IEC 62196 Electric Vehicle Charge Connector Assembly (Type 2 for Mode 2 and 3)

1. SCOPE

1.1. Content

This specification covers performance, tests and quality requirements for the TE Connectivity (TE) IEC 62196 EV Connector & Plug Assemblies. The Connector & Plug assemblies are designed to perform in accordance with “Plugs, Socket Outlets and Vehicle Inlets – Conductive Charging of Electric Vehicles”, IEC 62196. Although cable diameters and assembly current ratings may vary, the mechanical and environmental requirements contained in this specification apply to all.

1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 1 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

1.3. Qualification Test Results

Successful qualification testing on the subject product line has been completed. The Qualification Test Report number will be issued upon successful qualification testing.

1.4. Terms and definitions

Socket – outlet

Part of a plug and a socket-outlet intended to be installed with the fixed wiring.

Station Side Plug

Station Side Plug is intended to connect with the Socket – Outlet and is part of the supply cable and contains pin contacts.

Car Side / Vehicle Connector

Car Side Connector is intended to connect with the Vehicle inlet and is part of the supply cable.

Vehicle inlet

Vehicle inlet is assembled on the electrical vehicle and contains pin contacts.

2. DESCRIPTION

The enclosure of plugs and vehicle connectors completely encloses the terminals and the ends of the flexible cable. (IEC 62196-1, 18.1)

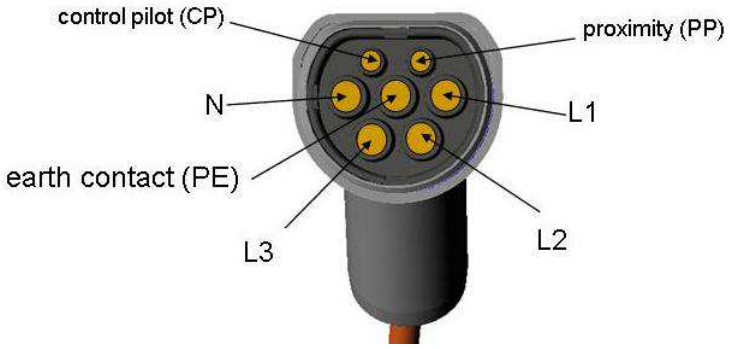
2.1. HOUSINGS

2.1.1. A One Phase

2.1.2. Car-side Connector

The Connector-housing contains one phase lines L1, one ground line (PE), one neutral line (N), one proximity pilot (PP) and one control pilot (CP).

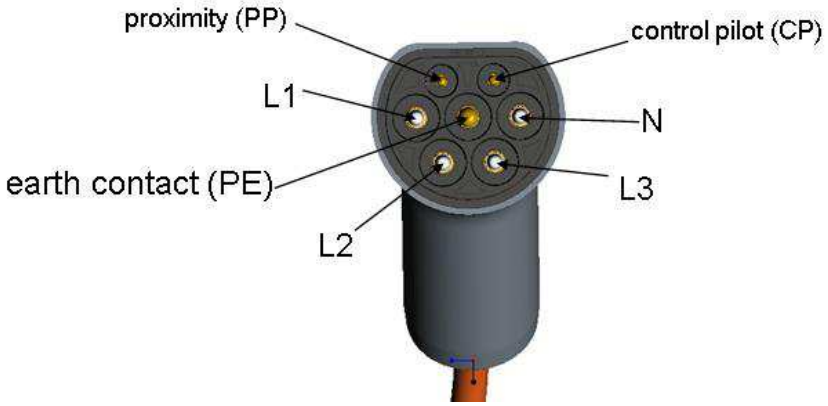
All contacts are receptacle contacts.



2.1.3. Station-side plug

The plug-housing contains one phase lines L1, one ground line (PE), one neutral line (N), one proximity pilot (PP) and one control pilot (CP).

All contacts are pin contacts.



2.1.4. Three Phase

The Three-Phase Plug is the same as the one-Phase Plug, with the L2 and L3 Phases line in place.

2.2. SOCKET CONTACTS

2.2.1. Power Socket and neutral pin contacts

Power receptacle contacts are mated in the Connector housing.

Pin diameter compatibility: 6 mm IEC 62196-2, Standard Sheet 2-IIb

Max wire range: See section 4.2.4

Raw material: Brass with Ag finish

Power pins must have an insulation cap at the end of the pin

Cable: see 4.2.3

2.2.2. Ground pin contact

Earth power receptacle contact is mated in the Connector housing
Pin diameter compatibility: 6 mm — IEC 62196-2, Standard Sheet 2-IIb
Max wire range: See section 4.2.4
Raw material: Brass with Ag finish.
Cable: see 4.2.3

2.2.3. Signal pin contacts

Signal receptacle contact is mated in the Connector housing.
Pin diameter compatibility: 3 mm — IEC 62196-2, Standard Sheet 2-IIb
Wire range: See section 4.2.4
Raw material: Brass with Ag finish
Cable: see 4.2.3

