

# HPC SERIES RECEPTACLE MALE AND PLUG FEMALE CONNECTOR

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## 1. SCOPE

### 1.1. Content

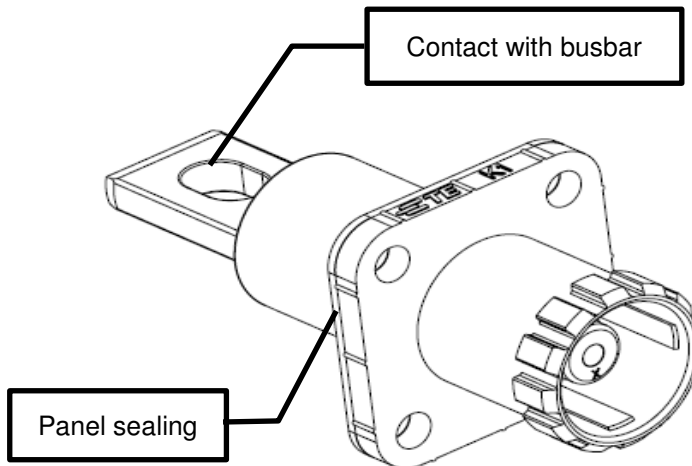
When tests are performed, the following specifications and standards shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

This specification defines the performance, tests and quality standards for HPC series products.

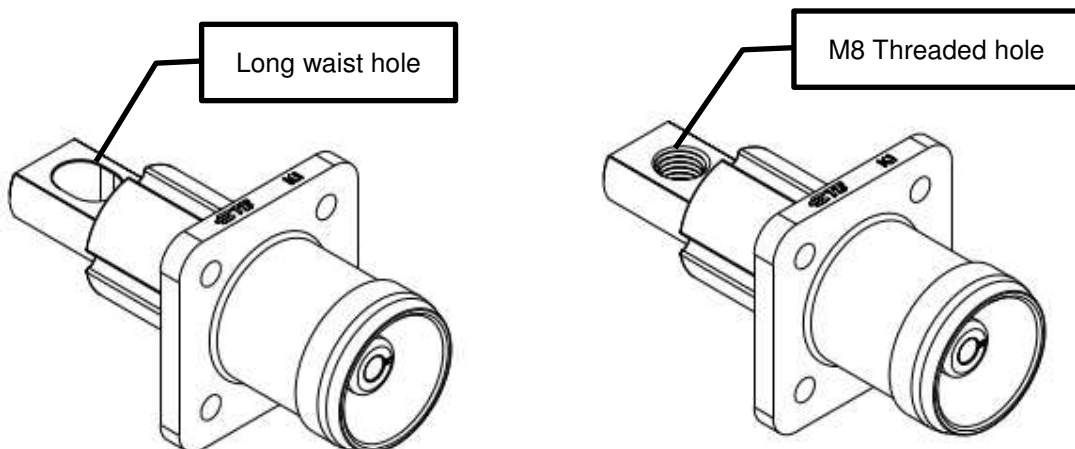
The HPC series is designed to fulfil the standard UL4128 & EN61984 and consequently section 7 of this standard which defined the type tests, specimens, sequence, ratings and measurements to be performed by the product in tests.

Male receptacle:

### HPC-200/250



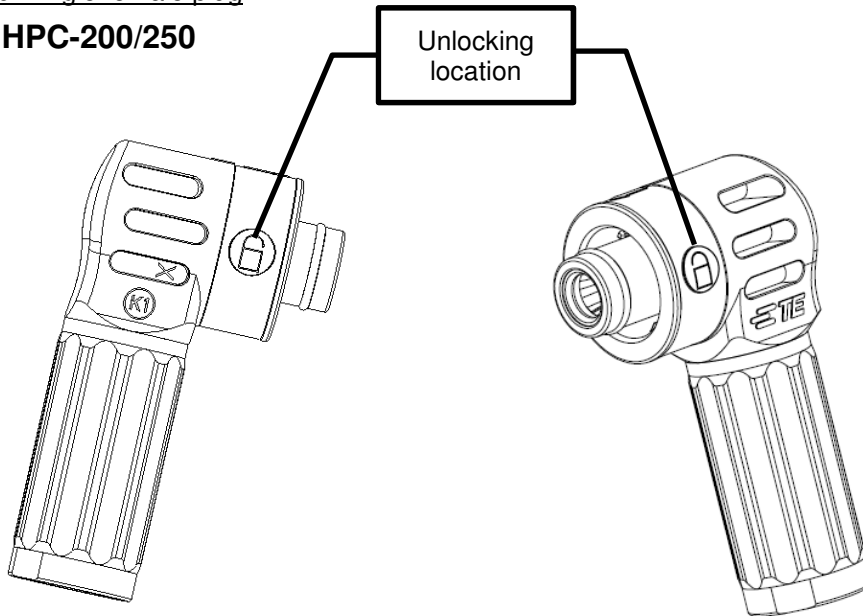
### HPC-350



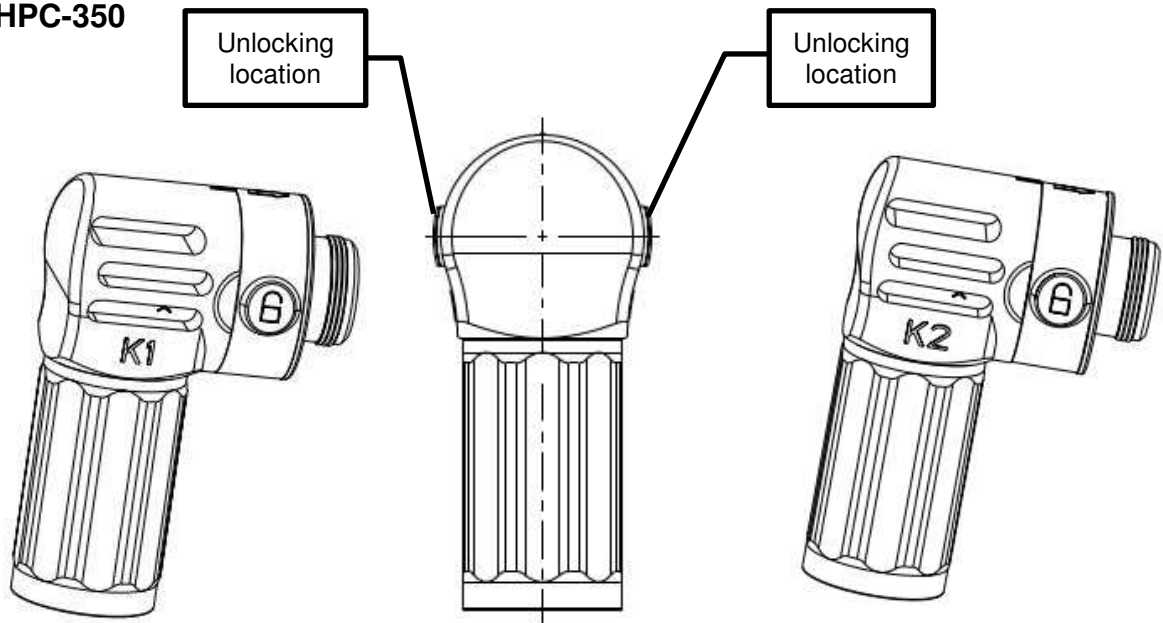


90° Angle female plug:

**HPC-200/250**



**HPC-350**



## 1.2. Qualification

When tests are performed, the following specifications and standards shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

## 2. APPLICABLE DOCUMENTS

The following documents form part of this specification to the extent specified herein. In the case of a conflict between the requirements of this specification and the product drawing or of conflicts between the requirements of this specification and the referenced documents, this specification shall take precedence.

### 2.1. TE Connectivity documents

#### Connectors:

Customer drawing and name  
HPC series product

#### Other / Download documents:

- <http://www.te.com>

### 2.2. Normative references

The following referenced standards are applicable, as well as the standards listed therein as applicable standards. For undated references, the last standard version in effect at the test date has been used.

- EN 61984: Connectors - Safety requirements and tests
- IEC 60068: Environmental testing
- IEC 60512: Connectors for electronic equipment - Test and measurements
- UL 4128: Outline of Investigation for Intercell and Intertier Connectors for Use in Electrochemical Battery System Applications
- UL 157: Gasket and seals
- UL 840: Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment
- NFF 00-363:1995 – Rolling stock – Products to be crimped for electrical connections
- EN 60529:1991+A1:2000 – Degree of protection procured by enclosures (IP code)
- EN 61373:2010 – Railway applications – Rolling stock equipment – Shock and vibrations tests
- EN50467:2012 – Railway Applications – Rolling Stock – Electrical connectors, requirements and test methods

### 3. REQUIREMENTS

#### 3.1. Design and Construction

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

#### 3.2. Ratings

Unless otherwise specified, severity of the service conditions shall be those per EN 61984 & UL 4128.

