C temperature rise. The current rating is to be determined by the current level at which the first contact exceeds 30°C temperature rise.

6.6 Crimp Resistance Low Level:

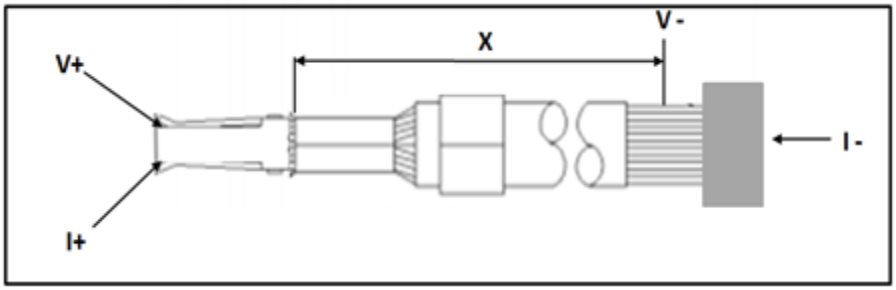
- When properly crimped, the change in crimp resistance shall not exceed 1.0 milliohms for wire sizes 22 – 26 AWG for Signal and 10 - 16 AWG for Power. Crimp resistance shall be measured in accordance with EIA-364-23 Terminals not to be inserted into housings for this test. The following conditions shall apply:

  a. Method of connection
     - For Signals attach current and voltage leads as shown in Figure 3
     - For Power attach current and voltage leads as shown in Figure 4
  b. Test Voltage – 20 mV DC max. open circuit
  c Test Current – Not to exceed 100 mA



Note: Dimension X should be more than 20 mm away from crimp

FIGURE 3



Note: Dimension X should be more than 20 mm away from crimp

FIGURE 4

7.0 MECHANICAL CHARACTERISTICS

7.1 Mating/Un-mating forces:

- Test condition:
  a) Cross head speed: 25.4mm per minute
  b) Utilize Fixed fixtures
  c) Reference: EIA 364-13
  d) Test with 1.57 +/- 0.13mm thickness of Edge card

Configuration	Edge card Mating Force (N) (Max. Allowance)	Edge card Un-Mating Force (N) (Min. Allowance)
36P+24S	46.08	12.15
4 BEAM POWER Contact	3.68	0.55
2 BEAM POWER Contact	2.6	0.42
Single SIGNAL Contact Beam	0.54	0.3

TABLE III

Configuration	Header Mating Force (N) (Max. Allowance)	Header Un-Mating Force (N) (Min. Allowance)
36P+24S	56.52	12.15
4 BEAM POWER Contact	4.28	0.55
2 BEAM POWER Contact	3.65	0.42
Single SIGNAL Contact Beam	0.75	0.3

TABLE IV

7.2 Contact Retention:

- Test condition: Per EIA 364-29; no movement out from housing load below force.
  Requirement:

Signal Pin

During mating, individual Receptacle Signal Pin shall withstand an axial retention load of 9.0N.

Power Contact

During mating, individual Receptacle Power Pin shall withstand an axial retention load of 90 N.

7.3 Crimp Tensile Strength: The force required to pull the properly crimped wire from the terminal shall not be less than the value specified in Table III for Power Cables and Table IV for Signal
Cables 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 effect on this test.

Cable Size (AWG)	10	12	14	16
Crimping Pull Force (N) min.	290	240	180	115

TABLE V (POWER ONLY)

Cable Size (AWG)	22	24	26
Crimping Pull Force (N) min.	60	40	25

TABLE VI (SIGNAL ONLY)

7.4 Crimp Acceptance Criteria:

General Appearance as defined by SAE/USCAR21 section 4.2.5.