2.3. Pin CONTACTS

2.3.1. Power socket and neutral socket contacts

Power receptacle contacts are mated in the plug housing.
Pin diameter: 6 mm — IEC 62196-2, Standard Sheet 2-IIb
Max wire range: See section 4.2.4
Raw material: Brass with Ag finish
Power pins must have an insulation cap at the end of the pin
Cable: see 4.2.3

2.3.2. Earth power receptacle contact

Earth power receptacle contact is mated in the plug housing
Pin diameter: 6 mm — IEC 62196-2, Standard Sheet 2-IIb
Max wire range: See section 4.2.4
Raw material: Brass with Ag finish
Cable: see 4.2.3

2.3.3. Signal receptacle contacts

Signal receptacle contact is mated in the plug housing.
Pin diameter: 3 mm — IEC 62196-2, Standard Sheet 2-IIb
Wire range: See section 4.2.4
Raw material: Brass with Ag finish
Cable: see 4.2.3

3. 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.

3.1. TE Documents

- 108-94348 EV Charger round crimp specification
- 108-94375 EV Charger round contact system
- 108-94348 EV Charge Round Contact Crimp System
- 108-94390 EV Charger Cable Strain Relief overmolded, with crimped Rivet

3.2. Industry Documents

- ISO 20653:2013-02 Road vehicles; degrees of protection (IP-code); protection against foreign objects; water and contact; electrical equipment
- IEC 60352-2:2014-04 Solderless connections – Part 2: Crimp connections - General requirements, test methods and practical guidance
- IEC 60529:2001-02: International Standard, Degrees of Protection Provided by Enclosure (IP Code)
- IEC 61851-1 Edition 2.0 2010-11: Electric vehicle conductive charging system, Part 1: General requirements
- DIN EN 60068-2-14:2010-04 Environmental testing - Part 2-14: Tests - Test N: Change of temperature
- DIN EN 60068-2-30:2006-06 Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)
- DIN EN 60068-2-38:2010-06 Environmental testing - Part 2-38: Tests - Test Z/AD: Composite temperature/humidity cyclic test
- DIN EN 60068-2-64:2009-04 Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance
- DIN EN 60068-2-78: Environmental testing - Part 2-78: Tests; Test Cab: Damp heat, steady state
  German comments on IEC 62196-2-x: German Proposal 20090430.doc
- DIN EN 61984:2009: Connectors- Safety requirements and tests
- IEC 60664-1:2007 Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests
- IEC 60664-3:2003 Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting or moulding for protection against pollution
- LV124 March 2010: vehicle connector evaluation instruction
- LV214 March 2010: vehicle connector evaluation instruction
- IEC 62196-1 Edition 2.0 2011-10: Plugs, socket-outlets, vehicle couplers and vehicle inlets – Conductive charging of electric vehicles – Part 1: General Requirements
- IEC 62196-2 Edition 1.0 2011-10: Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories
- IEC 62196-3 Edition 1.0 2011-10: Plugs, socket-outlets, vehicle connectors and vehicle inlets – conductive charging of electric vehicles

3.3. Reference Document

- 109-197 Test Specification (TE Test Specification vs EIA and IEC Test Methods)

4. REQUIREMENTS

4.1. Technical Requirements

4.1.1. Current and Voltage Ratings

TABLE 4-1: RATINGS OF CURRENTS AND VOLTAGES (IEC 62196-2, Table 102 & IEC 62196-1, 5.2)

Function	Current rating	Voltage rating
AC Power	20A up to three phases	250 VAC
Neutral	32A one phase, (three phases optional)	
Equipment Ground	Rated for fault	
Control Pilot	2 A	30 V
Proximity Detection	2 A	30 V

4.1.2. Ambient temperature

In operation: IEC 62196-1, 1 Site 9

Continuous ambient temperatures in the range of –30 °C to + 50 °C when supplied with the EVSE or installed in the EV/PHEV

4.1.3. Temperature rise

Maximum temperature rise of terminals does not exceed 50 K, TE intern 35K. IEC 62196-1, 24

Test procedure is described in 4.7.

4.1.4. Touch temperature

The maximum permissible temperature does not exceed the temperatures shown in TABLE 4-2 when tested at an ambient temperature of 40°C. IEC 62196-1, 16.5

TABLE 4-2: MAXIMUM SURFACE TEMPERATURES (IEC 62196-1, 16.5)

Location	Composition of surface[a]	
	Metal	Nonmetallic
parts of the plug and the vehicle connector that can be grasped during operation	50°C (122°F)	60°C (140°F)
Parts which may be touched but not grasped	60°C (140°F)	85°C (185°F)

Test procedure is described in 4.7.

