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Interested committees:

Title: Draft BS EN 61851-23 Electric vehicle conductive charging system. DC electric vehicle supply equipment.

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



69/641/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 61851-23 ED2

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2019-03-01

CLOSING DATE FOR COMMENTS:

2019-05-24

SUPERSEDES DOCUMENTS:

69/523/CD, 69/557B/CC

IEC TC 69 : ELECTRIC ROAD VEHICLES AND ELECTRIC INDUSTRIAL TRUCKS

SECRETARIAT:

Belgium

SECRETARY:

Mr Peter Van den Bossche

OF INTEREST TO THE FOLLOWING COMMITTEES:

SC 23E, SC 23H, TC 64

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☒ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

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TITLE:

Electric vehicle conductive charging system – Part 23: DC electric vehicle supply equipment

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Documents

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 23: DC electric vehicle supply equipment

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International Standard IEC 61851-23 has been prepared by IEC technical committee 69: Electric road vehicles and electric industrial trucks.

This second edition of IEC 61851-23 cancels and replaces the first edition published in 2014.

This edition has been technically revised and, in addition to the change in number, contains the following changes with respect to the previous edition:

- a) The structure of this document has been rearranged according to the third edition of IEC 61851-1 published in 2017.
- b) Test methods for checking conformity to the stated requirements have been mostly added. General provisions for compliance tests have been specified in clause 102.
- c) Specific requirements and/or information for the following functions have been added: bi-directional power flow control (Annex DD), multiple DC outputs (Annex GG), communication and charging process (Annex HH), and charging with thermal management system (101.4).

d) Annex AA (System A), Annex BB (System B) and Annex CC (System C) have been updated including additions in conjunction with b) and c).

The former Annex DD and Annex EE have been reordered as Annex EE and Annex FF respectively.

The text of this standard is based on the following documents:

FDIS	Report on voting
69/XX/FDIS	69/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This standard is to be read in conjunction with IEC 61851-1:2017.

The clauses of particular requirements in this standard supplement or modify the corresponding clauses in IEC 61851-1:2017. Where the text of subsequent clauses indicates an "addition" to or a "replacement" of the relevant requirement, test specification or explanation of Part 1, these changes are made to the relevant text of Part 1, which then becomes part of this standard. Where no change is necessary, the words "This clause of Part 1 is applicable" are used. The new clauses, which are not included in Part 1, have a clause number starting from 101, e.g. 3.101, 101.1, etc. The annexes of this standard are numbered using double-alphabet, e.g. Annex AA, to avoid confusion with the annexes in Part 1.

A list of all parts in the IEC 61851 series, published under the general title *Electric vehicle conductive charging system*, can be found on the IEC website.

In this document, the following print types are used:

– *test specifications: italic type.*

– notes: smaller roman type.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The National Committees are requested to note that for this publication the stability date is XX.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

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ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 23: DC electric vehicle supply equipment

1 Scope

This document applies to the DC EV supply equipment (herein also referred to as "DC charger") for charging electric road vehicles, with a rated supply voltage up to 1 000 V AC or up to 1 500 V DC and a rated output voltage up to 1 500 V DC.

This document specifies the DC EV supply equipment of systems A, B and C as defined in Annexes AA, BB and CC.

This document also provides the requirements for bi-directional power flow for System A as specified in Annex AA, with reverse output voltage up to 1 000 V AC or 1 500 V DC.

NOTE 1 The requirements for bi-directional power flow for System B and System C are under consideration. Annex DD also provides information about bi-directional power flow.

DC reverse output voltage to DC supply network or DC standard socket-outlets is not covered by this edition.

Requirements for non-isolated system are under consideration, and are not specified in this edition.

The requirements for digital communication between DC EV supply equipment and electric vehicle for control of DC charging are defined in IEC 61851-24.

Requirements for DC charging with an autoconnect charging device are given in IEC 61851-23-1 (under preparation).

Specific requirements for DC EV supply equipment where the secondary circuit is protected from primary circuit by electrical separation are given in IEC 61851-23-2 (under preparation).

NOTE 2 This document includes information on EV for conductive connection, but limited to the necessary content for describing the power and signalling interface.

NOTE 3 Typical diagrams and variation of DC charging systems are shown in Annex EE.

2 Normative references

This clause of Part 1 is applicable except as follows:

Addition:

IEC 60227-1, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 1: General requirements*

IEC 60309 (all parts), *Plugs, socket-outlets and couplers for industrial purposes*

IEC 60479-1:2005, *Effects of current on human beings and livestock – Part 1: General aspects*

IEC 60906-1, *IEC system of plugs and socket-outlets for household and similar purposes - Part 1: Plugs and socket outlets 16 A/250 V a.c.*

IEC 60906-2, *IEC system of plugs and socket-outlets for household and similar purposes - Part 2: Plugs and socket-outlets 15 A 125 V a.c. and 20 A 250 V a.c.*

IEC 61557-8, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems*

134 IEC 61851-1:2017, *Electric vehicle conductive charging system – Part 1: General*
135 *requirements*

136 IEC 61851-24:201X, *Electric vehicle conductive charging system – Part 24: Digital*
137 *communication between a DC EV supply equipment and an electric vehicle for control of DC*
138 *charging*

139 IEC 62368-1:2014, *Audio, video and communication technology equipment - Part 1: Safety*
140 *requirements*

141 IEC 62477-1:2012+Amd1:2016, *Safety requirements for power electronic converter systems*
142 *and equipment – Part 1: General*

143 IEC 62909-1(under development), *Bi-directional grid connected power converters – Part 1:*
144 *General requirements*

145 ISO 11898-1, *Road vehicles – Controller area network (CAN) – Part 1: Data link layer and*
146 *physical signalling*

147 ISO/IEC 15118-2:2014, *Road Vehicles – Vehicle to grid communication interface – Part 2:*
148 *Technical protocol description and Open Systems Interconnections (OSI) layer requirements*

149 DIN SPEC 70121, *Electromobility - Digital communication between a DC EV supply*
150 *equipment and an electric vehicle for control of DC charging in the Combined Charging*
151 *System*

152 **3 Terms and definitions**

153 This clause of Part 1 is applicable except as follows:

154 *Addition:*

155 The definitions included in this part are those having general application herein. Definitions
156 applying to isolating transformers, safety isolating transformers, switch mode power supplies,
157 and their construction are included in IEC 61558-1.

158 **3.1 Electric supply equipment**

159 **3.1.101**

160 **DC EV charging system**

161 a system composed of a DC charger, cable assembly and the equipment on EV that is
162 required to fulfil the charging function including digital communication for charging control

163 **3.1.102**

164 **isolated DC EV supply equipment**

165 DC EV supply equipment where the DC output circuit is separated by protective separation
166 from the AC supply network

167 **3.1.103**

168 **non-isolated DC EV supply equipment**

169 DC EV supply equipment where the DC output circuit is not separated by protective
170 separation from the AC supply network

171 **3.1.104**

172 **regulated DC EV supply equipment**

173 DC EV supply equipment that supplies vehicle battery with a charging current or charging
174 voltage in accordance with the request from vehicle

175 **3.1.105**

176 **non-regulated DC EV supply equipment**

177 under consideration

178 **3.1.106**
179 **plug and cable DC EV supply equipment**

180 DC EV supply equipment which is intended to be connected to the AC supply network using a
181 cable and plug according to IEC 60309-1 and IEC 60309-2 for industrial type, IEC 60884-1 for
182 domestic type, relevant national standards, or other standard plugs and socket outlets

183 **3.1.107**

184 **charging/discharging station**

185 a system composed of an EVPS and cable assembly that is required to fulfil the charging and
186 discharging functions including digital communication for charging and discharging control

187 **3.1.108**

188 **electric vehicle power system**

189 **EVPS**

190 equipment or a combination of equipment providing dedicated functions to provide AC or DC
191 reverse power to socket-outlets or a bi-directional grid connected power converter according
192 to IEC 62909 from an EV. It can provide dedicated functions to supply electric energy from a
193 fixed electrical installation or AC supply network to an EV for the purpose of charging.

194 **3.1.109**

195 **controlled current charging**

196 **CCC**

197 energy transfer method that the DC EV supply equipment regulates charging current
198 according to the current value requested by the vehicle

199 **3.1.110**

200 **controlled voltage charging**

201 **CVC**

202 energy transfer method that the DC EV supply equipment regulates charging voltage
203 according to the voltage value requested by the vehicle

204 **3.1.111**

205 **charging state**

206 a physical status of DC EV charging system

207 **3.1.112**

208 **discharging**

209 all functions necessary to condition energy of the RESS to a regulated voltage/current level to
210 AC or DC supply network or standard socket-outlets.

211 **3.1.113**

212 **(bi-directional) grid-connected power converter**

213 **GCPC**

214 power converter connected to the grid by bi-directional inverter with multiple DC-port
215 interfaces

216 [SOURCE: IEC 62909-1:2017,3.19]

217 **3.1.114**

218 **DC connection interface**

219 internal system DC bus between power electronic converters and bi-directional inverter in
220 GCPC

221 [SOURCE: IEC 62909-1:2017,3.4, modified – "in GCPC" has been added.]

222 **3.1.115**

223 **DC port interface**

224 interface between the DC/DC converter and EV or, in the case where the DC-connection
225 interface is directly connected to EV without DC/DC converter, between the DC-connection
226 interface and EV

227 [SOURCE: IEC62909-1:2017,3.5,modified – "distributed energy resources" has been replaced
228 with "EV".]

229 **3.1.116**

230 **maximum current control**

231 **MCC**

232 control mode where a DC EV charging/discharging supply equipment regulates
233 charging/discharging current according to the maximum current value communicated by the
234 vehicle

235 **3.1.117**

236 **controlled current charging**

237 **CCC**

238 energy transfer method that the DC EV supply equipment regulates charging current
239 according to the current value requested by the vehicle

240 **3.1.118**

241 **controlled voltage charging**

242 **CVC**

243 energy transfer method that the DC EV supply equipment regulates charging voltage
244 according to the voltage value requested by the vehicle

245 **3.1.119**

246 **constant current control mode**

247 **CCCM**

248 a control mode of EV supply equipment that regulates the output current as constant during
249 the control process according to the target-current value requested by the vehicle or the other
250 sources such as thermal management unit of EV supply equipment

251 **3.1.120**

252 **constant voltage control mode**

253 **CVCM**

254 a control mode of EV supply equipment that regulates the output voltage as constant during
255 the control process according to the target-voltage value requested by the vehicle

256 **3.1.121**

257 **constant power control mode**

258 **CPCM**

259 a control mode of EV supply equipment that regulates the output power as constant during the
260 control process according to the target-power value requested by the vehicle or the other
261 sources such as the demand management of the grid
262

263 **3.2 Insulation**

264 **3.2.101**

265 **isolation**

266 function intended to make dead for reasons of safety all or a discrete section of the electrical
267 installation by separating the electrical installation or section from every source of electric
268 energy

269 [SOURCE: IEC 826-17-01]

270 **3.2.102**

271 **(electrically) protective separation**

272 separation of one electric circuit from another by means of:

273 – double insulation; or

274 – basic insulation and protective screening (shielding); or

275 – reinforced insulation

276 [SOURCE: IEC 195-06-19]

277 3.3 Functions**278 3.3.101****279 control circuit**

280 circuit for signal and digital communication with vehicle, and for the management of charging
281 control process

282 3.3.102**283 DC charging control function****284 DCCCF**

285 a function embedded in a DC EV supply equipment which controls DC power output following
286 VCCF direction

