

HC-STAK25-2phi 90° Sealed Shielded Connection System

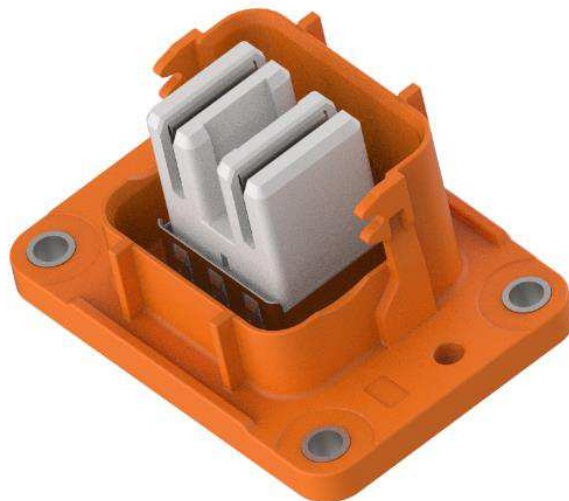
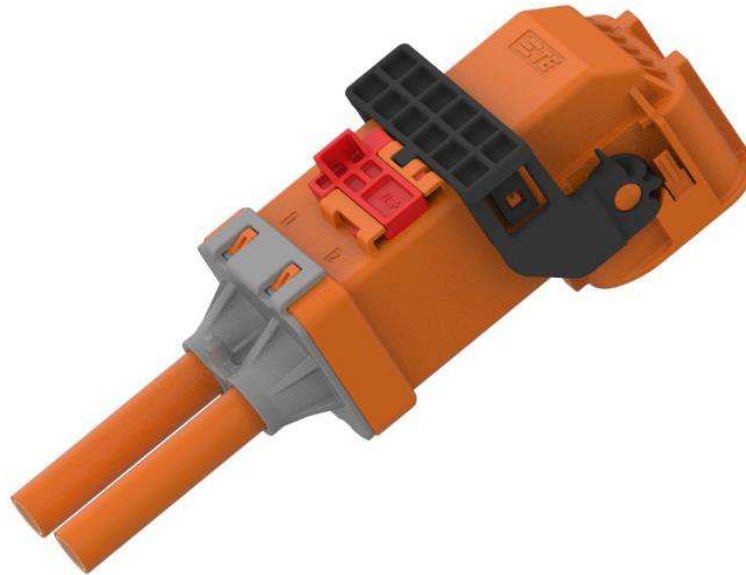


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1. Scope

1.1. Content

This specification covers the performance, tests and quality requirements for the 2 position Connector and Header with HC-STAK25 contact system. Performance, tests and quality requirements of the contact systems are not part of this specification but are included by the validation of the connector system.

1.2. Qualification

When tests are performed on the subject product line, procedures specified in Section 3.4 of this document shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

1.3. Qualification Test Results

The Qualification Test Report numbers are listed in Section 2.2 of this document. This documentation is on file at and available from Engineering Practices and Standards (EPS).

2. Applicable Documents and Forms

The following documents and forms constitute a part of this specification to the extent specified herein. Unless otherwise indicated, the latest edition of the document applies.

2.1. TE Documents

- [109-1](#): General Requirements for Testing
- [109-197](#): Test Specification (TE Test Specification vs EIA and IEC test Methods)
- [114-162001](#): Application Specification, HC-STAK25-2phi 90° PLUG CONNECTOR
- [408-160030](#): Instruction Sheet, HC-STAK25-2phi HIGH VOLTAGE 4-BOLT HEADER

2.2. Qualification Test Report

- [501-XXXXX](#): HC-STAK25-2phi 90° SEALED SHIELDED CONNECTION SYSTEM

2.3. Industry Documents

- IEC-60529: Degrees of Protection Provided by Enclosures (IP Code)
- USCAR-2: Performance Specification for Automotive Electrical Connector Systems
- USCAR-37: High Voltage Connector Performance Supplement to SAE/USCAR-2
- USCAR-25: Electrical Connector Assembly Ergonomic Design Criteria
- USCAR-38: Performance Specification for Ultrasonically Welded Wire Terminations

2.4. Customer Drawings

- [C-2349157](#): 2POS, HC-STAK25, Plug Reference Drawing
- [C-2379307](#): 2POS, HC-STAK25, Header Reference Drawing

The reference drawings listed above list all components required to make complete assemblies. Some components must be purchased separately.