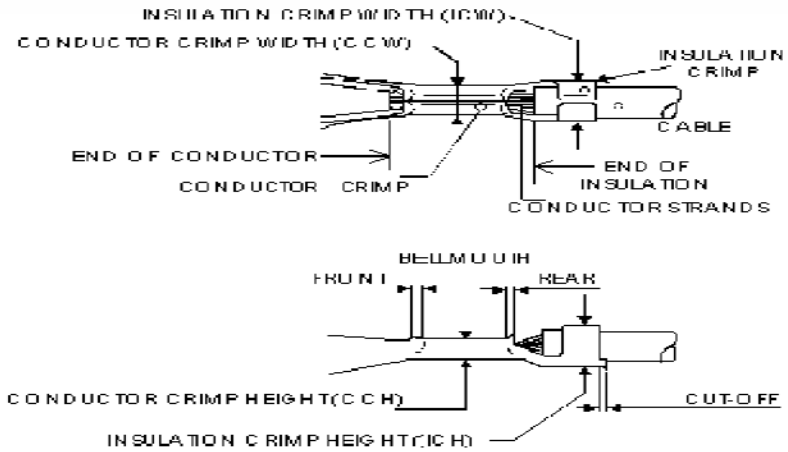


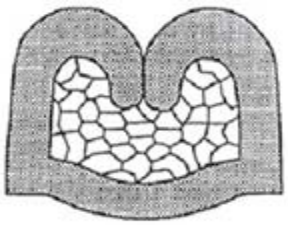
Figure 4.2.5: Appearance Acceptance Criteria

7.5 Cross Section Acceptance:

Cross section acceptance as defined by SAE/USCAR21 section 4.3.4 and 4.3.5

Exception: Max. allowable burr width is 0.20mm Max.

Crimped conductor grip attributes considered ideal



Crimped request :

a. Symmetric
b. wings to touch only conductor
c. terminal stock free of cracks/breaks

7.6 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.

8.0 ENVIRONMENTAL CONDITIONS

After exposure to the following environmental conditions in accordance with the specified test procedure EIA-364, the product shall show no physical damage and shall meet the applicable electrical and mechanical requirements of detailed in Table VII. Unless otherwise specified, assemblies shall be mated during exposure.

8.1 Thermal Shock:

- Test condition: Per EIA 364-32, Test condition 1. Cycle the connector -55ºC to +85ºC. Dwell time of 30 minutes at extreme temperature. Transfer time 5 minutes max.
- Requirement: No physical damages and meets sequenced tests.
  Test duration : 5 cycles

8.2 Humidity and Temperature:

- Test condition: Per EIA 364-31, method II. Exposes the connector to 40ºC±2ºC at humidity of 90% to 95%. The test condition A will be used and the test duration is 96 hours.
- Requirement: No physical damages and meets sequenced tests

8.3 High Temperature Life(preconditioning)

- Test condition: Per EIA 364-17, Test method A, 120 hours at temperature 105± 2Cº, pertaining to 65ºC for 10 years per EIA-364-1000.
- Requirement: No physical damages and meets sequenced tests.

8.4 High Temperature Life

- Test condition: Per EIA 364-17, Test method A, 240 hours at temperature 105± 2Cº pertaining to 65ºC for 10 years per EIA-364-1000.
- Requirement: No physical damages and meets sequenced tests.

8.5 Industrial Mixed Flowing:

- Test condition: Per EIA 364-65, Class IIA. Perform 10days mated.
- Requirement: No physical damages and meets sequenced tests.

8.6 Random Vibration:

- Test condition: Per EIA 364-28. Test condition VII, Condition E (4.90 g rms , 10-500HZ) This test shall be performed for a total of 1.5 hours in each axis.
- Requirement: No physical damages and no electrical discontinuity more than 1μ second.

8.7 Mechanical Shock:

- Test condition: Per EIA 364-27, Test condition A. Half-Sine pulse, 50G, 11ms, 3 shocks, 6 directions (18 shocks totally)
- Requirement: No physical damages and no electrical discontinuity more than 1μ second.

8.8 Durability (preconditioning)

- Test condition: per EIA 364-09

  a) Number of cycles: 20
  b) Cycling rate: 127 mm/minute
  c) Mating and un-mating force to be measured on the first and last cycle

- Requirement: There shall be no damage to the housing or contacts after 20 cycles.