287 3.3.103**288 DC charging/discharging control function****289 DCCDCF**

290 a function embedded in a DC EV charging/discharging supply equipment which controls DC
291 power input/output following VDCDF request
292

293 3.3.104**294 vehicle charging control function****295 VCCF**

296 a function in a vehicle which controls the charging parameters of off-board DC EV supply
297 equipment

298 3.3.105**299 vehicle charging/discharging control function****300 VDCDF**

301 a function in a vehicle which controls the charging/discharging parameters of off-board DC EV
302 charging/discharging supply equipment

303 3.3.106**304 normal shutdown**

305 termination of the charging process initiated by the user, by the vehicle or by the DC EV
306 supply equipment, and not caused by a failure

307 3.3.107**308 error shutdown**

309 termination of the charging process caused by a failure detected by the DC EV supply
310 equipment or the vehicle

311 3.3.108**312 emergency shutdown**

313 urgent termination of the charging process caused by a failure detected by the DC EV supply
314 equipment or the vehicle, that may present a safety hazard

315 Note 1 to entry: It may be done by disconnecting the DC EV supply equipment from supply network.

316 3.3.109**317 thermal sensing**

318 means for providing temperature data of accessories, cable assemblies or parts thereof

319 3.3.110**320 thermal transport**

321 means for managing heat dissipation of accessories, cable assemblies or parts thereof
322 independent from changing the current

323 3.3.111**324 thermal exchange**

325 means for cooling and dissipating thermal energy from the thermal transport

326 3.3.112**327 thermal management system**

328 system having thermal sensing, thermal exchange and thermal transport in order to keep the
329 temperature in the allowed limit

330 3.4 Vehicle**331 3.4.101****332 maximum voltage limit**

333 upper limit value of charging voltage sent by the vehicle to the DC EV supply equipment

334 3.4.102**335 maximum discharging current of the vehicle**

336 maximum limit of the discharging current of the vehicle which may change over time

337

338 3.4.103**339 maximum charging current of the vehicle**

340 maximum limit of the charging current of the vehicle which may change over time

341 3.5 Cords, cables and connection means**342 3.5.101****343 independent standard socket-outlet**

344 dedicated outlet placed in a house and building, and isolated from the supply network. It
345 enables the power supply from a vehicle during blackout etc.

346 3.6 Service and usage**347 3.6.101****348 ordinary person**

349 person who is neither a skilled person nor an instructed person

350 [SOURCE: IEC 60050-826:2004, 826-18-03, modified – Note 1 to entry has been added.]

351 NOTE 1 to entry: Ordinary persons include users of the DC EV supply equipment, persons who may have access to
352 the DC EV supply equipment, or who may be in the vicinity of the DC EV supply equipment. Under normal
353 operating conditions, ordinary persons should not be exposed to energy sources causing startle reaction, pain or
354 injury.

355 3.6.102**356 skilled person**

357 person with relevant education and experience to enable him or her to perceive risks and to
358 avoid hazards which electricity can create

359 [SOURCE: IEC 60050-826:2004, 826-18-01]

360 3.6.103**361 instructed person**

362 person adequately advised or supervised by electrically skilled persons to enable him or her
363 to perceive risks and to avoid hazards which electricity can create

364 [SOURCE: IEC 60050-826:2004, 826-18-02]

365

366 **3.7 General terms**

367 **3.7.101**

368 **primary circuit**

369 a circuit that is directly connected to the AC or DC supply network, and includes the primary
370 windings of transformers, other loading devices and the means of connection to the supply
371 network

372 **3.7.102**

373 **secondary circuit**

374 a circuit that has no direct connection to a primary circuit and derives its power from a
375 transformer, converter or equivalent isolation device

376 **3.7.103**

377 **rated current**

378 input or output current under normal operating conditions assigned by the manufacturer

379 **3.7.104**

380 **contact assembly**

381 power contact with a terminal and additional components if any

382

383 Note 1 to entry: e.g. termination, contact support, thermal sensing, thermal transport

384 **3.7.105**

385 **sleep mode**

386 deactivation or performance reduction of internal subsystem in order to minimize power
387 consumption

388 **3.7.106**

389 **DC output voltage**

390 voltage between DC power line terminals, i.e. between positive terminal DC+ and negative
391 terminal DC-

392

393 [SOURCE: IEC 61140:2016, 3.8.1]

394 **3.7.107**

395 **touch current**

396 electric current passing through a human body or through livestock when it touches one or
397 more accessible parts of an installation or of equipment

398 [SOURCE: IEC 61140:2016, 3.9]

399 **3.7.108**

400 **touch voltage**

401 voltage between conductive parts when touched simultaneously by a human or livestock

402

403 Note 1 to entry: The value of the effective touch voltage may be appreciably influenced by the
404 impedance of the person or the livestock in electric contact with these conductive parts.

405

406 [SOURCE: IEC 61140:2016, 3.8.1]

407

408 **3.7.109**

409 **fire enclosure**

410 part of the equipment intended to minimize the spread of fire or flames from within

411 **3.7.110**

412 **enhanced protection**

413 protective provision having a reliability of protection not less than that provided by two
414 independent protective provisions

415 [SOURCE: IEC 62477-1:2012,3.13]

416 **3.7.111**

417 **PELV (system)**

418 electric system in which the voltage cannot exceed the value of *extra low voltage*:

419 – under normal conditions; and

420 – under *single fault conditions*, except earth faults in other electric circuits

421 Note 1 to entry: PELV is the abbreviation for protective *extra low voltage*.

422 [SOURCE: IEC 60050-826:2004, 826-12-32]

423 **3.7.112**

424 **SELV (system)**

425 electric system in which the voltage cannot exceed the value of extra-low voltage:

426 – under normal conditions; and

427 – under single fault conditions, including earth faults in other electric circuits

428 Note 1 to entry: SELV is the abbreviation for safety extra low voltage.

429 [SOURCE: IEC 62477-1:2012,3.51]

430 **3.7.113**

431 **power electronic converter system**

432 **PECS**

433 one or more power electronic converters intended to work together with other equipment

434 [SOURCE: IEC 62477-1:2012,3.45]

435 **3.7.114**

436 **protective impedance**

437 impedance connected between hazardous live parts and accessible conductive parts, of such
438 value that the current, in normal use and under likely fault conditions, is limited to a safe
439 value, and which is so constructed that its ability is maintained throughout the life of the
440 equipment

441 [SOURCE: IEC 62477-1:2012,3.42]

442 **3.7.115**

443 **protective-equipotential-bonding**

444 equipotential bonding for purposes of safety (e.g. protection against electric shock)

445 [SOURCE: IEC 62477-1:2012,3.36]

446 **3.7.116**

447 **(electrically) protective screening**

448 separation of circuits from hazardous live-parts by means of an interposed conductive screen,
449 connected to the means of connection for a PE conductor, either directly or via protective
450 equipotential bonding

451 [SOURCE: IEC 62477-1:2012,3.43]

452

453 **3.7.117**

454 **single fault condition**

455 condition in which one failure is present which could cause a hazard covered by this
456 document

457 Note 1 to entry: If a *single fault condition* results in other subsequent failures, the set of failures is considered as
458 one *single fault condition*.

459 Note 2 to entry: Examples of hazards include, but are not limited to electric shock, fire, energy, mechanical, sonic
460 pressure etc.

461 [SOURCE: IEC 62477-1:2012,3.54]

3.7.118**startle reaction**

physiological reaction due to a minimum derived value of touch voltage for a population for which a current flowing through the body is just enough to cause involuntary muscular contraction to the person through which it is flowing

[SOURCE: IEC 62477-1:2012,3.55]

3.7.119**working voltage**

voltage, at rated supply conditions (without tolerances) and worst case operating conditions, that occurs by design in a circuit or across *insulation*

Note 1 to entry: The *working voltage* can be DC or AC. Both the r.m.s. and recurring peak values are used.

[SOURCE: IEC 62477-1:2012,3.64]

4 General requirements

This clause of Part 1 is applicable, except as follows:

The following sentence is not applicable:

Assemblies for EV supply equipment shall comply with IEC TS 61439-7 with the exceptions or additions as indicated in clause 13.

Addition:

NOTE In some countries, the DC EV supply equipments are designed to be used at an altitude up to 1 000 m according to the national standard: Japan.

5 Classification

This clause of Part 1 is applicable except as follows:

Addition:

DC EV supply equipments and systems may be classified as follows.

5.101 Category

5.101.1 According to the type of insulation between input and output:

- a) basic insulation with conductive protective screening (shielding) that is provided with a means for electrical connection to the protective earthing conductor;
- b) reinforced insulation,
- c) double insulation,

5.101.2 According to system control:

- regulated DC EV supply equipment:
 - a) controlled current charging,
 - b) controlled voltage charging,
 - c) combination of a) and b),
- non-regulated DC EV supply equipment.

5.101.3 According to the system used:

- system A (see Annex AA),
- system B (see Annex BB),

502 – system C (see Annex CC).

503 **5.101.3** According to thermal management system:

504 – using thermal sensing;

505 – using thermal sensing and thermal transport;

506 – none

507

508 **6 Charging modes and functions**

509 This clause of Part 1 is applicable except as follows:

510 **6.2 Charging modes**

511 **6.2.1 Mode 1**

512 *Not applicable*

513 **6.2.2 Mode 2**

514 *Not applicable*

515 **6.2.3 Mode 3**

516 *Not applicable*

517 *Replacement:*

518 **6.3 Functions provided in Mode 4**

519 *Replacement:*

520 **6.3.1 Mandatory functions in Mode 4**

521 **6.3.1.1 General**

522 *Replacement:*

523 The DC EV supply equipment shall supply a DC current or voltage to the vehicle battery in
524 accordance with a VCCF request.

525 For non-regulated charging, under consideration.

526 The following functions shall be provided by DC EV supply equipment as given below:

527 – continuous continuity checking of the protective conductor according to 6.3.1.2;

528 – verification that the EV is properly connected to the EV supply equipment according to
529 6.3.1.3;

530 – energization of the power supply to the EV according to 6.3.1.4;

531 – de-energization of the power supply to the EV according to 6.3.1.5;

532 – maximum allowable current according to 6.3.1.6.

533 – DC supply for EV according to 6.3.1.101;

534 – measuring current and voltage according to 6.3.1.102;

535 – latching of the vehicle coupler according to 6.3.1.103;

536 – compatibility assessment according to 6.3.1.104;

537 – insulation check before charging according to 6.3.1.105;

538 – protection against overvoltage at the interface according to 6.3.1.106;

- 539 – verification of vehicle connector voltage according to 6.3.1.107;
- 540 – control circuit supply integrity according to 6.3.1.108;
- 541 – short circuit test before charging according to 6.3.1.109;
- 542 – user initiated shutdown according to 6.3.1.110;
- 543 – overload protection for parallel conductors (conditional function) according to 6.3.1.111;
- 544 – voltage limitation between DC output and protective conductor according to 6.3.1.112.
- 545 – shutdown of DC EV supply equipment according to 6.3.1.113.

546 *Replacement:*

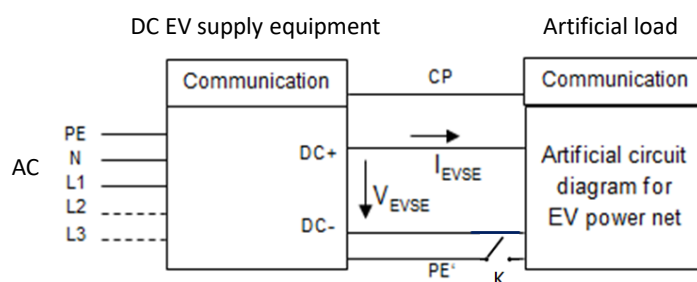
547 6.3.1.2 Continuous continuity checking of the protective conductor

548 The protective conductor continuity between the DC EV supply equipment and the vehicle
 549 shall be monitored continuously. For the rated voltage of DC 60 V or higher, the DC EV
 550 supply equipment shall trigger an emergency shutdown (see 6.3.1.113) within 10 ms after a
 551 loss of electrical continuity of the protective conductor between DC EV supply equipment and
 552 EV.