4.1.5. Clearance- and Creepage Distances

4.1.6. Clearance Distances

TABLE 4-3: Clearance Distance, Single Phase (DIN EN 60664-1)

Voltage Category 4 (Table F.1) Dirt Category 3, heterogeneous field (Table F.2) Consideration of Height (5500m, Table A.2)	4000V 3 mm 1,59
Resulting clearance distance	Min. 4,77 mm **Measured Value (Car/Station): Min 13,8 mm**

TABLE 4-4: Clearance Distance, Three Phases (DIN EN 60664-1)

Voltage Category 4 (Table F.1) Dirt Category 3, heterogeneous field (Table F.2) Consideration of Height (5500m, Table A.2)	6000V 5,5mm 1,59
Resulting clearance distance	Min. 8,75 mm **Measured Value (Car/Station): Min 13,8 mm**

4.1.7. Creepage Distance

TABLE 4-5: Creepage Distance Single Phase (DIN EN 60664-1, Table F.4)

Voltage effective Value (Table F.3)	250 V
Dirt Category 3 and Insulating Material Group 3 (Table F.4)	4mm (7,9 mm[1]) **Measured Value (Car/Station): Min 20 mm**

TABLE 4-6: Creepage Distance Three Phase (DIN EN 60664-1, Table F.4)

Voltage effective Value (Table F.3)	500 V
Dirt Category 3 and Insulating Material Group 3 (Table F.4)	8mm (7,9 mm[1]) **Measured Value (Car/Station): Min 20 mm**

[1]when a rib is used

4.1.8. Proximity Detection and Current Rating

Vehicle connectors and plugs using the proximity contact for simultaneous proximity detection and current capability coding of the cable assembly set have a resistor electrically placed between proximity contact and Protective Earthing contact with a value as indicated in

TABLE 4-7. The resistor is coded to the maximum current capability of the cable assembly. The EVSE interrupts the current supply if the current capability of the cable is exceeded as detected by the measurement of the Rc, as defined by the values for the recommended interpretation range in

TABLE 4-7.

The resistor is also used for proximity detection. IEC 61851-22, ANNEX B

TABLE 4-7: RESISTOR CODING FOR PLUGS (IEC 61851-22, ANNEX B)

Current capability of the cable assembly	Nominal resistance of Rc Tolerance +/- 3%	Recommended interpretation range by the EVSE
13 A	1.5 kΩ / 0,5 W	> 1 k Ω - 2.7 kΩ
20 A	680 Ω / 0,5 W	330 Ω – 1 kΩ
32 A	220 Ω / 0,5 W	150 Ω - 330 Ω
The power dissipation of the resistor caused by the detection circuit does not exceed the value given above. The value of the pull-up resistor is chosen accordingly.		

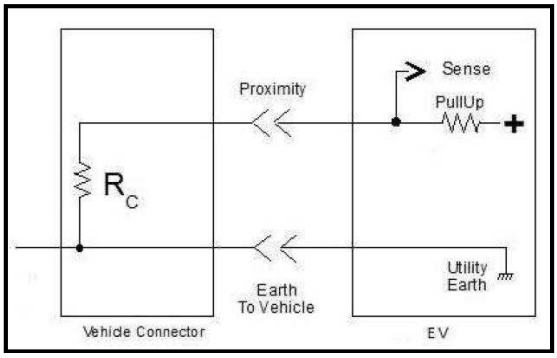


Figure 1: Diagram for current capability coding of 2 the cable assembly (IEC 61851-22, Annex B)

4.1.9. Electromagnetic Compatibility

Immunity: The operation of accessories within the scope of this standard in normal use is not affected by electromagnetic disturbances. IEC 62196-1, 32.1

Emission: Accessories within the scope of this standard are intended for continuous use. In normal use, they do not generate electromagnetic disturbances. IEC 62196-1, 32.2

4.1.10. Mating Cycles

10.000 times of mechanical operation without load and 50 times with load IEC 62196-1, Table 17

4.1.11. Mating / unmating forces

The force to insert and withdraw a plug or a vehicle connector is less than 100 N. This force is necessary to enable a translatory movement parallel to the areas of the friction pairings.

IEC 62196-1, 16.15

4.2. Design requirements

4.2.1. Interlocking Device

The vehicle connector and/or the plug may include a means to allow engagement of an optional locking mechanism to reduce the likelihood of tampering or unauthorized removal. The minimum force, which it withstands, is 753 ± 1 N for 60s. IEC 62196-1 Table 10 / Sheet 49 and IEC 62196-3 26.302 table 306

4.2.2. Contact system

See 2.2 for dimensions.

The contact system complies with all parameters of this specification. Furthermore, it provides a secure fastening which guarantees a solid connection between contacts and enclosures. The contact system is crimpable.