Only cables listed on the plug reference drawing are validated for use with this connector system. Any cables not listed on this drawing are not approved for use and must be validated.

3. Requirements

3.1. Design and Construction

The Product shall be of design, construction, materials, and physical dimensions specified on the applicable product drawing.

3.2. Material

See customer drawings and material specifications.

3.3. Ratings

Table 1

Description	Range
Temperature class	USCAR-2, Class T3 (-40°to +125°C)
Sealing class	USCAR-2, Class S3
Vibration class	USCAR-2, Class V1
Dielectric Withstand Voltage	3520 V _{DC}
Isolation Resistance	>100 MΩ
Material Group acc. to IEC 60664-1	See Appendix 5.2
Creepage/Clearance	See Appendix 5.2
Current carrying capability:	See Appendix 5.1
Degree of protection (IP code) against access, system un-mated	IP2XB; Touch Proof as per IEC 60529
Degree of protection (IP code), system mated	IP6K9K
Mating Cycles	10
HVIL capable	Yes
Identification of High Voltage component	Housing parts orange

3.4. Test Requirements and Procedures Summary

Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

Table 2

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Initial examination of product	Meets requirements of product drawing.	USCAR-2 5.1.8
Final examination of product	Meets visual requirements.	USCAR-2 5.1.8
ELECTRICAL		
Protection against accidental contact, Plug	No contact between HV and Finger probe at 10 N +/-10%	IEC 60529
Protection against accidental contact, Header	No contact between HV and Finger probe at 10 N +/-10%	IEC 60529
Voltage Drop	USCAR-2, Section 5.3.2.4 1 mΩ maximum (Power)	USCAR-2 5.3.2