553 NOTE Protective conductor continuity is monitored by the control pilot, see AA.3.1.2 and Annex AA.3.6.2 for
 554 System A, BB.5.9 for System B, and CC.4.4 for System C.

555 *Compliance is checked by the following test.*

556 *This test case applies to DC EV supply equipments with the maximum output voltage ≥ 60 V.*
 557 *The test system is shown in Figure 101.*



558

559 Key

K	switch or relay	L1, L2, L3	power line
CP	control pilot	I_{EVSE}	output current of EV supply equipment
PE	protective conductor	V_{EVSE}	output voltage of EV supply equipment
N	neutral contact		

NOTE Artificial load refers to Figure 123 and is specified in 102.2.3 unless otherwise specified.

560 Figure 101 – Effective earth continuity test system

561 The test shall be performed according to the following procedure:

- 562 1) *Connect the DC EV supply equipment to an artificial load with dedicated EV simulator*
 563 *with load for each system. For System A, EV simulator which has control pilot circuits*
 564 *shown in Figure AA.2 shall be used. The control pilot circuits of test load shall comply*
 565 *with the requirement in AA.3.13.*
- 566 2) *Measure the voltage ($V_{EVSE\ output}$) and current ($I_{EVSE\ output}$) of the power line continuously.*
- 567 3) *Start charging with the procedure specified by charger manufacturer.*
- 568 4) *Confirm that the DC bus is energized at the rated voltage and the DC EV supply*
 569 *equipment is operating at the maximum rated output current.*

- 570 5) Open the relay K.
- 571 6) Check that the DC EV supply equipment terminates the charging process and transfers to
- 572 shutdown stage, displaying a relevant alarm or error information, if any.
- 573 7) Check the result in Table 101.

574 **Table 101 – Verification criterion**

System	Verification criterion
A	See Table AA.5
B	The output current ($I_{EVSE\ output}$) is reduced to 5 A or less within t_{pe} after the loss of protective conductor continuity. t_{pe} includes the detection time and fall time of the current. See BB.4.5 for the specific time.
C	See Table CC.10 in CC.9.3.4

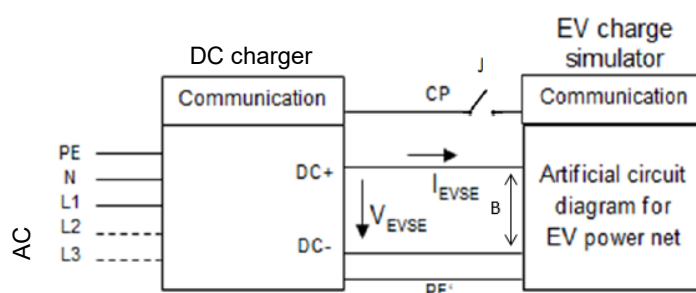
- 575 8) Confirm that the DC power line between DC charger and EV is de-energized to voltage
- 576 less than 60 V.

577 6.3.1.4 Energization of the power supply to the EV

578 Addition:

579 Compliance is checked by the following test.

580 The test system is shown in Figure 102.



581 Key

582

J	switch or relay	L1, L2, L3	power line
CP	control pilot	I_{EVSE}	output current of EV supply equipment
PE	protective conductor	V_{EVSE}	output voltage of EV supply equipment
N	neutral		

583 **Figure 102 – Control pilot test system**

584 The test shall be performed according to the following procedure:

- 585 1) Connect the DC EV supply equipment to an artificial load with dedicated EV simulator
- 586 with load for each system.
- 587 2) Measure the voltage (V_{EVSE}) of the power line continuously.
- 588 3) Simulate the open circuit of control pilot by opening the relay J. The control pilot lines to
- 589 be tested for each system are shown below:
- 590 System A: CP3 (see Figure AA.2)
- 591 System B: CC1 (see Figure BB.1)
- 592 System C: CP (see IEC 61851-1)
- 593 4) Start charging with the procedure specified by the manufacturer.

594 5) *Confirm that the power line at point B has not been energized.*

595 **6.3.1.5 De-energization of the power supply to the EV**

596 *Addition:*

597 *Compliance is checked for system A by the test in AA.3.1.2, for System B by the test in*
598 *BB.5.2, and for system C by the test in CC.9.3.3.*

599 In the case of failure in control circuit of DC EV supply equipment, such as short-circuit, earth
600 leakage, CPU failure or excess temperature, the DC EV supply equipment shall terminate the
601 supply of charging current, and disconnect the supply of control circuit.

602 In the case where earth fault or overcurrent is detected, the conductor shall be disconnected
603 from its supply.

604 *Compliance is checked according to ISO 26262 or IEC 61508.*

605 *Addition:*

606 **6.3.1.101 DC supply for EV**

607 The DC EV supply equipment shall supply DC voltage and current to the vehicle battery in
608 accordance with VCCF's controlling.

609 For regulated systems, the DC EV supply equipment shall supply regulated DC voltage or
610 current (not simultaneously, but as requested by the vehicle during charging) to the vehicle
611 battery in accordance with VCCF's controlling. Requirements for charging performance of
612 regulated DC current / voltage are given in 101.2.1.1, 101.2.1.2, 101.2.1.3, 101.2.1.4,
613 101.2.1.5 and 101.2.1.6.

614 In either case mentioned above, the maximum ratings of the DC EV supply equipment shall
615 not be exceeded.

616 *Compliance is checked by measurement.*

617 The vehicle can change the requested current and/or requested voltage.

618 NOTE Electric vehicles are equipped with different technologies and different voltages of battery. In order to
619 avoid any error during charging and to guarantee that the DC EV supply equipment will be able to charge all
620 existing and future batteries, any charging process is controlled by the vehicle. Any vehicle that is to be connected
621 to a DC EV supply equipment is equipped with a VCCF for controlling the charging process.

622 **6.3.1.102 Measuring current and voltage**

623 The DC EV supply equipment shall measure the output current and output voltage that is
624 supplied to the EV. The accuracy of these measurements shall meet the defined accuracy for
625 each system in AA.4.4, BB.4.1, BB.4.3 and CC.6.4.

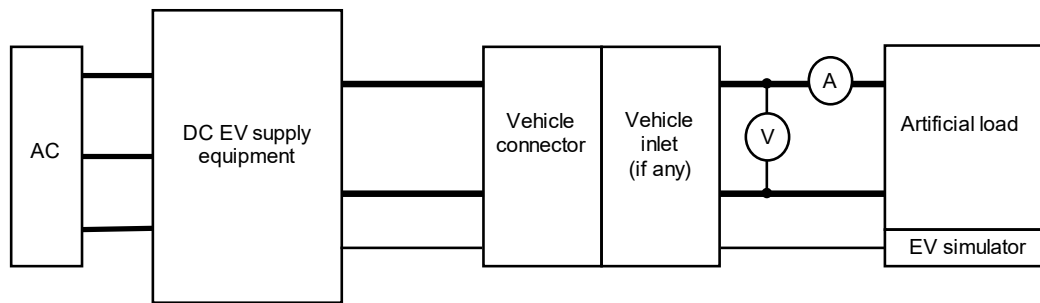
626 The measured values of voltage and current shall be provided by the DC charger to the EV
627 through digital communication.

628 *Compliance is checked by the following test.*

629 *The test system is shown in Figure 103.*

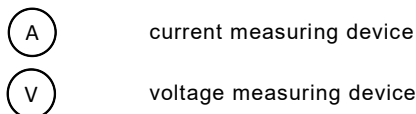
630

631



632

633 Key



634

Figure 103 – DC supply test system635 *The test shall be performed according to the following procedure:*636 1) *Connect the DC EV supply equipment to an artificial load with a dedicated EV simulator*
637 *for each system.*

638 NOTE Artificial load indicates Figure 112 unless otherwise specified.

639 2) *Start charging with the procedure specified by charger manufacturer.*640 3) *Set the CCC target values at I_{max} , I_{avg} and I_{min} of the DC charger.*641 4) *Set the CVC target values at V_{max} , V_{ave} and V_{min} of the DC charger. For System A, the*
642 *output current shall be adjusted to set the output voltage at V_{max} , V_{ave} and V_{min} of the DC*
643 *charger.*644 5) *Trend chart of output voltage and current which is measured at output terminals of the DC*
645 *charger and vehicle coupler.*646 6) *Check that the difference between the measured values of the DC EV supply equipment*
647 *and the measuring instrument are within the limits specified in AA.4.4, BB.4.2 or CC.6.4.*648 I_{max} , I_{avg} , I_{min} , V_{max} , V_{ave} and V_{min} are defined by each system.

649 System A:

650 I_{max} = Rated current specified by each manufacturer651 I_{avg} = $I_{max} / 2$ 652 I_{min} = 5A653 V_{max} = Maximum voltage specified by the manufacturer654 V_{ave} = $(V_{max} + V_{min}) / 2$ 655 V_{min} = Minimum voltage specified by the manufacturer

656

657 System B:

658 I_{max} = Maximum current specified by each manufacturer659 I_{med} = $(I_{max} + I_{min}) / 2$ 660 I_{min} = The greater value between 5 A and minimum rated current specified by each
661 manufacturer662 V_{max} = Maximum rated voltage specified by each manufacturer

663 $V_{med} = (V_{max} + V_{min}) / 2$

664 V_{min} = Minimum rated voltage specified by each manufacturer

665 System C: See CC.9.3.19.

666 6.3.1.103 Latching of the vehicle coupler

667 A vehicle connector used for DC charging shall be latched on a vehicle inlet if the voltage is
668 higher than 60 V DC.

669 The vehicle connector shall not be unlatched (if the latching mechanism is engaged) when
670 voltage exceeding 60 V DC is detected through the charging process including after the end
671 of charging. In case of charging system malfunction, a means for safe disconnection may be
672 provided.

673 NOTE 1 The actuation portion of the latching function can be in either the vehicle connector or the vehicle inlet.

674 NOTE 2 Voltage criteria for latching / unlatching function can be lower than 60 V DC; ex. 10 V in System A.

675 The DC EV supply equipment shall have the following functions when the latching is done by
676 the DC EV supply equipment:

- 677 – electrical or mechanical latching function to retain the latched status, and
- 678 – function to detect the disconnection of the electrical circuits for the latching function.

679 Compliance is checked by the following tests a) and b).

680 a) Normal condition test

681 *Simulate a normal charging operation. Check that the vehicle connector is latched on the*
682 *vehicle inlet whenever the voltage at the inlet is higher than or equal to 60 V DC.*

683 b) Abnormal condition test

684 *Simulate a condition in which the voltage at the vehicle inlet remains higher than or equal*
685 *to 60 V DC after the end of charging, e.g by forcibly keeping the EV contactors closed.*
686 *Check that the vehicle connector is latched on the vehicle inlet whenever the voltage at*
687 *the inlet is higher than or equal to 60V DC.*

688

689 Additional requirement are given in AA.3.4, BB.5.9 and CC.4.2.

690 Vehicle connectors and vehicle inlets shall comply with the requirements of IEC 62196-1 and
691 IEC 62196-3. See also clause 9.101.

692 6.3.1.104 Compatibility assessment

693 Compatibility of EV and DC EV supply equipment shall be checked with the information
694 exchanged at the initialization phase as specified in 7.1.105.1.