4.2.3. Type of wire

TABLE 4-8 List of usable cables

Producer	**ID-No.**	**VDE-Clearance-No.**
Coroplast	S05BQ-F 3 G 2,5 mm² + 0,5 mm²	VDE REG.-NR. 8491 [JJ/KW] CE
Coroplast	S05BQ-F 3 G 6 mm² + 0,5 mm²	VDE REG.-NR. 8491 [JJ/KW] CE

4.2.4. Wire Sizes

Non-rewireable accessories are provided with soldered, welded, crimped or equally effective permanent connections (terminations). The accessory is constructed that the cable or wiring cannot be separated from the accessory without making it permanently useless

IEC 62196-1, 25.2.2

TABLE 4-9: SUMMARY OF WIRE SIZES IN FUNCTION OF DEVICE RATINGS (IEC 62196-1, 13.1.2)

	Device rating	Wire Gauge (mm^2)
Signal Line	2A	0,5 mm^2
Earth & Power Line	≤ 20A	2,5 mm^2
	≤ 32 A	6 mm^2

4.2.5. Strain Relief

Rewirable accessories are provided with a strain relief means designed to prevent the twisting of the cable that may occur. IEC 62196-1, 25.2.2

Non-rewirable plugs and vehicle connectors shall be provided with a suitable flexible cable appropriate for the rating of the plug and vehicle connector and as specified by the manufacturer.

Non-rewirable plugs and vehicle connectors shall be tested as a cable assembly. IEC 62196-1, 25.2.1

4.2.6. Contact crimping area

See the areas in 4.2.4. => 108-94348

4.2.7. Insulating Material

Insulating parts supporting live parts are of material resistant to tracking. IEC 62196-1, 29.6

4.2.8. Protection against Manipulation

Protected against manipulation acc. to 62196-1, 16. 16.9 See 4.5.1.

4.2.9. Sealing of Interface-contact Area

The sealing area is free of shrinkage, toolcuts and ejectors according to Standard Sheets 2-IIb and 2IIc. IEC 62196-2, Standard Sheet 2-IIb & Standard Sheet 2-IIe

4.2.10. Other design requirements

None

4.3. Features (Form, Fit, Function, Material Requirements)

4.3.1. Dimensional constraints: Dimensions max L/W/H/Diameter

See IEC 62196/2011-07-22 Standard sheets 2-II.

4.4. Reliability

4.4.1. Fluid Resistance

The plug is resistant to the following chemicals. The functionality is not negatively influenced. All the specifications of this document are met after the plug has been in contact with the chemicals.

Following Table also see LV 214:2010-03 PG 22A att. E
Pouring over: Min. 100 ml (acc. to DIN EN ISO 175
min. 8 ml / cm² surface)
rubbing: impregnated cotton cloth
spraying: ca. 1 s each side

TABLE 4-10: OVERVIEW OF CHEMICALS AGAINST WHICH THE PLUG SHALL BE RESISTANT

TE Spezifikation 108-94323, angelehnt an LV 214 PG 22					
ID	Chemikalie	Beschreibung	PG	Temperatur	Dauer
1	Diesel	DIN EN 590	22 B	T RT	22 h
2	Bio Diesel	EN 14214	22 B	T RT	22 h
3	FAM Test Fuel	handelsüblich	22 B	T RT	10 min
4	Motoröl	Multigrade Oil SAE 0W40, API SL-CF	22 B	50	22 h
5	Servolenkungsöl	handelsüblich	22 B	50	22 h
6	Automatic transmission oil	ATF Full synthetic	22 B	50	22 h
7	Schmierfett	Heisslagerfett	22 A	50	22 h
8	Batteriesäure	verdünnte Schwefelsäure; Dichte 1,28 g/ml	22 B	50	22h
9	Bremsflüssigkeit	DOT4-DOT5	22 B	50	22 h
10	Frostschutzmittel	Ethylen Glycol für -40°C	22 B	50	22 h
11	AdBlue wässrige Harnstofflösung	ISO 22241-1	22 B	TRT	22h
12	Windschutzscheibenreiniger, Winter	handelsüblich, unverdünnt	22 A	50	2 h
13	Innenreiniger, Cockpitspray	handelsüblich	22 A	50	2 h
14	Motor- und Kaltreiniger	handelsüblich, z.B. Caramba 605415	22 A	50	22 h
15	Schweiß	DIN 53160		T RT	22 h
16	Kosmetische Produkte z.B. Creme	z.B. Nivea, Kenzo		T RT	22 h
17	Tausalzlösung	3 % Salzlösung	22 B	50	22 h
18	Isopropanol	handelsüblich	22 A	T RT	22 h

Compliance is to be checked by the Fluid resistance test in section **Error! Reference source not found.**.

4.5. Requirements concerning Serviceability

4.5.1. Requirements concerning Maintainability

The housing of the plug consists of two parts: the cover and the plug-housing. Inside the plug-housing all components are assembled and at the end the cover is welded to the housing. Due to the welding, maintaining work is made impossible and defect plugs have to be disposed.