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Dry Circuit Resistance - HVIL	USCAR-2, Section 5.3.2.4 20 mΩ maximum (Signal, HVIL)	USCAR-2 Section 5.3.1
Dry Circuit Resistance - Shield	USCAR-2, Section 5.3.2.4 Record values for information only (Signal, Shield)	USCAR-2 Section 5.3.1
Insulation Resistance	USCAR-2, Section 5.5.1.4 1000VDC Circuit to circuit, circuit to shield	USCAR-2 Section 5.5.1.3
Dielectric Withstand	USCAR-37, Section 5.5.2 No breakdown @3520VDC	USCAR-37 Section 5.5.2
MECHANICAL		
Terminal insertion, HC-STAK25 Weld Tab, Plug	225 N maximum – TE exception to USCAR-37.	USCAR-37, Section 5.4.1.4
Terminal push-through, HC-STAK25 Weld Tab, Plug	USCAR-37, Section 5.4.1.4.3 50 N minimum or terminal insertion force, whichever is greater.	USCAR-37, Section 5.4.1.4
Terminal retention, HC-STAK25 Weld Tab, Primary Lock only (TPA is used as Primary Lock), Plug	USCAR-37, Section 5.4.1.4. 330N minimum.	USCAR-37, Section 5.4.1.4
Terminal retention, HC-STAK25 Weld Tab, Primary and Secondary Lock (Cable Seal and Cable Seal Retainer used as Secondary Lock), Moisture Conditioning, Plug	USCAR-37, Section 5.4.1.4 450 N minimum.	USCAR-2, Section 5.4.1.3-B8 USCAR-37, Section 5.4.1.4
Terminal retention, HC-STAK25 Weld Tab, Primary and Secondary Lock (Cable Seal and Cable Seal Retainer used as Secondary Lock), Temp/Humidity cycling, Plug	USCAR-37, Section 5.4.1.4. 225 N minimum.	USCAR-2, Section 5.6.2 USCAR-37, Section 5.4.1.4
Terminal retention, Header Tab, Primary and Secondary Lock, Temp/Humidity cycling, Header	USCAR-37, Section 5.4.1.4. 225N minimum	USCAR-2, Section 5.6.2 USCAR-37, Section 5.4.1.4
Terminal retention, MQS Pin, Primary and Secondary Lock, Temp/Humidity cycling, Header	USCAR-2, Section 5.4.1.4 50 N minimum	USCAR-2, Section 5.6.2 USCAR-2, Section 5.4.1.3-B
Terminal retention, HC-STAK25 Weld Tab, Primary and Secondary Lock (Cable Seal and Cable Seal Retainer used as Secondary Lock), High Temperature Exposure, Plug	USCAR-37, Section 5.4.1.4. 225 N minimum.	USCAR-2, Section 5.6.3 USCAR-37, Section 5.4.1.4
Terminal retention, Header Tab, Primary and Secondary Lock, High Temperature Exposure, Header	USCAR-37, Section 5.4.1.4. 225N minimum	USCAR-2, Section 5.6.3 USCAR-37, Section 5.4.1.4
Terminal retention, MQS Pin, Primary and Secondary Lock, High Temperature Exposure, Header	USCAR-2, Section 5.4.1.4 50 N minimum	USCAR-2, Section 5.6.3 USCAR-2, Section 5.4.1.3-B
Terminal insertion, Tab, Header	225 N maximum – TE exception to USCAR-37.	USCAR-37, Section 5.4.1.4
Terminal insertion, MQS Pin, Header	USCAR-2, Section 5.4.1.4-1 30 N maximum	USCAR-2, Section 5.4.1.3-A
Terminal push-through, Tab, (TPA in Pre-Lock position), Header	USCAR-37, Section 5.4.1.4.3 50 N minimum or terminal insertion force, whichever is greater.	USCAR-37, Section 5.4.1.4
Terminal push-through, MQS Pin, Header	USCAR-2, Section 5.4.1.4.2 50 N minimum	USCAR-2, Section 5.4.1.3-A
Terminal retention, Tab, Header	280 N minimum – TE exception to USCAR-37.	USCAR-37, Section 5.4.1.4
Terminal retention, MQS Pin, Primary Lock only, Header	USCAR-2, Section 5.4.1.4 30 N minimum	USCAR-2, Section 5.4.1.3-B
Terminal retention, Tab, Primary and Secondary Lock, Moisture Conditioning, Header	280 N minimum – TE exception to USCAR-37.	USCAR-2, Section 5.4.1.3-B8 USCAR-37, Section 5.4.1.4