695 The compliance is checked by the following test.

- 696 1) Connect the DC EV supply equipment to an artificial load with a dedicated EV simulator
697 with load for each system.
- 698 2) Start charging with the procedure specified by charger manufacturer.
- 699 3) Using the EV simulator, transmit the data or message in Table 102 to the DC EV supply
700 equipment via digital communication.

701

702

Table 102 - Data/message for transmission test

System	Data /Message (refer to IEC 61851-24)	Value
A (Case 1)	Target battery voltage	420 V
	Maximum battery voltage	410 V
A (Case 2)	Target battery voltage	min (available output voltage +10V, 595) V
	Maximum battery voltage	600 V
B	Maximum permissible charge voltage of battery system	minimum rated voltage specified by each manufacturer - 10 V
C	See CC.9.3.1	

703 4) For each case, check that the DC EV supply equipment terminates the charging process
704 and transfers to shutdown stage, displaying a relevant alarm or error information, if any.

705 4a) For System A, perform the test separately for each case.

706 4b) For System C, see CC.9.3.1.

707 5) Confirm that the DC power line between the DC EV supply equipment and the EV is de-
708 energized to voltage less than 60 V.

709 **6.3.1.105 Insulation check before charging**

710 The DC EV supply equipment shall confirm the insulation resistance between its DC output
711 circuit and protective conductor to the vehicle chassis, including the supply equipment
712 enclosure, before the EV contactors are allowed to close.

713 If the required value is not met, the DC EV supply equipment shall terminate charging process
714 and indicate the vehicle that the charging is not allowed.

715 For System A and System B, insulation resistance shall be measured as follows:

716 For each output circuit, the appropriate relays in the DC output circuit of the DC EV supply
717 equipment shall be closed during the insulation check.

718 The required value of insulation resistance R shall be as shown in Formula (1):

$$719 \quad R \geq 100 \, \Omega/V \times U \quad (1)$$

720 where

721 U is rated output voltage of the DC EV supply equipment or maximum battery voltage of EV.

722 Compliance is checked by the tests in AA.4.3.3 and BB.8. For System C, see CC.4.1.3.

723 **6.3.1.106 Protection against overvoltage between positive terminal DC+ and negative** 724 **terminal DC- at the interface**

725 The DC EV supply equipment shall trigger an error shutdown within the maximum time given
726 in Table 103 to prevent overvoltage at the interface after occurrence of the fault according to
727 Table 103.

728 Specific requirement for detection and shutdown are defined in AA.3.8 and BB.5.6.

729 NOTE Except for System B, the vehicle can change the maximum voltage limit during charging process. The
730 vehicle should consider some margin between the target battery voltage and maximum voltage limit communicated
731 to the DC EV supply equipment to avoid unwanted stop of the charging process.

732

Table 103 – Error shutdown trigger timing

System	Fault	Maximum time after occurrence of the fault to trigger error shutdown
A	Output voltage exceeds the maximum voltage limit sent by the vehicle	2 s
B	Output voltage exceeds the maximum voltage limit sent by the vehicle.	500 ms
C	Output voltage exceeds the maximum voltage limit sent by the vehicle for 400 consecutive milliseconds	10 ms

Compliance is checked by the following test.

The test shall be performed according to the following procedure:

- 1) Connect the DC EV supply equipment to an artificial load with a dedicated EV simulator appropriate for the system under test. The setup of the test load in Figure 123 is in Table 104.

Table 104 - Test load setup

System	Switches					Circuit parameter setup
	S0	S1	S3	Sa	Sb	
A	close	close	open	open	close	L1: 0 H R1, R5: 0 Ω (bypassed) V1: Not used U1: An electronic load operating under constant voltage mode shall be used.
B	close	close	open	close	open	L1: 0 H R1: 0 Ω R2: Variable V1: controlled voltage source C2: 5 600 μ f (different case depended)
C	See CC.9.3.6.					

- 2) Measure the voltage ($V_{EVSE\ output}$) and current ($I_{EVSE\ output}$) of the power line continuously.
- 3) Start charging with the procedure specified by charger manufacturer.
- 4) Using the EV simulator, transmit the data or message in Table 105 to the DC EV supply equipment via digital communication.

Table 105 - Data/message for transmission test

System	Data /Message Name	Value
A	Target battery voltage	410 V
	Maximum battery voltage	420 V
	Target battery current	$I_{EVSE\ max}$
B	Maximum permissible charge voltage of battery system	$\leq$ maximum rated voltage specified by each manufacturer
	Voltage requirement	= battery maximum allowable charging voltage - 10 V
C	See CC.9.3.6.	

5) Confirm that the DC power line between the DC EV supply equipment and the EV is energized at the rated voltage and the DC EV supply equipment is operating at the designated voltage and current.

6) Simulate overvoltage at the interface by the method(s) in Table 106 and check the results.

Table 106 - Charging stop method

System	Method(s) to simulate overvoltage at the interface	Verification criterion
A	Set U1 = voltage higher than the maximum battery voltage	The output current ($I_{EVSE\ output}$) is reduced to 5 A or less within 3 s after the overvoltage is applied.
B	Set V1 = voltage higher than the maximum permissible charge voltage of battery system	The output current ($I_{EVSE\ output}$) is reduced to 5 A or less within 1 s after the overvoltage is applied.
C	See CC.9.3.6.	

7) Check that the DC EV supply equipment terminates the charging process and transfers to shutdown stage, displaying a relevant alarm or error information (if any).

6.3.1.107 Verification of vehicle connector latching

This clause is only applicable for supply equipments which are responsible for latching of vehicle connector, such as System A and System B.

The DC EV supply equipment shall not energize the charging cable when the vehicle connector is unlatched. Compliance is checked by inspection, operation and, for System A and System B, the following test .

1) A vehicle inlet shall be prepared with a modification in which the latch holder (hole) of the inlet is covered by a metal plate or an equivalent hard material that inhibits the latch holding of the vehicle connector. See Figure 104.

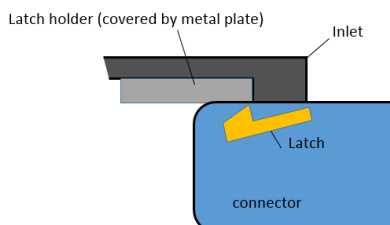


Figure 104 – Example of vehicle inlet with the latch holder covered by a metal plate that inhibits latch holding

2) Connect the DC charger to an artificial load and a dedicated EV simulator.

3) Start charging with the procedure specified by the manufacturer.

4) Confirm that the DC bus is not energized to voltage above 60 V and the DC charger terminates the charging process and transfers to shutdown stage, displaying a relevant alarm or error information, if any.

6.3.1.108 Control circuit supply integrity

If an earth fault, short circuit or overcurrent is detected in the output circuit of DC EV supply equipment, the power circuit shall be disconnected from its supply, but the power supply for control circuit shall not be interrupted until the charging sequence is completed and the vehicle coupler is safely unlatched.

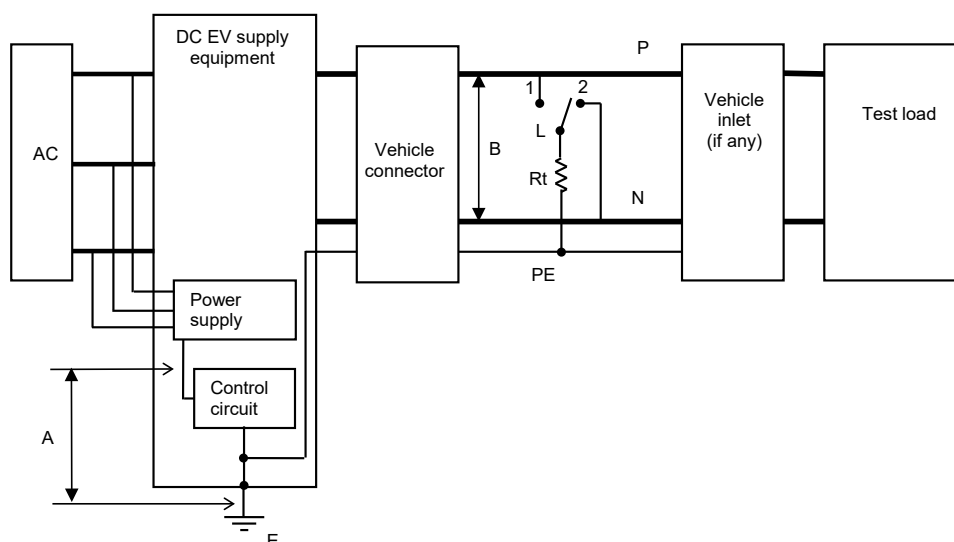
The compliance is checked by the following tests according to Table 107.

Table 107 – Control circuit supply integrity test

Fault Scenario	System A	System B	System C
Earth fault	Test a)	Not applied	Test a)
Short circuit	Test b)	Test b)	Test b)
Overcurrent	Design review	Test c)	Test c)

a) *Earth-fault test*

The test system is shown in Figure 105.

**Key**

A	voltage of the power supply for control circuit	N	negative
B	voltage of the power line	P	positive
E	earth	PE	protective conductor
L	selector switch	Rt	earth-fault resistance
1	terminal 1 to replicate earth-fault between P and E		
2	terminal 2 to replicate earth-fault between N and E		

Figure 105 – Earth-fault test system

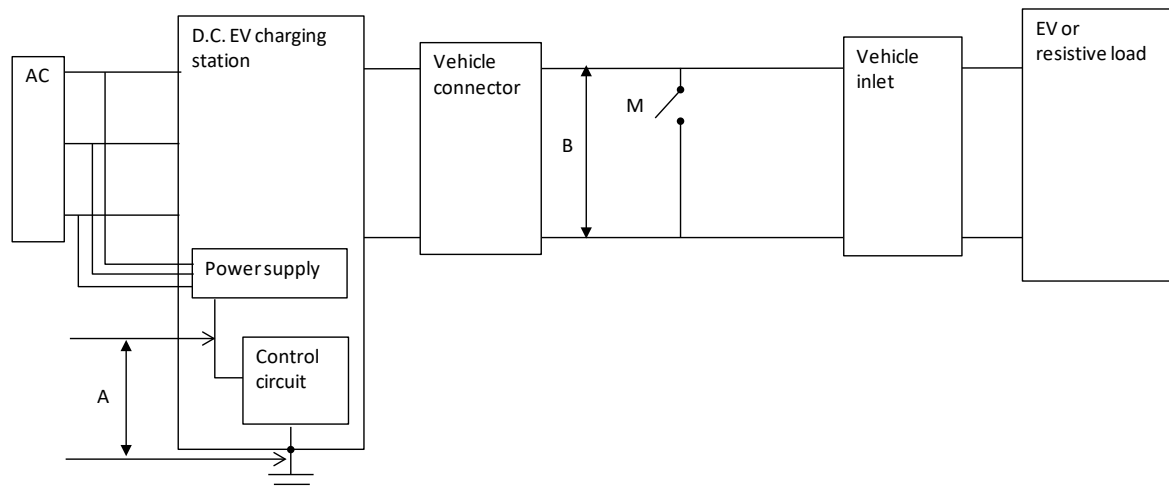
The test shall be performed according to the following procedure.

- 1) An artificial load with a dedicated EV simulator for each system (see 102.2.3) is connected to DC EV supply equipment correctly under normal operation.
- 2) The power line is energized at the rated voltage.
- 3) The DC EV supply equipment is operated in the constant voltage control mode (in case of System C) and constant current control mode (in case of System A).
- 4) Simulate the earth-fault by changing the position of the relay or switch L from open to 1.
- 5) Check that the earth-fault is detected properly and the DC charger transfers to a fault state.