4.6. Safety requirements

4.6.1. Accessibility of live parts

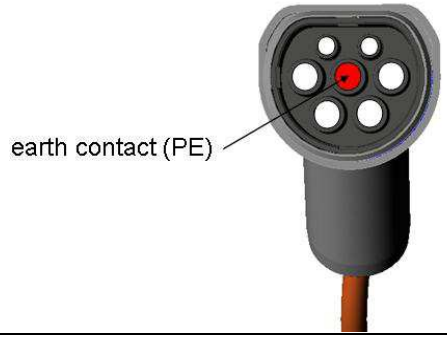
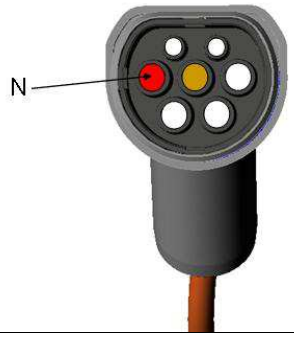
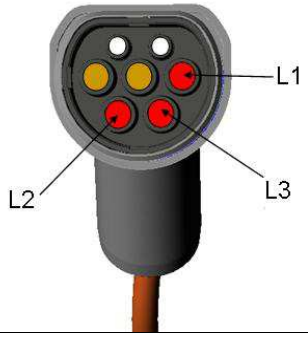
Accessories are so designed that live parts of socket-outlets and vehicle connectors, when they are wired as in normal use, and live parts of plugs and vehicle inlets, when they are in partial or complete engagement with the complementary accessories, are not accessible.

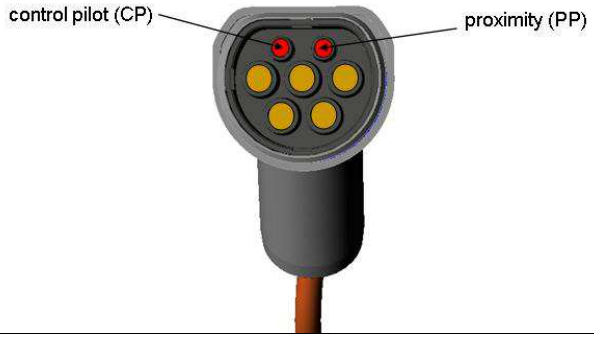
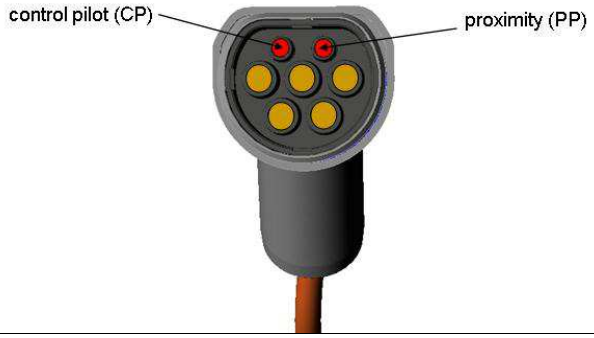
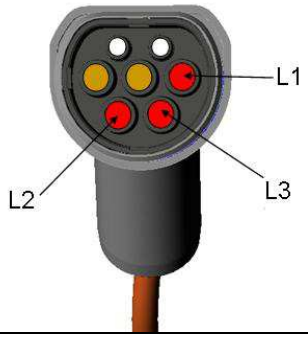
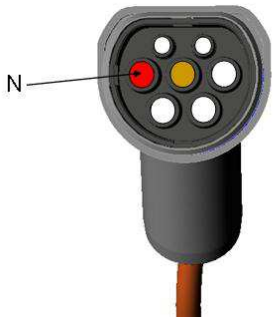
This can be tested by means of a test finger. But already design of the plug is regulated in that way, that access of live parts with the test finger should be impossible. Thus a further testing seems to be superfluous. IEC 62196-1, 10.1

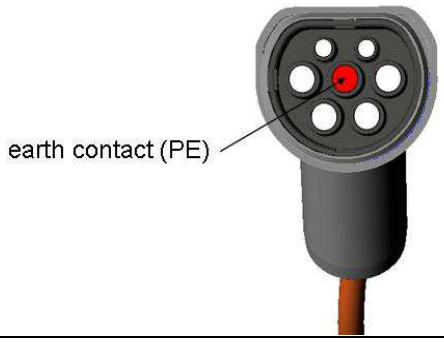
4.6.2. Contacting Sequence

The connections shall be made accordingly with TABLE 4-11 (IEC 62196-1, 6.8 and 10.3)

TABLE 4-11: SEQUENCE OF CONNECTIONS

Inserting the plug	**Step 1**	
	Step 2[a]	
	Step 3[a]	

	Step 4[b]	
Charging		
Withdrawing the Plug	**Step 1[c]**	
	Step 2[a]	
	Step 3[a]	

	Step 4	

[a] Can be made/braked simultaneously.

[b] Proximity connection can be made before the control connection.

[c] Proximity connection can be braked before the control connection.

4.6.3. Protection degrees

Live parts of socket-outlets and vehicle connectors, when they are wired as in normal use, and live parts of plugs and vehicle inlets, when they are in partial or complete engagement with the complementary accessories, are not accessible.
IEC 62196-1, 10.1

Plugs incorporate means for ensuring the marked degree of protection when in complete engagement with the complementary accessory.
IEC 62196-1, 18.3

The parts of the vehicle connector shall be fixed together that they will not work loose in normal use. Dismantle without tools shall be impossible.