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Terminal retention MQS Pin, Primary and Secondary lock, Moisture Conditioning, Header	USCAR-2, Section 5.4.1.4 60N minimum	USCAR-2, Section 5.4.1.3-B8 USCAR-2, Section 5.4.1.4
Terminal/cable seal retainer insertion (unpopulated Cable Seal, Collet, Retainer), Plug	290 N maximum – TE exception to USCAR-37.	USCAR-2, Section 5.4.5.1
CPA Engagement, Plug (unmated, Lever open, Pre-Set → Lock)	USCAR-2, Section 5.4.5.2.4 60N minimum	USCAR-2, Section 5.4.5.2
CPA Engagement, Plug (mated, Lever closed, Pre-Set → Lock)	USCAR-2, Section 5.4.5.2.4 22N maximum	USCAR-2, Section 5.4.5.2
CPA Disengagement, Plug (mated, Lever closed, Lock → Pre-Set)	USCAR-2, Section 5.4.5.2.4 10N minimum, 30N maximum	USCAR-2, Section 5.4.5.2
CPA removal, Plug (unmated, Lever open, Pre-Set → Remove)	USCAR-2, Section 5.4.5.2.4 30N minimum	USCAR-2, Section 5.4.5.2
Audible Click	USCAR-2, Section 5.4.7.4 Record values for information only	USCAR-2, Section 5.4.7
Audible Click, Moisture Conditioning	USCAR-2, Section 5.4.7.4 Record values for information only	USCAR-2, Section 5.4.7
Pre-Lock Engage Force	USCAR-2, Section 5.4.3.4-1 75N maximum (5.4.3.4 Acceptance criteria, Note 1)	USCAR-2, Section 5.4.3.3.A
Connector Mating Force (with Lever)	USCAR-2, Section 5.4.3.4-4 75N maximum (5.4.3.4 Acceptance criteria, Note 4)	USCAR-2, Section 5.4.3.3.C.1
Un-mating Force (using Lever) (CPA disable)	USCAR-2, Section 5.4.3.4-4 75N maximum (5.4.3.4 Acceptance criteria, Note 4)	USCAR-2, Section 5.4.3.3.C.3
Pre-Lock Disengagement Force (CPA disable, Lever open)	USCAR-2, Section 5.4.3.4-2 15N minimum, 75N maximum (5.4.3.4 Acceptance criteria, Note 2)	USCAR-2, Section 5.4.3.3.A
Retention Force (unpopulated, CPA disable, Lever closed)	USCAR-2, Section 5.4.3.4-6 110N minimum (5.4.3.4 Acceptance criteria, Note 6)	USCAR-2, Section 5.4.3.3.D
Lever Release Force (from closed position with latches engaged, CPA closed)	USCAR-2, Section 5.4.3.4-5 60N minimum (5.4.3.4 Acceptance criteria, Note 5)	USCAR-2, Section 5.4.3.3.C.2
Force to release Lever from shipping position (Class 3)	USCAR-2, Section 5.4.3.4-3 60N minimum (5.4.3.4 Acceptance criteria, Customer agreed upon acceptance criteria)	USCAR-2, Section 5.4.3.3.B
Polarization feature Effectiveness (incorrect orientation 90, 180)	USCAR-2, Section 5.4.4.4.1 No functional damage No electrical contact	USCAR-2, Section 5.4.4.3.4b
Drop Test, Plug (Lever closed, CPA in Lock position)	USCAR-2, Section 5.4.8.4	USCAR-2, Section 5.4.8
Drop Test, Header	USCAR-2, Section 5.4.8.4 Record values for information only	USCAR-2, Section 5.4.8
Connector Seal Retention (mated connector)	USCAR-2, Section 5.4.14.3 Peripheral seal not displaced	USCAR-2, Section 5.4.14.2
Mechanical Assist Integrity	USCAR-2, Section 5.4.12.4 No damage	USCAR-2, Section 5.4.12.3
Shunt Retention, Plug	USCAR-2, Section 5.7.1.4 30N minimum	USCAR-2, Section 5.7.1.3
Shield Termination Ferrule Retention	USCAR-37, Section 5.2.4.5 150N minimum	USCAR-37, Section 5.2.4

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
ENVIRONMENTAL		
Vibration/Mechanical Shock	USCAR-2, Section 5.1.9 No loss of continuity for more than 1µs	USCAR-2, Section 5.4.6
Thermal Shock	Conditioning only	USCAR-2, Section 5.6.1
Temperature/Humidity cycling	Conditioning only	USCAR-2, Section 5.6.2
High Temperature Exposure	Conditioning only	USCAR-2, Section 5.6.3
Pressure/Vacuum Leak - Initial	USCAR-2, Section 5.6.6.4 48kPa, No leaks	USCAR-2, Section 5.6.6
Pressure/Vacuum Leak – After Conditioning	USCAR-2, Section 5.6.6.4 28kPa, No leaks	USCAR-2, Section 5.6.6
Submersion	USCAR-2, Section 5.6.5.4 Conditioning only • 0°C Solution • 30-40cm depth • 30 minutes	USCAR-2, Section 5.6.5
High Pressure Spray	USCAR-2, Section 5.6.7.4 Conditioning only • 14-16 L/min • 8,000-10,000 kPa • 80±5°C	USCAR-2, Section 5.6.7
Fluid Resistance	No excessive swelling that impacts function	USCAR-2, Section 5.6.4 9 fluids per table 5.6.4.3



NOTE

Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Requalification Test Sequence shown in Section 3.5.