- 6) Confirm that the voltage of the power supply for control circuit at point A remains the same or within a specified range that ensures the normal operation of the control circuit.
- 7) Check that the DC supply equipment terminates the charging process and transfers to the error shutdown stage according to 6.3.1.113.3. Confirm that the measured DC voltage at point B is less than 60 V within 1s for System C after the DC EV supply equipment detects the earth-fault in 5). For System A, see Table AA.5.
- 8) Repeat the procedures 1) to 7) for the case in which the position of the relay or switch L is changed from open to 2 in 4).

b) Short-circuit test

The test system is shown in Figure 106.



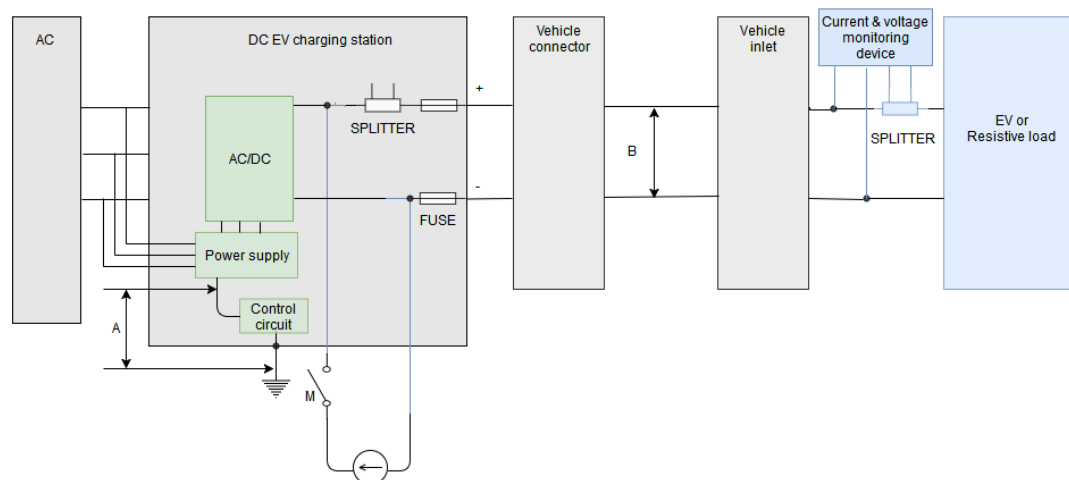
Key

- A voltage of the power supply for control circuit
- B voltage of the power line
- M switch or relay to replicate short-circuit

Figure 106 – Short-circuit test system for testing control circuit integrity

The test shall be performed according to the following procedure.

- 1) An artificial load with dedicated EV simulator with load for each system is connected to the DC EV supply equipment correctly under normal operation. If an electronic load is used, it shall not interfere with the measurement.
- 2) The power line is energized at the rated voltage.
- 3) The DC EV supply equipment is operated in the constant voltage control mode (in case of System B and System C) and constant current control mode (in case of System A, B and C).
- 4) Simulate the short circuit by closing the relay or switch M.
- 5) Check that the short circuit was detected properly and the DC charger transferred to a fault state.
- 6) Confirm that the voltage of the power supply for control circuit at point A remains the same or within a specified range that ensures the normal operation of the control circuit.
- 7) Check that the DC supply equipment terminates the charging process and transfers to the emergency shutdown stage according to 6.3.1.113.3 for System B and System C, and transfer to error shutdown for System A. Confirm that the measured DC voltage at point B is less than 60 V within 1 s for Systems A and C and within 500 ms for System B after the DC EV supply equipment detects the short circuit in 5).

829 c) *Overcurrent test*830 *The test system is shown in Figure 107.*831
832 **Key**

- 833 A voltage of the power supply for control circuit
 834 B voltage of the power line
 835 M switch or relay to replicate overcurrent
 836

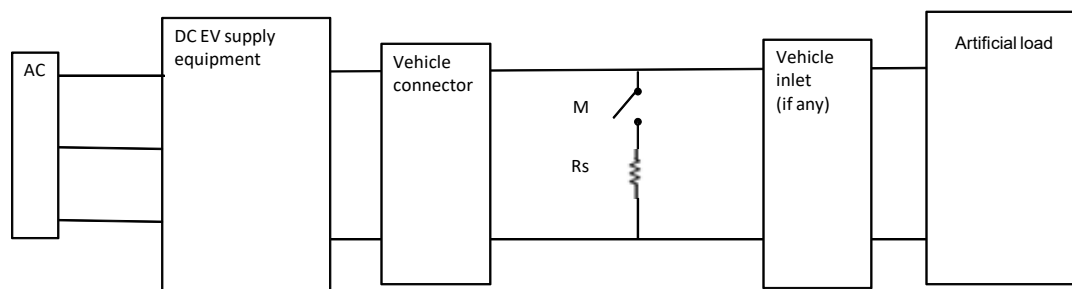
837 **Figure 107 – Overcurrent test system for testing control circuit integrity**838 *The test shall be performed according to the following procedure.*

- 839 1) *An artificial load with dedicated EV simulator with load for each system is connected*
 840 *to the DC EV supply equipment correctly under normal operation. If an electronic*
 841 *load is used, it shall not interfere with the measurement.*
 842 2) *The power line is energized at the rated voltage.*
 843 3) *The DC EV supply equipment is operated in the constant current control mode.*
 844 4) *Simulate the overcurrent by closing the relay or switch M.*
 845 5) *Check that the overcurrent was detected properly and the DC charger transferred to*
 846 *a fault state.*
 847 6) *Confirm that the voltage of the power supply for control circuit at point A remains the*
 848 *same or within a specified range that ensures the normal operation of the control*
 849 *circuit.*
 850 7) *Check that the DC supply equipment terminates the charging process and transfers*
 851 *to the emergency shutdown stage according to 6.3.1.113.3. Confirm that the*
 852 *measured DC voltage at point B is less than 60 V within 1 s for system C and within*
 853 *500 ms for System B after the DC EV supply equipment detects the overcurrent in 5).*
 854

855 **6.3.1.109 Short-circuit test before charging**

856 With the EV connected to the DC EV supply equipment and before the EV contactor is closed,
 857 the DC EV supply equipment shall have a means to check for a short circuit between DC
 858 output circuit positive and negative for the cable and vehicle coupler.

859 *Compliance is checked by the following test.*860 *The test system is shown in Figure 108.*

**Key**

M switch or relay

Rs short-circuit resistance

Figure 108 – Short circuit test system to check the short circuit before charging

The test shall be performed according to the following procedure.

- 1) Connect the DC EV supply equipment to an artificial load correctly under normal operation.
- 2) The EV contactors are open.
- 3) The short-circuit resistance R_s shall be $100\ \Omega$.
- 4) Switch M is open.
- 5) Simulate the short circuit of the power line by closing the switch M .
- 6) Start charging with the procedure provided by charger manufacturer.
- 7) After the short-circuit test is performed, the DC charger shall transfer to a fault state.

6.3.1.110 User initiated shutdown

The DC EV supply equipment shall have a means to allow the user to initiate the normal shutdown.

NOTE For System A, a means to trigger an error shutdown is also possible.

Compliance is checked by the tests in AA.8, BB.4.6, and CC.9.3.20.

6.3.1.111 Overload protection for parallel conductors (conditional function)

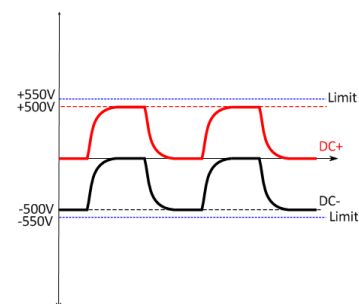
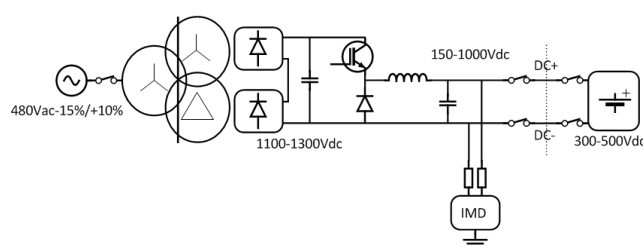
If more than one conductor or wire and/or vehicle connector contact is used in parallel for DC current supply to the vehicle, the DC EV supply equipment shall have a means to ensure that none of the conductors or wires will be overloaded.

Compliance is checked by inspection.

NOTE E.g. the currents on the different path can be monitored or more than one power source can be used.

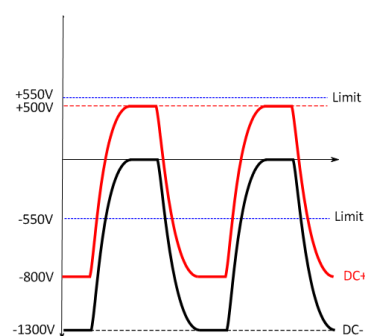
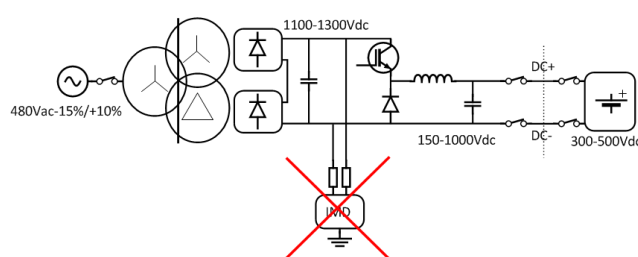
6.3.1.112 Voltage limitation between DC output and protective conductor**6.3.1.112.1 Maximum voltage between DC power line terminals and protective conductor in conditions without earth fault**

Under normal operation no voltage higher than the DC output voltage plus 50 V shall occur between DC power line terminals (DC+ as positive terminal, and DC- as negative terminal) and protective conductor at the output of the DC EV supply equipment. This voltage limitation does not apply for transient overvoltages. See Figure 109 and Figure 110.



(to be replaced)

Figure 109 - Typical voltages between DC+/- and protective conductor in conditions without earth fault



(to be replaced)

Figure 110 - IMD connection which results in exceedance of maximum voltage limits

6.3.1.112.2 Maximum voltage between DC+/- and protective conductor in conditions with a single earth fault

For DC EV supply equipments serving a maximum rated output voltage up to 500 V, no voltage higher than 550 V shall occur for more than 5 s at the output between DC+ and protective conductor or between DC- and protective conductor.

If a voltage higher than 550 V is present for more than 1 s between DC+ and protective conductor or between DC- and protective conductor, the DC EV supply equipment shall have completed an emergency shutdown within 5 s after occurrence of the overvoltage.

For DC EV supply equipments serving a maximum output voltage above 500 V and up to 1 000 V, no voltage higher than 110 % of DC output voltage shall occur for more than 5 s at the output between DC+ and protective conductor or between DC- and protective conductor.

If a voltage higher than 110 % of the DC output voltage is present for more than 1 s between DC+ and protective conductor or between DC- and protective conductor, the DC EV supply equipment shall have completed an emergency shutdown within 5 s after occurrence of the overvoltage.

For voltage above 1 000 V, under consideration.