- Rated Voltage: 1500V
- Overvoltage Category: OV3
- Pollution Degree: PD3
- RMS Withstand Voltage @ 50 - 60 Hz required:
- Rated Impulse Voltage ( $U_{Ni}$ ) per UL 840, tab. 7.1: 12kV
- Withstand Voltage per UL 4128, tab. 12.1: 6.8kV
- Insulation Resistance: > 5000M $\Omega$
- Contact resistance: < 0.5m $\Omega$ (50mm<sup>2</sup>) / < 0.3m $\Omega$ (70mm<sup>2</sup>) / < 0.15m $\Omega$ (95mm<sup>2</sup>)
- Rated Current: According to related drawings
- Operating Temperature range: -40 / +125°C
- Degree of Protection per EN60529: IP67
- Mating Cycles: 500
- Vibration & Shocks per EN61373: Category 1B

#### 3.3. Performance and tests description

Product shall be designed to meet the electrical, mechanical and environmental performance requirements specified in Paragraph 3.4. Unless otherwise specified, all tests shall be performed at ambient environmental conditions per EN 61984 / EN 60068-1.

## 3.4. Tests Requirements and Procedures summary

Table 1 – General, Group 0 (non-normative)

No.	Measurements to be performed		Condition	Requirements
	Test Items	EN 60512		
01	Visual & dimensional examination	1a, 1b	Any existing cover shall be removed, if required	Dimensions shall comply with the drawings
02	Contact resistance	2b	Mated specimen Test current: assigned current. Measuring points: at the end of the termination. Test Voltage DC: $1 < U (V) < 60$	Contact resistance shall be 0.5m $\Omega$ (50mm <sup>2</sup> ) max, 0.3m $\Omega$ (70mm <sup>2</sup> ) max and 0.15m $\Omega$ (95mm <sup>2</sup> ) max
03	Insulation resistance	3a	Test voltage 500V DC Time:60s IEC 60512-3-1 Test 3a Method B	Insulation resistance shall be >5000M $\Omega$
04	Dielectric strength	4a	Mated specimen Measurement points: Contact/earth Test voltage: RMS withstand voltage 6.8 kV	EN 61984, 6.13 There shall be no breakdown or flashover

Table 2 – Mechanical Tests, Group A (per EN 61984, tab. 10)

Test phase (a)	Test Designation	Test according to		Severity or conditions	Measurements to be performed		Requirements
		EN 60512	EN 61984		Designation	EN 60512	
A1	Visual and dimensional examination		7.3.11	Any existing cover shall be removed, if required	Visual and dimensional examination	1a, 1b	6.2, 6.9.2, 6.9.3, 6.11, 6.19 Dimensions shall comply with the drawings
A2 (b)	Durability of marking		7.3.2	With the naked eye	Visual examination	1a	Markings according to 6.2
A3 (c)	Polarization and coding	13e		Tests force: 1,5 x mating force, but not higher than 80 N	Visual examination	1a	6.3, 6.9.1 No damage likely to impair function
A4 (d)	Provisions for earthing		7.3.3		First make last break		6.5.1
				Any existing cover shall be removed, if required	Visual examination	1a	6.5.4

A5 (e)	Interlock		7.3.4				6.7
A6	Terminations						6.6
A7 (f)	Contact retention in insert	15a		Test load shall be 3 times the specified insertion force (mating) of 1 contact or the specified insertion force of 1 contact + 50N, whichever is less. The minimum test load shall not be less than 20N.			6.18.2
					Visual examination	1a	No axial displacement likely to impair normal operation
A8.1 (g)	Cable clamp resistance to cable pull	17c		With cables having the largest and smallest diameter suitable for clamping specified in the DS or by the manufacturer. Any existing covers associated with the cable anchorage shall be mounted as specified.	Visual examination	1a	6.17, Table 6
A8.2 (g)	Cable clamp resistance to cable torsion	17d			Visual examination	1a	6.17, Table 6
A9	Mechanical strength impact	7b		Only free connector (plug) Dropping height: - 750mm for specimens of mass $\leq$ 250g Dropping cycles: 8 Position in 45° steps, 1 cycle per position			EN 50467, 6.15
					Visual examination	1a	Parts used for protection against electric shock shall not be damaged. Reduction of clearance and creepage distances is not allowed
<p>Note: (a) test phase numbers are those per EN 61984.  (b) product in test is molded, so not removeable. test A2 is not applicable.  (c) single pole connector, test A3 is not applicable.  (d) no earthing system, test A4 is not applicable.  (e) no interlock system, test A5 is not applicable.  (f) contact is over molded, contact is not removeable. test A7 is not applicable.  (g) product in test is not equipped of stain relief, test A8 is not applicable.</p>							