IEC 62196-1, 18.2

Vehicle connectors are totally enclosed when fitted with a flexible cable as in normal use and when not in engagement with the vehicle inlet. In addition, they incorporate means for ensuring the marked degree of protection when in complete engagement with the vehicle inlet.

IEC 62196-1, 18.4

TABLE 4-12: PROTECTION DEGREE ON PRODUCTS (acc. IEC 61851-1, 11.3.1)

State	CAR-side Connector	STATION-side Plug
Mated	IP 44	IP 44
Unmated (with cap)	IP 24	IP 24
Unmated	IP 20	IP 20

4.7. Performances and descriptions

General note 1: Tables and figures named in this section can be found in ANNEX A if there is not a reference to another section.

General note 2: CR means Customer Request, the, to the code (Customer X) corresponding, costumer is defined in a separate document.

4.7.1. Test Requirements and Procedures Summary

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

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Visual examination of product	Meets requirements of product drawing and Meets visual requirements	
ELECTRICAL		
Measurement of contact resistance		Contact 108-94375 Crimp 108-94348
Insulation resistance Test	The insulation resistance shall be not less than 5 MΩ.	IEC 62196-1, 21.1; 21.2
Comparative Tracking Index Test	The material under test shall pass at a proof tracking index of 175 V	IEC 62196-1 29.6 / IEC 60112 A flat surface at least 15 mm – 15 mm and 3 mm thick is placed in the horizontal position on the apparatus. Test solution A with an interval between drops of 30 s ± 5 s
Flammability glow-wire test	No flame or glowing of the specimen or the surroundings extinguish within 30 s after removal of the glow-wire, and the surrounding parts have not burned away completely. There shall be no ignition of the tissue paper or scorching of the board.	IEC 62196-1, 29.5
Dielectric Strength	1 minute hold with no breakdown or flashover, no deformation that effects mating polarization or proper functioning of specimen	IEC 62196-1, 21.3 Subject 3 unmated specimens between live parts of opposite polarity, secondary circuits and ground, and secondary circuits and live parts to 2000Vac at 50 – 60Hz, uniformly and rapidly applied, beginning at ½ the voltage. Number of samples: at least 6
Current Load Cyclic	Temperature Rise < 35 K Change of Resistance acc. to 108-94348 Table: contact resistance overview: initial and after aging	TE internal 16 Amps, DC load 120 min ON., 60 min OFF, 25 cycles 70°C ambient temperature Use testing-device for fixation of plugs with continuity check of temperature and resistance.
Temperature Rise Test	The temperature rise of terminals shall not exceed 50 K.	IEC 62196-1, 24.1 The test current is an alternating current of the value shown in IEC 62196-1, table 18. For the purpose of this test, a length of at least 2 m of the

		cable shall be connected to the terminals.
Contact Resistance and Temperature Monitoring	High Voltage 1 GOhm Low Voltage: Limit for Connection test: 100 Ohm Limit for short circuit test: 20 kOhm	VDE 0623 Part 5 and VDE – AR-E 2623-2-2 PM 348 E 2010-06-18 High Voltage: Testing Voltage: 1500V DC (ISO) Testing Voltage: 2000V AC (Dielectric Withstanding Test) Duration: 1s Low Voltage Testing Voltage: 20V
Derating temp rise	contact temperature rise < 50K after 1 hour test duration	IEC 60512-5-2 16 A
Breaking capacity	An accessory classified "Not suitable for making and breaking an electrical circuit under load" shall have sufficient breaking capacity to interrupt the circuit in case of a fault, without any indication of a fire or shock hazard. The accessory need not remain functional after the completion of the test. It shall not be used for any further tests. Compliance is checked by testing the mating accessories in accordance with 22.2 for up to three making and breaking operations, if the accessory permits, under the indicated load. Following the test, the accessories shall comply with a dielectric test in accordance to 21.3	IEC62196-1,22.3
MECHANICAL		
Polarization Integrity Test	The devices shall not be able to mate in any manner that would energize the grounding feature of the device. The force required to mate the devices shall not exceed 180 N (40 lbf).	DIN EN 61984:2009, 6.9.1 (TE-Intern) Compliance with the requirements specified in shall be determined by using each of three devices assembled in its intended housing with the polarization feature removed.
Cable Pull Test / Torque Test	During the tests, the cable shall not be damaged.	IEC 62196-1, 25.3 The cable is then subjected 100 times to a pull of the value shown in IEC 62196-1, table 19. Each pull is applied without jerks and has a duration of 1 s.
Drop test	No defect adversely affecting correct operation	IEC 62196-1, 26.3 Plug (and socket) samples are preconditioned at (-30±2)°C for 16 hours