Within the first 5 s of an earth fault condition, the DC EV supply equipment shall limit the temporary overvoltage V_{tov} as defined in ISO 6469-3 and IEC 60664-1 between DC+/- and protective conductor to:

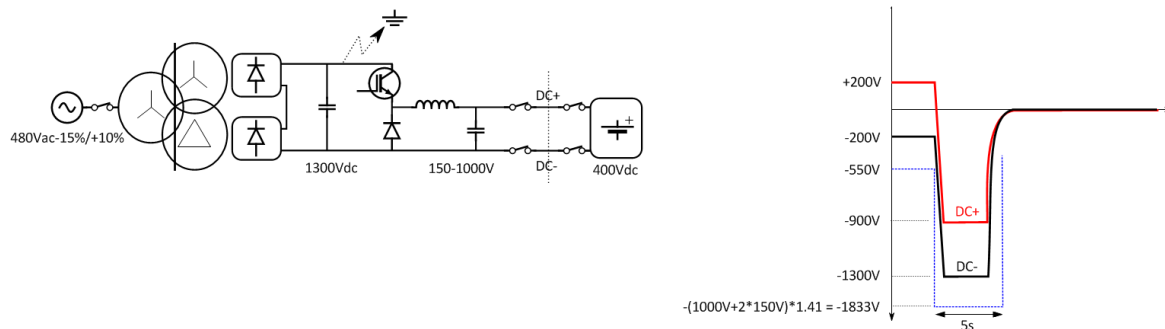
$$(2 U_{min} + 1\,000) \times 1,41 \text{ V or;}$$

$$(U_{min} + 1\,200) \times 1,41 \text{ V, whichever is less}$$

where

922 $U_{\min}$ is the minimum rated DC charger output voltage.

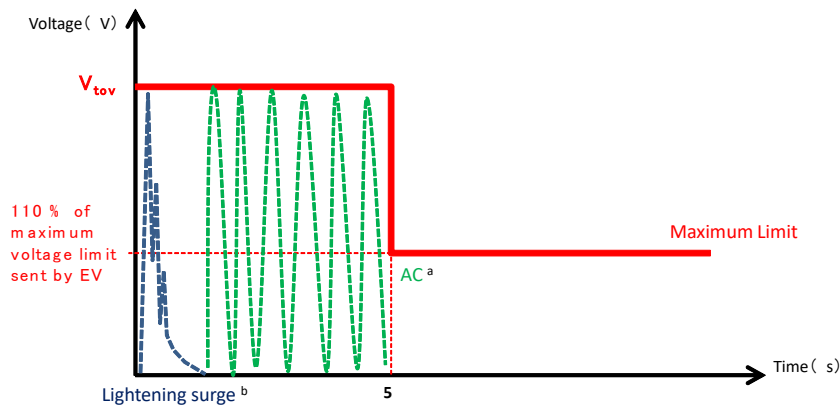
923



924

925 **Figure 111 - Maximum voltage between DC+/- and protective conductor in conditions**
926 **with a single earth fault**

927 Figure 112 shows an example of temporary voltage waveform and the maximum voltage limit
928 at the DC output.



929

930 (To be replaced)

931 EXAMPLE

932 ^b Lightening surge appears at the common-mode DC output as a result of its input to the AC-input circuit of DC
933 EV supply equipment.

934 **Figure 112 – Examples of temporary voltage waveform and the maximum voltage limit at**
935 **the DC output**

936 6.3.1.113 Shutdown of DC EV supply equipment

937 6.3.1.113.1 Normal shutdown

938 Normal shutdown occurs as a result of an intrinsic reaction of the vehicle or the DC EV supply
939 equipment or a user interaction, for other reasons than the presence of a failure.

940 Further requirements are specified in AA.4.3.5.1, BB(TBD) and CC.3.3.

941 6.3.1.113.2 Error shutdown

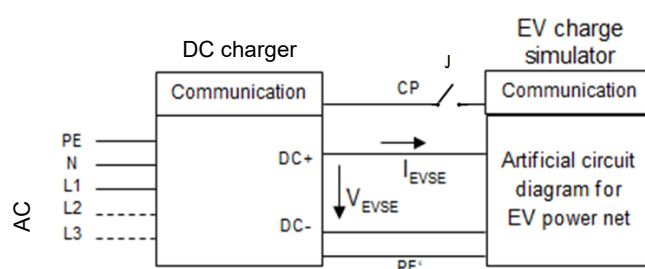
942 The DC EV supply equipment shall reduce its output to:

943 - ≤ 60 V (between DC+ and DC-, between DC+ and earthing terminal, and between DC-
944 and earthing terminal) , and

945 - ≤ 5 A

946 within

- 947 - 3 s for System A
- 948 - 500 ms for System B, and
- 949 - 1 s for System C,
- 950 after the error shutdown was triggered by the DC EV supply equipment.
- 951 Initiate error shutdown according to Table AA.5 and Table AA.6 for System A, and according
- 952 to BB.5.1, BB.5.4 and BB.5.6 for System B.
- 953 Further requirements are specified in AA.4.3.5.2, BB.5.1 and CC.3.4.
- 954 **6.3.1.113.3 Emergency shutdown**
- 955 The DC EV supply equipment shall reduce the:
- 956 – DC output current ≤ 5 A within 30 ms after the emergency shutdown is triggered, and shall
- 957 be designed such that
- 958 – DC output voltage ≤ 60 V (between DC+ and DC-) and ≤ 28 V (between DC+ and earthing
- 959 terminal, and DC- and earthing terminal) within 1 s for Systems A and C, and 500 ms for
- 960 System B, after the emergency shutdown was triggered.
- 961 Further requirements are specified in AA.4.3.5.3, BB.5.1 and CC.3.4.
- 962 NOTE A welded contactor on the vehicle can prevent the DC EV supply equipment to reduce the voltage.
- 963 *Compliance is checked by the following test.*
- 964 *The test system is shown in Figure 113.*



- 965
- 966 Key
- | | | | |
|----|----------------------|------------|---------------------------------------|
| J | switch or relay | L1, L2, L3 | power line |
| CP | control pilot | I_{EVSE} | output current of EV supply equipment |
| PE | protective conductor | V_{EVSE} | output voltage of EV supply equipment |
| N | neutral | | |

967 **Figure 113 – Control pilot test system**

968 *The test shall be performed according to the following procedure.*

- 969 1) *Connect the DC EV supply equipment to an artificial load with dedicated EV simulator*
- 970 *with load for each system.*
- 971 2) *Start charging with the procedure specified by charger manufacturer.*
- 972 3) *Confirm that the DC power line between DC charger and EV is energized at the rated*
- 973 *voltage and the DC EV supply equipment is operating at the maximum rated output*
- 974 *current.*
- 975 4) *Initiate emergency shutdown*
- 976 – *for System A. according to Table AA.8 and Table AA.9*
- 977 – *for System B, according to BB.5.1, BB.5.2, BB.5.3 and BB.5.5.*

978 5) *The DC EV supply equipment shall terminate the charging process and transfer to*
979 *shutdown stage, displaying a relevant alarm or error information, if any.*

980 *The voltage of the DC power line between DC EV supply equipment and EV shall be less*
981 *than 60 V, within 1s for Systems A and B, and (TBD) s for System C.*

982 *Replacement of title 6.3.2:*

983 **6.3.2 Optional functions for Mode 4**

984 **6.3.2.1 General**

985 *Replacement:*

986 The following functions, if provided by the DC supply equipment, shall comply with applicable
987 clauses as given below:

- 988 – ventilation during supply of energy according to 6.3.2.2;
- 989 – Mode 4 using the combined charging system according to 6.3.2.4;
- 990 – wake up of DC EV supply equipment by EV according to 6.3.2.101;
- 991 – detection/adjustment of the real time available load current of the DC EV supply
992 equipment according to 6.3.2.102;

993 Other additional functions may be provided.

994 NOTE 1 Un-intentional live disconnect avoidance functions may be incorporated in the latching function interlock
995 system.

996 NOTE 2 A positive means to prevent unintentional disconnect is required in some countries: US

997 NOTE 3 Primary protection against overvoltage and overcurrent of vehicle battery is the responsibility of the
998 vehicle.

999 *Addition:*

1000 **6.3.2.101 Wake up of DC EV supply equipment by EV**

1001 The DC EV supply equipment may support a sleep mode to minimize power consumption. In
1002 this case, the DC EV supply equipment shall be able to be woken up by the EV.

1003 For System A, the DC EV supply equipment shall be woken up by receiving the specific CAN
1004 ID from the vehicle.

1005 *Compliance is checked by the following test.*

1006 1) *DC EV supply equipment in sleep mode*

1007 2) *Send a proper signal from EV simulator to DC EV supply equipment.*

1008 3) *The DC EV supply equipment shall:*

1009 *For System A, transmit CAN message ID: H'708 after receiving H'700 from the EV*
1010 *simulator as indicated in Table A.2 and A.3 of IEC 61851-24.*

1011 *For System B, under consideration*

1012 *For System C, see CC.5.2.*

1013 **6.3.2.102 Detection/adjustment of the real time available load current of the DC EV** 1014 **supply equipment (smart charging)**

1015 The DC EV supply equipment may support the smart charging operation. In such case, the
1016 DC EV supply equipment may change the available current and shall transmit it to vehicle via
1017 digital communication. The vehicle should limit the current request value in accordance with
1018 the change in the available current. The current request value shall be less than or equal to
1019 the available current

1020 This clause is only applicable to System A and System C. For specific requirements, see AA.7
1021 for System A and CC.XX (TBD) for System C.

1022 **7 Communications**

1023 This clause of Part 1 is applicable except as follows:

1024 **7.1 Digital communication between the EV supply equipment and the EV**

1025 *Addition:*

1026 Annex DD provides general information on the communication and charging process between
1027 EV and DC EV supply equipment.

1028 Requirements on the communication for bidirectional power flow control for System A are
1029 specified in Annex AA.

1030 *Addition:*

1031 **7.1.101 Basic communication interface**

1032 Typical interfaces of control pilot function on DC EV charging systems are specified in
1033 Annexes AA, BB and CC. Each system carries out control pilot function through the control
1034 pilot conductors and terminals specified in IEC 62196-3.

1035 **8 Protection against electric shock**

1036 *Replacement:*

1037 **8.101 General**

1038 Requirements for protection against electric shock shall be according to 4.4 of IEC 62477-
1039 1:2012/Amd.1:2016, which provides safety requirements for Power Electronic Converter
1040 Systems (PECS) and equipment.

1041 For the purposes of this document, DC EV supply equipment is considered to be a type of
1042 PECS equipment.

1043 Hazard based safety models according to IEC 62368-1:2014 may be used to evaluate
1044 protection against electric shock.

1045 Protection against the risk of electric shock and the hazard associated with the output circuit
1046 of DC EV supply equipment under conditions of intended use and reasonably foreseeable
1047 misuse shall be provided by one of the following measures.

1048 - Basic protection and fault protection, see 8.102 and 8.103

1049 - Enhanced protection, see 8.104

1050 Protection under normal operating conditions is provided by basic protection, and protection
1051 under single fault conditions is provided by fault protection.

1052 Specific protective measures for the secondary circuit supplying the DC output are provided in
1053 8.105.

1054 Additional protection may be provided by RCD according to 8.105.7.

1055 Specific requirements for protective measures for DC EV supply equipment having non-
1056 isolated DC output circuits are under consideration.

1057 **8.102 Basic protection**

1058 **8.102.1 Intended use and reasonably foreseeable misuse**

1059 Considering intended use and reasonably foreseeable misuse:

1060 - hazardous-live-parts shall not be accessible and accessible-conductive-parts shall not be
1061 hazardous live; and

1062 - hazardous currents shall not be disconnected with the vehicle connector. See 6.3.1.103.

1063 **8.102.2 Limitation of touch current or touch voltage**

1064 Under normal operating conditions and single fault conditions, an ordinary person shall be
1065 protected against a harmful electric shock by either:

1066 - limiting the touch currents; or

1067 - limiting the touch voltage.