3.5. Product Qualification and Requalification Test Sequence

Table 3

TEST OR EXAMINATION	TEST GROUP												
	1			2				3		4			
	SAMPLE SIZE												
	10	10	10	10	10	10	10	10	10	10	10	10	16
TEST SEQUENCE (a)													
Visual Inspection	1,8	1,5	1,5	1,5	1,5	1,4	1,4	1,3	1,5	1,7	1,3	1,6	1
Terminal insertion, HC STAK25 tab terminal to inner housing	2				2								
Terminal push-through, HC STAK25 blade	3												
Terminal retention, HC STAK25, Primary lock only	4												
Terminal insertion, MQS 064 receptacle (pair) to plug	5												
Terminal push-through, MQS 064 pin	6												
Terminal retention, MQS 064 receptacle, Primary lock only	7												

TEST OR EXAMINATION	TEST GROUP													
	1				2				3		4			
	SAMPLE SIZE													
	10	10	10	10	10	10	10	10	10	10	10	10	10	16
	TEST SEQUENCE (a)													
Moisture Conditioning		2					2	2						3
Terminal retention, HC STAK25, Primary lock only		3												
Terminal retention, MQS 064 receptacle, Primary lock only		4												
Temp/Humidity Cycling			2						2					
Terminal retention, HC STAK25, Primary lock only			3											
Terminal retention, MQS 064 receptacle, Primary lock only			4											
High-Temp Exposure				2						2				
Terminal retention, HC STAK25, Primary lock only				3										
Terminal retention, MQS 064 receptacle, Primary lock only				4										
Terminal push-through, HC STAK25 Tab					3									
Terminal retention, HC STAK25 Tab to inner housing					4									
Terminal insertion, MQS 064 Pin						2								
Terminal retention, MQS 064 Pin						3								
Header Tab Retention, HC STAK25 Tab							3							
Terminal retention, MQS 064 Pin, Primary lock							4							
Header Pin Retention, HC STAK25 Tab									3					
Terminal Retention, MQS064 pin, Primary Lock									4					
Header Pin Retention, HC STAK25 Tab										3				
HC STAK25 Header Inner Housing Insertion to Outer Housing										4				
HC STAK25 Header Inner Housing Retention to Outer Housing										5				
Terminal Retention, MQS064 pin, Primary Lock										6				
Terminal Retainer Insertion, this is seal retainer (Plug, Unpopulated. Wire present)											2			
CPA Engagement (Unmated, Plug, Pre-set → Lock, Lever open)													2	
CPA Engagement (Mated, Plug, pre-set → Lock, Lever closed)														3
CPA Disengagement (Mated, Plug, Lock → Pre-Set, Lever closed)														4
CPA Removal (Unmated, Plug, pre-set → Remove, Lever open)														5
Audible Click, Ambient sound 80 dB(A) MIN per Ford SDS 5B-1														2,4