Table 3 – Service Life Tests, Group B (per EN 61984, tab. 11)

Test phase (a)	Test Designation	Test according to		Severity or conditions	Measurements to be performed		Requirements
		EN 60512	EN 61984		Designation	EN 60512	
B1	Initial measurement			Mated specimen Test current: assigned current. Measuring points: at the end of the termination. Test Voltage DC: $1 < U (V) < 60$	Contact resistance	2b	Reference value for subsequent measurement
B2 (b)	Breaking capacity		7.3.5	For CBCs only Breaking capacity with operating cycles according to manufacturer's specification			6.14.2
					Visual examination	1a	No damage shall occur which could impair normal use
B3	Mechanical operation	9a	7.3.9	Operating cycles: 500			6.14.1
					Visual examination	1a	No damage shall occur which could impair normal use
B4	Final measurement			Same conditions as for test phase B1.	Contact resistance	2b	The change of contact resistance shall be no more than 50% of the reference value or $\leq 5\text{m}\Omega$ . The higher value is permissible.
			7.3.12	Same conditions as for test phase D6	Voltage proof	4a	EN 61984, 6.13 There shall be no breakdown or flashover

Note: (a) test phase numbers are those per EN 61984  
(b) test breaking capacity only for CBCs, consequently test B2 is not applicable

**Table 4 – Thermal Tests, Group C (per UL 4128)**

Test phase (a)	Test Designation	Test according to		Severity or conditions	Measurements to be performed		Requirements
		EN 60512	UL 4128		Designation	EN 60512	
C1	Temperature rise	5a	16	Mated specimen, wired to cables of 800-1000mm length 6 pairs of connectors connected together with rated current. Continue 4 hours even through stabilized temperature .			UL 4128, 16.1 The temperature rise shall not exceed 45°C

Note: (a) test phase numbers are those per UL 4128

Table 5 – Climatic test, Group D (per EN 61984, tab. 13)

Test phase (a)	Test Designation	Test according to		Severity or conditions	Measurements to be performed		Requirements
		EN 60512	EN 61984		Designation	EN 60512	
D1	Initial measurement			Mated specimen Test current: assigned current. Measuring points: at the end of the termination.	Contact resistance	2b	Reference value for subsequent measurement
D2	Cold	11j		Mated specimen Test temperature: -40°C Test duration: 2hours			EN 61984, 6.6.3; 6.8; 6.15; 6.18.3
					Visual examination	1a	No damage shall occur which could impair normal use
D3	Dry heat	11i		Mated specimen Test temperature: +125°C Test duration: 7days			EN 61984, 6.6.3; 6.8; 6.15; 6.18.3
					Visual examination	1a	No damage shall occur which could impair normal use
D4 (b)	Salt mist test	11f	7.3.14	Mated specimen Test duration: TBD	Visual examination	1a	No damage shall occur which could impair normal use
D5	Final measurement			Same conditions as for test phase D1.			No damage shall occur which could impair normal use
					Contact resistance	2b	The contact resistance rise shall be no more than 50% of the reference value or 5mΩ. The higher value is permissible
D6	Insulation resistance	3a		Test voltage 500V DC Time:60s IEC 60512-3-1 Test 3a Method B			Insulation resistance shall be > 500MΩ
D7	Dielectric strength		7.3.12	Mated specimen Measurement points: Contact/earth Test voltage: RMS withstand voltage 6.8 kV	Voltage proof	4a	EN 61984, 6.13 There shall be no breakdown or flashover

Note: (a) Test phase numbers are those per EN 61984  
(b) Salt mist test focus on metal housing, the HPC product without metal housing, consequently, test D4 is not applicable