1068 Body impedance considerations correspond to water wet conditions in 3.1.8 of IEC TS 60479-
1069 1.

1070 NOTE The skin of a sweating person or a person after immersion in seawater is not considered.

1071 **8.102.3 Threshold of perception and startle reaction**

1072 Protective measures shall be provided to prevent startle reactions during intended use, before,
1073 during and after an energy transfer session, under normal conditions and during single fault
1074 conditions. Such reactions could cause harm to the ordinary person due to falling,
1075 accidentally entering traffic, etc.

1076 The intended use involves:

1077 - handling of energy transfer accessories: charging cable, vehicle connector, vehicle inlets;

1078 - initiating an energy transfer session;

1079 - ending an energy transfer session;

1080 - an ordinary person or animal entering or exiting the EV;

1081 - opening and retrieving an item from the car trunk/boot or other storage areas;

1082 - touching the EV chassis; and

1083 - touching exposed metal parts of the DC EV supply equipment.

1084 Protection by means of limitation of touch current shall be provided, such that a steady-state
1085 touch current flowing between simultaneously accessible conductive parts shall not exceed:

1086 - 0,5 mA AC / 2 mA DC under normal operation

1087 - 3,5 mA AC/ 10 mA DC under single fault condition

1088 Additional protection shall be provided, such that in case of a double fault, touch current does
1089 not exceed the DC2 limit (line B) in Figure 22 and Table 13 of IEC 60479-1.

1090 Protection by means of limitation of discharge energy shall be provided, such that discharge
1091 energy shall not exceed:

1092 - 5 µJ under normal operation

1093 - 0,5 mJ under single fault condition

1094 Additional protection shall be provided, such that in case of a double fault, the discharge
1095 energy does not exceed the C1 limit in Figure 23 of IEC 60479-2:2017.

1096 *Compliance is checked by measurement according to 12.6.*

1097 **8.102.4 Provisions for basic protection**

1098 **8.102.4.1 General**

1099 Basic protection in DC EV supply equipment shall be according to 4.4.3.1 of IEC 62477-
1100 1:2012/Amd.1:2016.

1101 **8.102.4.2 Protection by means of basic insulation of live parts**

1102 Protection by means of basic insulation of live parts in DC EV supply equipment shall be
1103 according to 4.4.3.2 of IEC 62477-1:2012/Amd.1:2016.

1104 Basic insulation shall be provided by solid insulation or clearance and/or creepage distance.

1105 Any accessible conductive part is considered to be a hazardous live part if not separated from
1106 the live parts by required insulation.

1107 Basic insulation shall be designed and tested to withstand the impulse voltages and
1108 temporary overvoltages for the circuits to which they are connected.

1109 *Compliance is checked by inspection and test.*

1110 *Test shall be conducted according to 5.2.3.2 and 5.2.3.4 of IEC 62477-1:2012/Amd.1:2016.*

1111 **8.102.4.3 Protection by means of enclosures or barriers**

1112 Protection by means of enclosures or barriers in DC EV supply equipment shall be according
1113 to IEC 62477-1:2012/Amd.1:2016, 4.4.3.3.

1114 Enclosures shall be suitable for use in their intended environments.

1115 The DC EV supply equipment shall have adequate mechanical strength and shall be so
1116 constructed that no hazard occurs when subjected to intended use and expected misuse over
1117 the expected lifetime.

1118 It shall only be possible to open enclosures or remove barriers:

1119 - with the use of a tool or key; or

1120 - after de-energization of hazardous live parts

1121 For constructional requirements see clause 12.4.101.

1122 **8.102.4.4 Protection by means of limitation of voltage**

1123 Basic protection by the provision of limitation of voltage is fulfilled where both of the following
1124 conditions are met:

1125 a) touch voltage under no circumstance exceeds the values in Table 108 and Table 109,
1126 and

1127 b) the voltage is supplied by one of the following sources:

1128 1) a safety isolating transformer for the auxiliary circuit including control pilot;

1129 NOTE Safety isolating transformers are those that comply with IEC 61558-2-6.

1130 2) a source of voltage providing a degree of safety equivalent to that of a safety isolating
1131 transformer;

1132 3) electrochemical (e.g., battery).

1133

1134 **Table 108 – Touch Voltage under normal operation (Water Wet)**

Body Contact Area	AC (rms)	DC
Part of body	Basic protection required	
Hand		
Finger tip	8,0 V	22,0 V
NOTE Values from IEC 62477-1:2012/Amd.1:2016, Table A.3 and Table 5. The values are based on a current path from the contact area of the body to feet, with the person in standing position.		

1135

1136 **Table 109 – Touch Voltage under single fault conditions (Water Wet)**

Body Contact Area	AC (rms)	DC
Part of body	Basic protection required	
Hand		
Finger tip	12,0 V	28,0 V
NOTE 1 Values from IEC 62477-1:2012/Amd.1:2016, Table A.2 and Table 5. The values are based on a current path from the contact area of the body to feet, with the person in standing position.		
NOTE 2 If these values cannot be met under single fault conditions, protective separation is needed.		

1137

1138 *Compliance is checked by inspection and measurement.*

1139 **8.102.4.5 Protection by means of limitation of steady-state touch current**

1140 Limitation of steady-state touch current is a provision whereby touch currents is limited to
1141 non-hazardous values. The limits are provided in 8.102.4.

1142 The protective impedance limiting the touch current shall comply with 4.4.5.4 of IEC 62477-
1143 1:2012/Amd.1:2016.

1144 The protective impedance shall be so designed and tested to withstand the impulse voltages and
1145 temporary overvoltages as tested according to 5.2.3.2 and 5.2.3.4 of IEC 62477-1:2012/Amd.1:2016.

1146 *Compliance is checked by measurement according to 12.6.*

1147 **8.103 Provisions for fault protection**

1148 **8.103.1 General**

1149 Fault protection provides protection against bodily harm due to contact with hazardous
1150 electrical energy during and after failure of the basic protection.

1151 Fault protection shall be provided by one or a combination of one or more of the following
1152 measures:

- 1153 - protective equipotential bonding in 8.103.2 in combination with the protective conductor;
- 1154 - automatic disconnection of supply in 8.103.4;
- 1155 - supplementary insulation in 8.103.5; and
- 1156 - electrically protective screening in 8.103.6.

1157 Fault protection shall be independent and additional to those for basic protection.

1158 In case the the DC EV supply equipment or the DC charging/discharging station can supply
1159 more than one vehicle simultaneously, independent protection means (overcurrent and fault
1160 current) for each vehicle connector shall be provided.

1161 **8.103.2 Protective-equipotential-bonding**

1162 Protective-equipotential-bonding is a provision whereby items are bonded together to avoid
1163 hazardous touch voltages.

1164 Protective-equipotential-bonding in DC EV supply equipment shall be according to 4.4.4.2 of
1165 IEC 62477-1:2012/Amd.1:2016.

1166 *Compliance is checked by inspection.*

1167 **8.103.3 Effective earth continuity between the enclosure and the external protective** 1168 **circuit**

1169 Exposed conductive parts of the DC EV supply equipment shall be effectively connected to
1170 the terminal for the external protective earthing conductor, and the resistance from the
1171 conductive part to the terminal of the external protective earthing conductor shall not exceed
1172 0,1 Ω . The test shall be conducted in accordance with national regulations.

1173 *Compliance is checked by the following test.*

1174 1) *Make verification using a resistance measuring instrument which is capable of driving a*
1175 *current of at least 10 A (AC or DC.). Pass the current between each exposed conductive*
1176 *part and the terminal for the external protective conductor.*

1177 2) *Confirm that the resistance does not exceed 0,1 Ω .*

1178 NOTE 1 It is recommended to limit the duration of the test where low-current equipment otherwise may be
1179 adversely affected by the test.

1180 NOTE 2 Routine testing performed according to 5.2.3.11.4 *Protective equipotential bonding continuity test (routine test)* in
1181 IEC 62477-1:2012/Amd.1:2016.

1182 **8.103.4 Automatic disconnection of supply**

1183 Automatic disconnection of supply in DC EV supply equipment shall be according to 4.4.4.4 of
1184 IEC 62477-1:2012/Amd.1:2016.

1185 For automatic disconnection of supply:

- 1186 - a protective-equipotential-bonding system shall be provided, and
- 1187 - a protective device operated by the fault current shall disconnect one or more of the line
1188 conductor(s) supplying the DC EV supply equipment in the event of a fault of basic
1189 insulation between a line conductor and an exposed-conductive-part or a protective
1190 conductor in the equipment.

1191 The protective device shall be suitable for isolation according to (under consideration).

1192 The protective device shall interrupt the fault current within a time specified by Figure 1,
1193 Figure 2 or Figure 3 in 4.4.2.2.3 of IEC 62477-1:2012/Amd.1:2016.

1194 The protective device may be provided in any suitable upstream part of the installation or DC
1195 EV supply equipment.

1196 *Compliance is checked by inspection and measurement.*

1197 **8.103.5 Supplementary insulation**

1198 Supplementary insulation in DC EV supply equipment shall be according to 4.4.4.5 of IEC
1199 62477-1:2012/Amd.1:2016.

1200 Supplementary insulation is an independent insulation applied in addition to basic insulation
1201 for fault protection. See clause 8.102.5.1. Supplementary insulation shall be dimensioned to
1202 withstand the same stresses as specified for basic insulation.

1203 *Compliance is checked by inspection.*

1204 **8.103.6 Electrically protective screening**

1205 Electrically protective screening in DC EV supply equipment shall be according to 4.4.4.5 of
1206 IEC 62477-1:2012/Amd.1:2016. Electrically protective screening shall consist of a conductive
1207 screen interposed between hazardous-live-parts of the DC EV supply equipment and the part
1208 being protected.

1209 The protective screen shall:

- 1210 – be connected to the protective-equipotential-bonding system of the DC EV supply
1211 equipment and that interconnection shall comply with the requirements of 6.2.1.1.2.2 of
1212 IEC 62477-1:2012/Amd.1:2016, and
- 1213 – comply with the requirements for elements of the protective-equipotential-bonding system
1214 according to 6.2.1.1.2.2.3, 6.2.1.1.2.2.4 and 6.2.1.1.2.2.5 of IEC 62477-1:2012/Amd.1:2016.

1215 *Compliance is checked by inspection.*

1216

1217 **8.104 Enhanced protective provisions**

1218 **8.104.1 General**

1219 An enhanced protective provision shall provide both basic protection under normal conditions
1220 and protection under single fault conditions.

1221 **8.104.2 Reinforced insulation**

1222 Reinforced insulation in DC EV supply equipment shall be according to 4.4.5.2 of IEC 62477-
1223 1:2012/Amd.1:2016. Reinforced insulation shall be designed to be able to withstand electric,
1224 thermal, mechanical and environmental stress with the same reliability as provided by double
1225 insulation (basic insulation and supplementary insulation) according to 4.4.3.2 and 4.4.4.5 of
1226 IEC 62477-1:2012/Amd.1:2016.

1227 *Compliance is checked by inspection.*

1228 **8.104.3 Protective separation between circuits**

1229 Protective separation between circuits in DC EV supply equipment shall be according to
1230 4.4.5.3 of IEC 62477-1:2012/Amd.1:2016.

1231 Protective separation between a circuit and other circuits shall be achieved by means of:

- 1232 - double insulation (basic insulation and supplementary insulation, each rated for the
1233 highest voltage present), or
- 1234 - reinforced insulation rated for the highest voltage present, or
- 1235 - electrically protective screening with the protective screen being separated from each
1236 adjacent circuit by basic insulation rated for the adjacent circuit voltage, or
- 1237 - a combination of these provisions.