8.9 Durability

- Test condition: Per EIA 364-09
  a) Number of cycles: 200
  b) Cycling rate: 127 mm/minute
  c) Mating and un-mating force to be measured on the first and last cycle
- Requirement: There shall be no damage to the housing or contacts after 200 cycles.

8.10 Thermal Disturbance:

- Test condition: Per EIA-364-1000, Test group 4. Cycle the connector between 15ºC ±3ºC and 85ºC ±3ºC, as measured on the part. Ramps should be a minimum of 2ºC per minute, and dwell times should insure that the contacts reach the temperature extremes (a minimum of 5 minutes) Humidity is not controlled. Perform 10 such cycles.
- Requirement: No physical damages and meets sequenced tests.

8.11 Dust Contamination:

- Perform in accordance with EIA 364-91 Dust contamination 1 (benign), unmated receptacle connectors.

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 ISO 9000.

9.2 Inspection conditions:

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

a) Temperature: 25 ±5ºC
b) Relative humidity: 30 to 80%
c) Barometric Pressure: Local ambient

9.3 Sample Quantity and Description:

The sample size and description is listed for each test in the appropriate section of this document.

9.4 Acceptance:

Electrical and mechanical requirements placed on test samples as indicated in the sections of this specification shall be established from test data using appropriate statistical techniques or shall otherwise be customer specified, and all samples tested in accordance with the product specification shall meet the stated requirements.

Failures attributed to equipment, test set-up or operator error shall not disqualify the product. If product failure occurs, corrective action shall be taken and samples resubmitted for qualification.

9.5 Qualification Testing:

Qualification testing shall be performed on sample units with equipment and procedures normally used in production. Test sequence is as shown in Table VII.

9.6 Re-qualification Testing:

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 VII.

a) A significant design change is made to the existing product that impacts the product form, fit or function. Examples 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.

10. Qualification Test Matrix

Table VII

TEST GROUP ID:		1	2	3	4	5	6	7	8	9
TEST DESCRIPTION	**SECTION**	Mixed Flowing Gas	Temp Life	Dielectric	Thermal Shock & Humidity	Mech. Shock & Vibration	Current Rating	MECH /Crimp	ENV./ Crimp	Terminal Retention
Visual Examination	5.5	1, 13	1,9	1,10	1,14	1,14	1,6	1	1,7	1,3
Mate header or edge card		2,	2,		2,	2	2			
ELECTRICAL:										
Contact Resistance Low Level (Signal and Power)	6.1	3,8,10, 12,	3,6,8,		3,7,9, 11,13,	3,5,9, 11,13				
Contact Resistance (Power)	6.2						5			
Insulation Resistance	6.3			2,5,8						
Dielectric Withstanding Voltage	6.4			3,6,9						
Current Rating (Power)	6.5						3			
Current Rating (Signal)	6.5						4			
Crimp Contact Resistance (LLCR) (Power/Signal)	6.6								2,4,6	
MECHANICAL:										
Mating / Un-mating Force	7.1	4,6	4		4,6	6,8				
Contact Retention (Power & Signal)	7.2									2
Crimp Tensile Strength	7.3							2		
Crimp Cross Section Acceptance	7.5							3		
ENVIRONMENTAL:										
Thermal Shock	8.1			4	8					
Humidity & Temperature.	8.2			7	12				3	
High Temperature Life (Preconditioning)	8.3	7				4				
High Temperature Life	8.4		7						5	
MFG - 10 days (EIA-364-65 Class IIA, table 4.1)	8.5	9								
Random Vibration	8.6					10				
Mechanical Shock	8.7					12				
Durability, 20 Cycles (Preconditioning)	8.8	5	5		5					
Durability, 200 Cycles	8.9					7				
Thermal Disturbance	8.10	11								
Dust Contamination	8.11				10					
SAMPLE NEED										
Sample Quantity		5	5	5	5	5	5	5	5	5

11. REVISION RECORD

REV	PAGE	DESCRIPTION	EC#	DATE
A	ALL	Release product specification	N/A	**30 May. 13**
B	ALL	Change the product specification title and Update 7.2; 7.3; 7.5;		**26 July. 13**