		Drop height 1m on concrete floor 2.25 m fixed to a wall and rotated through 45° each time
Vehicle drive over Part 1 & Part 2	There shall be no severe cracking, breakage, or deformation.	IEC 62196-1, 33
Ball pressure test at temperature	Mark diameter must be smaller than 2 mm	IEC 62196-1, 29.3 The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against this surface by a force of 20 N. The test is made in a heating cabinet at a temperature of: – (125 ± 5) °C for parts supporting live parts of rewireable accessories; - (80 ± 3) °C for other parts. Duration 1 hour
Cable flexing test	No defect adversely affecting correct operation	IEC 62196-1, 26.4 A current equal to the rated current of the accessory is passed through the conductors, the voltage between them being the rated voltage. The oscillating member is moved backwards and forwards through an angle of 90° (45° on either side of the vertical), the number of flexing being 20 000 and the rate of flexing 60 per minute.
Torque Test values for glands	After the test, the glands and the enclosures of the samples shall show no damage within the meaning of this standard.	IEC 62196-1, 26.5 The glands are then tightened by means of a suitable spanner, the force shown in IEC 62196-1, 25.3 being applied to the spanner for 1 min, at a point 25 cm from the axis of the gland.
Vibration Test	The sample must be fully functional before, during and after the test, and all parameters must meet the specifications	LV124 PG 17, This test simulated the vibrational load of the component during driving operation. The test serves to verify the resistance of the part to faults, such as component displacement or material fatigue. Number of samples: 6 Random:10–1000 Hz, 19,7m/s² Temperature: -40 – 105°C Shock: 30g/6ms 2x3x1000

Retention force of the plug in the socket with latching mechanism	VDE § 16 The plug shall not be released	IEC 62196-1, 16.8 With the latching mechanism in place, the mating accessory shall be pulled with a force F equal to the weight of the accessory and a 4m length of the maximum size cable or cable assembly used with the accessory.
Insertion and withdraw force of the connector, plug in the socket	Operating speed : TBD different from 62196-1	IEC 62196-1, 16.15 VDE § 16 100 N max
Touch temperature test	The maximum permissible temperature of those parts of the plug and the vehicle	IEC 62196-1, 16.5 Parts are loaded with maximum rated current at ambient temperature of (25±5) °C Test is checked by Temperature rise.
10.000 mating/unmating cycles	– no wear impairing the further use of the accessory or of its interlock, if any – no deterioration of enclosures or barriers – no damage to the entry holes for the plug contacts that might impair proper working – no loosening of electrical or mechanical connections; – no seepage of sealing compound – the continuity between mating signal and pilot contacts are maintained. The samples shall then withstand a dielectric strength test, the test voltage, however, being decreased by 500 V.	IEC 62196-1, 23 Speed of mating-unmating cycles : 0.8±0.1m/s Maximum number of cycles/mn : 7.5 cycles/mn Durability : 10000 cycles with no load Durability : 50 cycles with load If load, samples are loaded with rated current at rated voltage products are connected using Figure 3 – Circuit diagrams for breaking capacity and normal operation tests – IEC 62196-1
ENVIRONMENTAL		
Enclosure Test: compliance of IP-Code	In general, if any water has entered, it shall not: - be sufficient to interfere with the correct operation of the equipment or impair safety; - deposit on insulation parts where it could lead to tracking along the creepage distances; - reach live parts or windings not designed to operate when wet; - accumulate near the cable end or enter the cable if any. If the enclosure is provided with drain-holes, it should be proved by	IEC 62196-1, 20.1/20.2 IEC 60529, 14.2.5, 14.3(VDE + TE Intern) IP 44 The test is made by spraying the enclosure from all practicable directions with a stream of water from a standard test nozzle defined in IEC 62196. The conditions to be observed are as follows: - internal diameter of the nozzle: 6,3 mm; - delivery rate: 12,5 l/min ± 5 %;

	inspection that any water which enters	- water pressure: to be adjusted to achieve the specified delivery rate; - core of the substantial stream: circle of approximately 40 mm diameter at 2,5 m distance from nozzle; - test duration per square meter of enclosure surface area likely to be sprayed: 1 min; - minimum test duration: 3 min - distance from nozzle to enclosure surface: between 2,5 m and 3 m. After this test, the dielectric withstand test shall be conducted on the probes. Minimum degrees of protection as required in IEC 61851-1.
IPXY X: Protection against ingress of foreign objects	Min. Protection Degree: Mated: X=4 Unmated: X=2	ISO20653 (VDE)
IPXY Y: Protection against water	Min. Protection Degree: Mated: Y=4 Unmated: Y=4	IEC 62196-1, 10.1 (VDE) ISO 20653
Protection against electrical shock	No electrical contact established between test finger and pilot line contacts, power lines and neutral line contact	IEC 62196-1, 10.1 Test finger definition : see 62196-1 fig 2 Umin = 40 V
Humidity treatment	After this treatment, the samples shall show no damage within the meaning of the standard.	IEC 62196-1, 20.3 Samples are introduced in the cabinet at a temperature of T to T+4 °C stabilized. Pre-conditioning : Relative humidity : 91 % to 95 % Temperature : T=(25 ± 5) °C Duration : 168h (7 days) Immediately after pre-conditioning Insulation resistance and Dielectric strength are performed.
ENDURANCE		
Min. Max Temperature storage	All sample parameters must meet the specifications.	LV 124 , K-01 24 hours (12h each), between -40 - +85 °C , 2 cycles
Resistance to heat	No defect adversely affecting correct operation	IEC 62196-1, 29.1 IEC 62196-1, 29.2