**Table 6 – Degree of Protection Tests, Group E (per EN 61984, tab. 14)**

Test phase (a)	Test Designation	Test according to		Severity or conditions	Measurements to be performed		Requirements
		EN 60512	EN 61984		Designation	EN 60512	
E1 (b)	Protection against electric shock						
E2 (c)	Provision for earthing						
E3	Degree of protection IP code		7.3.7	IP6x IPx7			EN 61984, 6.12

Note: (a) test phase numbers are those per EN 61984

(b) connectors non IP2X, specified as not to be used under load when disconnected, test E1 is not applicable

(c) connectors without earthing contact, consequently, test E2 is not applicable

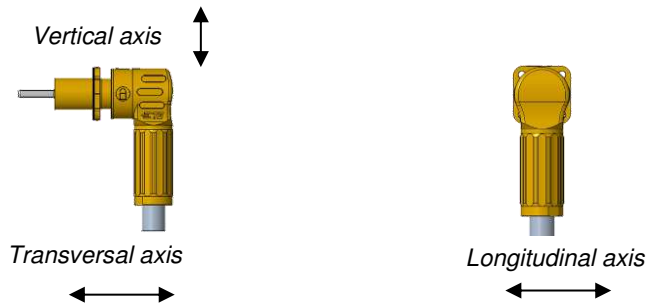


**Table 7 – Vibration and Shocks Tests, Group F (per EN 50467, tab. 10)**

Test phase (a)	Test Designation	Test according to		Severity or conditions	Measurements to be performed		Requirements
		EN 60512	EN 50467		Designation	EN 60512	
F1	Simulated long life random vibration at increased levels		EN 61373:1999, Clause 9	Connectors mated, all contacts wired in series and monitored for micro interruption. According to classification of intended mounting location: category 1B			EN 50467, 6.16
					Contact disturbance	2e	Micro interruption $\leq 1 \mu s$
					Visual examination	1a	No damage likely to impair function
F2	Shocks		EN 61373:1999, Clause 10	Connectors mated. According to classification of intended mounting location: category 1B			EN 50467, 6.16
					Visual examination	1a	No damage likely to impair function
F3	Dielectric strength		7.12	Mated specimen Measurement points: Contact/earth Test voltage: RMS withstand voltage 6.8 kV	Voltage proof	4a	EN 50467, 6.12 There shall be no breakdown or flashover

Note: (a) test phase numbers are those per EN 50467

Figure 1 – Vibrations and shocks axis



### 3.5. Specimens

Number of Specimens as below table:

<b>Table 8 - Number of Specimen – HPC Series connectors version</b>		
<b>Test</b>	<b>Description</b>	<b>Numbers &amp; consist of</b>
Group A	Mechanical	3 pair of connectors
Group B	Service Life	3 pair of connectors
Group C	Thermal	6 pair of connectors
Group D	Climatic	3 pair of connectors
Group E	Degree of Protection	3 pair of connectors
Group F	Vibration and Shocks	3 pair of connectors
Sum of test specimens		21

## 3.6. Tests Sequence for HPC series connectors

Table 9 - Tests Sequence – HPC series connector							
Test or Examination	Test Group						
	A1	A2	B	C	D	E	F
	Test Sequence						
Visual and dimensional examination	1,3	1,3	1,6	1,3	1,8	1,4	1,5
Crimp tensile strength		2					
Mechanical strength impact	2						
Contact resistance			2,4		2,5		
Mechanical operation (Durability)			3				
Insulation resistance					6		
Dielectric strength - Voltage withstanding			5		7		4
Temperature rise				2			
Cold					3		
Dry heat					4		
Degree of protection – IP6X						3	
Degree of protection – IPX7						2	
Simulated long life random vibration at increased levels							2
Shocks							3

**Notes:**

- Numbers indicate the sequence in which the tests are performed.

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1. Qualification Testing

#### 4.1.1. Specimens Selection

Specimens shall be prepared in accordance with applicable Instruction Sheets and shall be selected at random from current production.

#### 4.1.2. Test Sequence

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

### 4.2. Requalification Testing

If changes significantly affecting form, fit or functions are made to the product or manufacturing process, product assurance 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 paragraph 3.4. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and specimens resubmitted for qualification. Testing to confirm corrective action is required before re-submittal.

### 4.4. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification. Bulk wire resistance shall be subtracted from resistance readings.