Table 4, Continued

TEST OR EXAMINATION	TEST GROUP													
	5				6	7	17	18	19	11	12	13	14	
	SAMPLE SIZE													
	10	5	1	10	10	2	18	10	5	10	10	10	10	10
	TEST SEQUENCE (a)													
Visual Inspection	1,6	1,3	1,3	1,3	1,3	1,3	1,5	1,3	1,3	1,4	1,9	1,3,11	1,9	1,9
Pre-Lock Engage Force (Fully populated)	2													
Connector Mating Force (with Lever) (Fully populated)	3													
Un-mating Force (using Lever) (CPA disabled)	4													
Pre-Lock Disengagement Force (CPA open, Lever open)	5													
Retention Force (unpopulated, CPA open, Lever closed)		2												
Retention Force (unpopulated, CPA open, Lever open)			2											
Lever Release Force (from closed position with latches engaged, CPA closed)				2										
Force to release Lever from shipping position (Class 3, Lever locked in open position)					2									
Polarization feature Effectiveness (incorrect orientation 90, 180, correct key, populated)						2								
Drop Test, (Plug Connector, Meter, connector per orientation, 6 orientations (X-up, X-down, Y-up, Y-down, Z-up, Z-down))							2							
Drop Test (Header Outer Assy, 1 Meter, 2 without inner housing, 1 with inner housing assembled connector per orientation, 6 orientations (X-up, X-down, Y-up, Y-down, Z-up, Z-down))							3							
Drop Test (Header Inner Assy, 1 Meter, 3 connector per orientation, 6 orientations (X-up, X-down, Y-up, Y-down, Z-up, Z-down))							4							
Connector Seal Retention, Peripheral Seal (mated Connector)								2						
Mechanical Assist Integrity									2					
Shield termination isolation test										2				
Shield termination retention										3				
Mate/Unmate connector halves (1 cycle)												2		
Connector Cycling (10 mating/unmating cycles)											2	4	2	2
Voltage Drop (HV Conductors only 250 A)											3,6	5,8	3,6	3,6
Dry Circuit Resistance (HVIL only)											4,7	6,9	4,7	4,7
Vibration/Mechanical Shock (V1 profile, 8hrs random, 10x shocks/axis @35g)											5			
Thermal Shock (max. temp. 125°C, 100x cycles)												7		
Temp/Humidity Cycling (max. temp. 125°C, 40x cycles)													5	

TEST OR EXAMINATION	TEST GROUP													
	5				6	7	17	18	19	11	12	13	14	
	SAMPLE SIZE													
	10	5	1	10	10	2	18	10	5	10	10	10	10	10
TEST SEQUENCE (a)														
High Temp Exposure (max. temp. 125°C, 1008hrs)														5
Dielectric Withstand											8	10		8

Table 5, Continued

TEST OR EXAMINATION	TEST GROUP					
	15	16	20	22	23	24
	SAMPLE SIZE					
	10	10	14	1	1	10
TEST SEQUENCE (a)						
Visual Inspection	1,15	1,15	1,3	1	1	1
Connector Cycling	2	2				
Isolation Resistance	3,5,7,9,11, 13	3,5,7,9,11, 13				
Pressure/Vacuum Leak (48 kPa)	4	4				
Temp/Humidity Cycling (max. temp. 125°C, 40x cycles) (max. temp. 125°C, 40x cycles)	6					
High Temp Exposure		6				
Pressure/Vacuum Leak (28 kPa)	8	8				
Submersion	10	10				
High Pressure Spray	12	12				
Dielectric Withstand	14	14				
Fluid Resistance (30 min soak, 9 fluids)			2			
Protection against accidental contact, Header				2		
Protection against accidental contact, Plug					2	
Shunt Retention, Plug						2


NOTE

(a) Numbers indicate sequence in which tests are performed.

4. Quality Assurance Provisions

4.1. Qualification Testing

4.1.1 Specimen Selection

The samples shall be prepared in accordance with product drawings and shall be selected at random from current production.

4.1.2 Test Sequence

Qualification inspection shall be verified by testing specimens as specified in Chapter 3.5.

4.2. Requalification Testing

If changes significantly affecting form, fit, or function depending on the product or manufacturing process, product engineering shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality, and reliability engineering.

4.3. Acceptance

Acceptance is based on verification that the product meets the requirements of chapter 4. Failures attributed to equipment, test setup, or operator deficiencies shall not disqualify the product. When product failure occurs, corrective action shall be taken, and samples resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

4.4. Quality Conformance Inspection

The applicable quality inspection plan will specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable customer drawing and this specification.