		The samples are kept for 1 h in a heating cabinet at a temperature of (110 ± 5) °C.
Rapid Change of Temperature	The samples must be fully functional before and after the test, and all parameters must meet the specifications	DIN EN 60068-2-14 LV 124, K-016 300 cycles, -40 °C/ 85 °C by 60 minutes per cycle
Humid heat, (cyclic with frost) Test	The samples must be fully functional before, during and after the test, and all parameters must meet the specifications.	DIN EN 60068-2-38 LV 124, K-09 25 °C/55 °C, 10 days, 95 % humidity with frost combination Total test duration: 240 h Number of cycles: 10
Solar irradiation	The part must be fully functional before, during and after the test, and all parameters must meet the specifications.	DIN 75220 LV 124, K-17 Simulation of sun and UV irradiation. For coverage of the durability of the component of material fatigue like cracks, color change. Test acc. to DIN 75220: • Mode I.a • Profile Z-out, table 2+5 • Duration 25 d, (15 dry, 10 wet) • Cycles: 1
Dry Temperature Storage	Product Requirements shall be maintained during the test. The test is continued with functional test under normal climate condition.	IEC-60068-2-2, Bb 120 hours/ 85°C
Fluid Resistance Testing	The Tested plug shall be fully functional before and after the test, and all parameters shall meet the specifications.	See list 4.4.1 based on PG 22 B A, attachment E The chemical must be applied to the test object at T_{RT}. Unless otherwise defined one of the following applications has to be selected.
Accelerated Ageing Test – Rubber compounds	No crack visible to the naked eye, nor shall the material have become sticky or greasy.	IEC 62196-1, 15 (70 ± 2) °C and 10 days (240 h), for rubber;
Accelerated Ageing Test – thermoplastic	No crack visible to the naked eye, nor shall the material have become sticky or greasy	IEC 62196-1, 15 (80 ± 2) °C and 7 days (168 h), for thermoplastic;
Breaking capacity	An accessory classified "Not suitable for making and breaking	IEC62196-1,22.3

	an electrical circuit under load" shall have sufficient breaking capacity to interrupt the circuit in case of a fault, without any indication of a fire or shock hazard. The accessory need not remain functional after the completion of the test. It shall not be used for any further tests. Compliance is checked by testing the mating accessories in accordance with 22.2 for up to three making and breaking operations, if the accessory permits, under the indicated load. Following the test, the accessories shall comply with a dielectric test in accordance to 21.3	

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 Figure 2.

4.8. Product Qualification and Requalification Test Sequence

TEST OR EXAMINATION	TEST GROUP (a)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 (c)
	TEST SEQUENCE (b)														
Test Sample	3	3	3	6	4	2	3	3	4	3	3	2	2	3	3
Visual examination of product	1, 10	1, 10	1,7	1, 7	1, 5	1, 4	1, 5	1,3, 5	1, 4	1, 3	1, 3	1, 4	1,3, 5	1,4	1,3
Insulation resistance Test	6	7				3	3		3			3			
Comparative Tracking Index														3	
Flammability glow-wire test														2	
Dielectric Strength	7	8													
Current Load Cyclic			4												
Temperature Rise Test															2
Contact Resistance and Temperature Monitoring	9	9	2,6												
Derating temp rise			3,5												
Polarization Integrity Test															2
Cable Pull Test / Torque Test											2				
Drop test	8														
Vehicle drive over Part 1&2												2			
Ball pressure test at temperature													4		

Cable flexing test									2					
Torque Test values for glands														2
Vibration Test												2		
Retention force of the plug in the socket with latching mechanism										2				
Insertion and withdraw force of the connector, plug in the socket														2
10.000 mating/unmating cycles		4, 6												
Enclosure Test: compliance of IP-Code														2
IPXY X: Protection against ingress of foreign objects				3, 6										
IPXY Y: Protection against water				2	2, 4									
Protection against electrical shock														2
Humidity treatment							2							
Min. Max Temperature storage	2	2		4										
Resistance to heat														2
Rapid Change of Temperature	4	5												
Humid heat, (cyclic with frost) Test	5													
Solar irradiation					3									
Dry Temperature Storage	3	3		5										
Fluid Resistance Testing						2								
Accelerated Ageing Test – Rubber compounds								4						
Accelerated Ageing Test – thermoplastic								2						

NOTE

(a) Specimens shall be prepared in accordance with applicable Manufacturing Process Instructions (MPI) and shall be selected at random from current production. Each test group shall consist of quantities and design as described in the Procedure

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

(c) All the single test are listed in column 15

LTR	REVISION RECORD	DWN	APP	DATE
A	Creation of the Design Objective	T.Meissner	F.Wittrock	18.04.16