5. Appendix

5.1. Housing influence on derating

HC-STAK25-2phi 90° Plug - Header

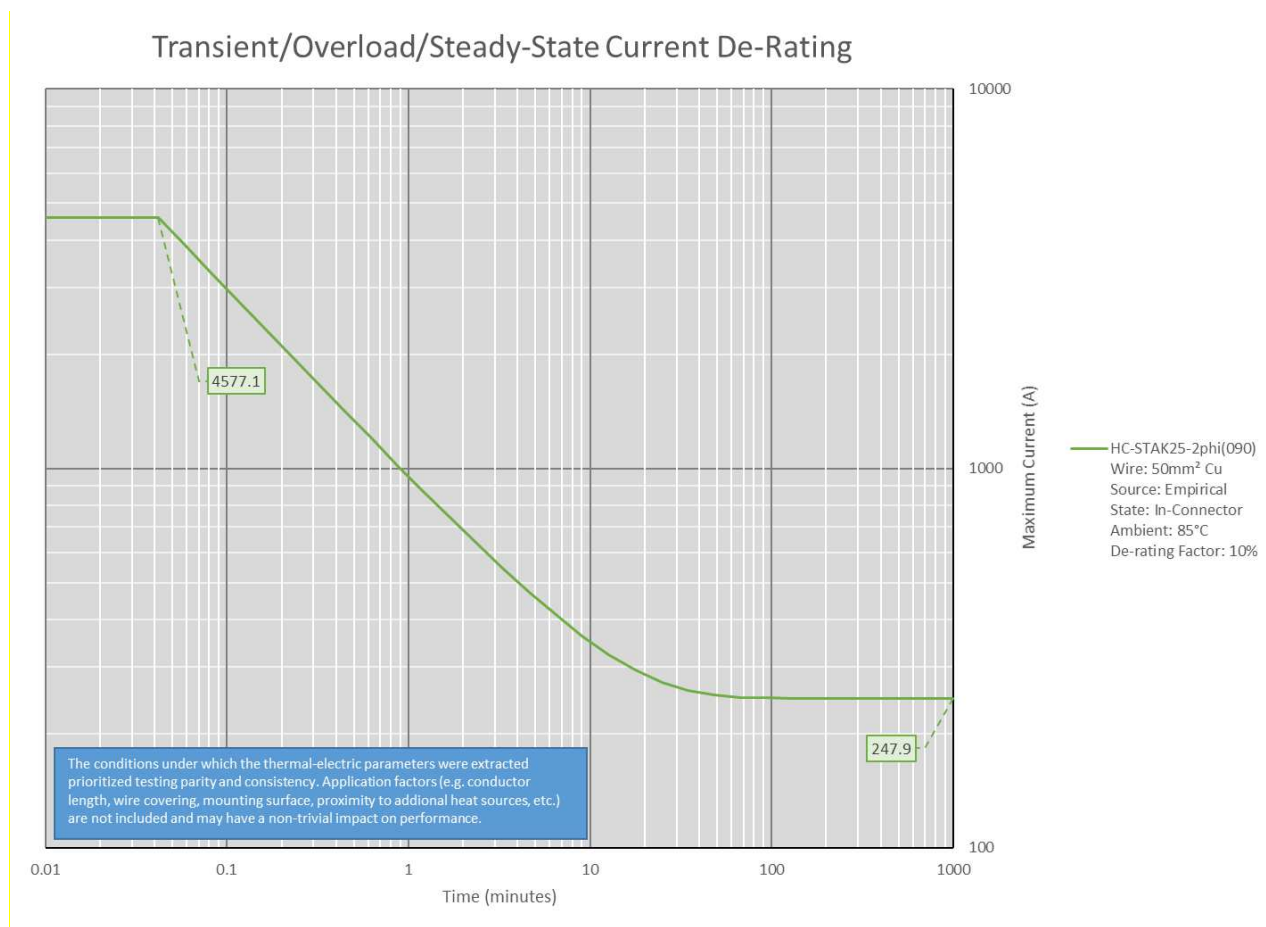
Maximum Material Service Temperature (T_M): 150 °C

Receptacle: Ag plated

Tab: C11000 base material with Ag plating

Cable: HV 50mm², Copper, Shielded

Figure 1: Transient/Overload/Steady-State Current De-Rating



5.2. Creepage and Clearance

Table 6

Assembly	Description	Minimum Clearance Distance (mm)	Minimum Creepage Distance (mm)
Header Assembly – Unmated Condition (Header Housing: CTI 600)	HV to HV	12.90	12.90
	HV to Shield	9.47	10.91
	HV to HVIL	11.81	10.42
Plug Assembly – Unmated Condition (Plug Housing: CTI 525)	HV to HV	16.96	17.45
	HV to Shield	9.48	8.44
	HV to HVIL	9.18	12.03
Plug and Header Assembly - Mated	HV to HV	12.90	12.90
	HV to Shield	9.12	8.44
	HV to HVIL	11.56	10.42



NOTE

Values are derived from CAD model with nominal geometry.

5.3. Dynamic Load

System will be validated with strain relief at 100mm. Each application must be evaluated independently with regards to the external influences on the system. Having strain relief, which moves with the connector body, close to the end of the connector will have a positive influence on the performance of the connector. Having strain relief further from the end of the connector or that moves independent of the connector body will have a negative influence on the performance of the connector.

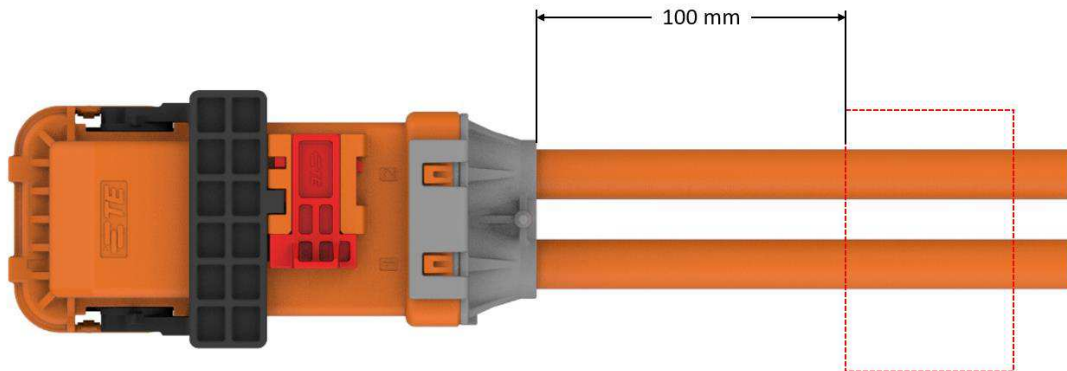


Figure 2: Conductor attachment

Table 7: Class Schedule for Shock (USCAR-2 Rev6)

Vibration Class	Shocks per Axis	Wave Shape	Direction (+/-)	Duration (ms)	Acceleration (g)
V1	10	Half Sine Wave	Positive	5 ~ 10	35

Table 8: Vibration Duration

Vibration Class	Sine Duration (Hrs./axis)	Random Duration (Hrs./axis)	Thermal Cycling
V1	N/A	8	N/A

Table 9: Vibration Schedule: V1 - Random

F (Hz)	PSD (m/s ²) ² /Hz	PSD (g ² /Hz)
5.0	0.192	0.00200
12.5	23.8	0.24800
77.5	0.307	0.00320
145.0	0.192	0.00200
200.0	1.13	0.01180
230.0	0.031	0.00032
1000.0	0.002	0.00002
g _{rms}	17.74	1.81 g