1238 If conductors of the separated circuit are contained together with conductors of other circuits
1239 in a multi-conductor cable or in another grouping of conductors, they shall be insulated,
1240 individually or collectively, for the highest voltage present, so that double insulation is
1241 achieved.

1242 *Compliance is checked by inspection*

1243 **8.105 Requirements of the isolated DC EV supply equipment**

1244 **8.105.1 General**

1245 Between the DC circuit and the ordinary person protective separation shall be used as basic
1246 and fault protection.

1247 Insulation monitoring or leakage current monitoring in the DC EV supply equipment or the EV
1248 shall detect the first fault and disconnect the supply or shutdown the transfer of energy. This
1249 is not protection against electric shock but can prevent a hazardous electric shock on a
1250 second fault. The insulation monitor or leakage current monitor cannot be used as basic or
1251 fault protection.

1252 Y capacitance shall be less than $2 \times 500 \text{ nF}$ for DC EV supply equipment.

1253 The interconnected EV could exceed the limits of clause 8.102.3. Therefore, the limitation of
1254 stored energy in the Y-capacitors shall not be used as fault protection for the DC EV supply
1255 equipment.

1256 For specific requirement in System A DC EV supply equipment with a rated output voltage up
1257 to 500 V, see AA.3.15.

1258 Additional protection may be provided by limited impedance between the DC output and the
1259 protective conductor, including the connected EV. See clause 8.102.4 for the requirements for
1260 additional protection.

1261 The capacitance from the DC output to the protective conductor shall be limited to ensure the
1262 reaction time of the insulation monitor or ground leakage detector.

1263 Requirements for the isolated DC EV supply equipment for protection against electric shock
1264 hazard are defined for each system in AA.3.1, BB.2 and CC.4.1.

1265 If a large (short circuit) current occurs in the DC circuit, between DC+ and DC-, when a
1266 component or functional insulation fails, or under single fault condition, this failure and
1267 associated consequent failures shall only occur inside of a fire enclosure.

1268 In case the DC charging/discharging station can supply more than one vehicle simultaneously,
1269 independent protection means (overcurrent and fault current) for each vehicle connector shall
1270 be used in order to ensure selectivity.

1271 In addition, if the DC EV supply equipment has multiple DC outputs designed for simultaneous
1272 operation, each output circuit shall be isolated from each other by basic insulation, double or
1273 reinforced insulation.

1274 NOTE In the following countries, both isolated and non-isolated electric vehicle supply equipment and DC EV
1275 supply equipments comply with the requirements in national standards: US, CA

1276 **8.105.2 Degrees of protection against access to hazardous-live-parts**

1277 The different parts of the DC EV supply equipment as mentioned shall fulfil the following
1278 requirements:

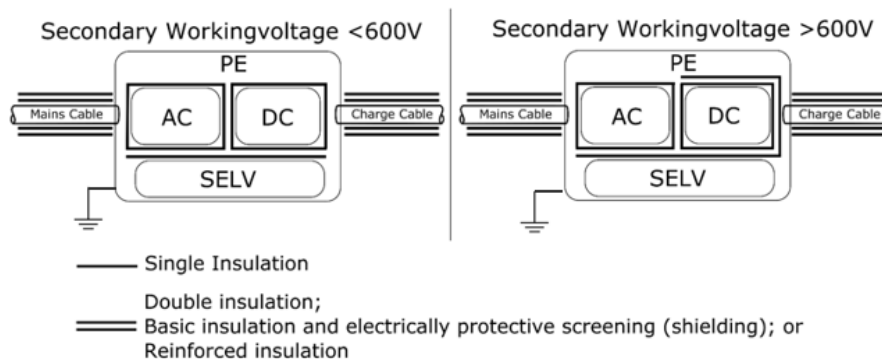
- 1279 - IP ratings for enclosures shall fulfil at least IPXXC;
1280 - vehicle connector when mated with vehicle inlet shall fulfil at least IPXXD.

1281 *Compliance is checked by inspection and measurement.*

1282 **8.105.3 Insulation barriers**

1283 Figure 114 depicts the insulation barriers within the DC EV supply equipment. Table 110
1284 defines the minimum required insulation for each barrier.

1285



(To be replaced)

Figure 114 - Insulation barriers

Table 110 – Minimum protective measures

	DC	SELV	Protective Conductor	Ordinary Person
AC	Protective	Protective	Single (A)	Protective
DC		Protective (B)	Single (< 600 V) Double (> 600 V)(C)	Protective
SELV			Functional (D)	None
PE				None

This table shows the relation of different circuits and the protection against electric shock.

Key

Single Single Insulation

Double insulation; or

Protective Basic insulation and electrically protective screening (shielding); or
Reinforced insulation

Functional Functional insulation

SELV Safety Extra Low Voltage according to IEC 62477-1, 3.51

(A) Local regulations may require double insulation. In some countries, extra monitoring of protective conductor is required when using single insulation. For some system, for example TT systems, double insulation to protective conductor is required up to the RCD, if one is installed in the DC EV supply equipment

(B) If the SELV circuit is connected to protective conductor and will not be damaged by the fault current, no hazardous voltages shall occur in the SELV circuit, and the IMD or GFD will detect the failure and trigger an error shutdown within 10 s (TBD), single insulation between DC and SELV is allowed for some components, for example: contactors.

(C) If on the secondary (DC) side, there is a circuit with a working voltage greater than 600 V, double insulation to the protective conductor is required. Additional protective measures are taken to limit the impedance to the protective conductor.

(D) SELV may be connected to the protective conductor. If SELV is floating a 500 V r.m.s. test voltage may be applied to test the insulation

NOTE Communication interfaces may have special requirements regarding isolation coordination. See IEC 60950-1 and IEC 62368-1 for their requirements.

8.105.4 Stored energy

8.105.4.1 Disconnection of plug and cable connected DC EV supply equipment

For plug and cable connected DC EV supply equipment, where the connection pins are accessible after unplugging, one second after disconnecting the standard plug from the standard socket-outlet, for instance as described in IEC TR 60083:2015 or IEC 60309-1, the voltage between any combination of accessible contacts of the standard plug shall be less

1298 than or equal to 28 V DC and 12V AC (r.m.s.) or the stored energy available shall be less than
1299 0,5 mJ.

1300 *Compliance is checked by inspection and by test with the EV disconnected according to*
1301 *2.1.1.5 of IEC 60950-1:2005.*

1302 NOTE Requirements for the EV are specified in ISO 17409.

1303

1304 **8.105.4.2 Loss of supply voltage to permanently connected DC EV supply equipment**

1305 The voltage between power lines or power lines and protective earthing conductor, when
1306 measured at the input supply terminals of the DC EV supply equipment, shall be less than or
1307 equal to 28 V DC and 12 V AC (r.m.s.) or the stored energy shall be less than or equal to 0,5
1308 mJ within 5 s after disconnecting the power supply voltage to the DC EV supply equipment.

1309 *Compliance is checked by inspection and by test with no EV connected to the DC EV supply*
1310 *equipment according to 2.1.1.7 of IEC 60950-1:2005.*

1311 **8.105.5 Disconnection from vehicle**

1312 Following requirement is applied to the vehicle connector if the voltage between any contacts
1313 exceeds 28 V DC or 12 V AC (r.m.s.) during charging.

1314 The vehicle connector shall comply with at least one of the following requirements:

1315 - The energy between any contacts shall be below 0.5mJ within 1 s after disconnection of
1316 the vehicle connector from the vehicle inlet.

1317 - The voltage between any contacts shall be below or equal to 28 V DC and 12 V AC
1318 (r.m.s.) within 1 s after disconnection of the vehicle connector from the vehicle inlet.

1319 The voltage or energy shall be measured at the unmated vehicle connector.

1320 *The test shall be performed according to the following procedure:*

1321 *[Case 1: Stop sequence and the output voltage]*

1322 1) *The DC EV supply equipment is connected to an artificial load as defined in 102.2.3.*

1323 2) *The power line is energized at the maximum output voltage.*

1324 3) *Stop charging based on the stop sequence defined by each system.*

1325 4) *Check that the voltage values between any contacts fall to less than 28 V in 1 s or less*
1326 *after disconnecting all the signal lines or the connector latch circuit. For System A, check*
1327 *that the stored energy in the output circuit of DC EV supply equipment is less than the*
1328 *value above.*

1329 *[Case 2]*

1330 *The stored energy shall be less than the defined value above. The Energy is calculated by*
1331 *using the corresponding values of capacitances determined before and the documented*
1332 *voltage 1s after triggering. See Formula (2).*

$$1333 \quad E = 0,5 \times C \times V^2 \quad (2)$$

1334 where

1335 E is the energy 1 s after triggering in Joule;

1336 C is the capacity in Farad;

1337 V is the voltage 1 s after triggering in Volt.

1338 *Compliance is checked by inspection and by the test with the EV disconnected according to*
1339 *IEC 60950-1 and IEC 62477-1.*

1340 **8.105.6 Protective earthing conductor from supply network**

1341 The protective earthing conductor and the protective conductor shall be of sufficient rating in
1342 accordance with requirements of IEC TS 61439-7.

1343 NOTE In the following countries, the size and rating of the protective earthing conductor are determined by
1344 national codes and regulations: CA, US, JP

1345 The DC EV supply equipment shall provide either:

1346 a) a protective earthing conductor from the input earthing terminal of the AC supply network
1347 to the EV

1348 or

1349 b) a protective conductor from the DC EV supply equipment to the EV if fault protection is
1350 based on electric separation.

1351 For Mode 4 permanently connected DC EV supply equipment, protective earthing conductors
1352 shall not be switched.

1353 Protection Class II DC EV supply equipment shall have a lead-through protective conductor
1354 with double insulation for earthing the EV chassis.

1355 *Compliance is checked by inspection.*

1356 **8.105.7 Residual current protective devices**

1357 DC charging/discharging stations intended for fixed installation, may rely on RCD(s)
1358 incorporated in the DC charging/discharging stations and/or provided upstream by the
1359 installation as defined in the installation manual of the DC charging/discharging station and
1360 relevant wiring diagrams.

1361 Plug and cable DC charging station shall be provided with RCD(s) within the charging station
1362 or on the cable, and double insulation to the protective conductor is required between the plug
1363 and any parts not protected by RCD(s).

1364 RCDs incorporated in charging station shall be at least of type A and comply with one of the
1365 following standards: IEC 61008-1, IEC 61009-1, IEC 60947-2 and IEC 62423.

1366 RCDs shall disconnect all live conductors.

1367 NOTE In some countries, the RCD must be located within 0,3 m of the plug of the DC charger or in the plug: US,
1368 Canada

1369 Manufacturer shall check compliance with RCDs incorporated in the charging stations, or to
1370 be provided by the installation, by simulation or calculation of current in the protective
1371 conductor under normal and single fault conditions according to the guideline provided in
1372 Annex H of IEC 62477-1:2012/Amd.1:2016.

1373 For DC charging/discharging stations intended for fixed installation the installation manual
1374 shall include information about the protective measure to be provided by the installations. If
1375 under normal and fault conditions any resulting d.c. component of the current in the protective
1376 conductor may exceed 6 mA, a caution notice and the symbol ISO 7010-W001 (2011-06) shall
1377 be provided in the installation manual, and the symbol shall be placed on the product. The
1378 caution notice shall be the following or equivalent:

1379 - "This product can cause a DC current in the protective conductor. Where a residual
1380 current-operated protective device (RCD) is used for protection against electrical shock,
1381 only an RCD of Type B is allowed on the supply side of this product." (see also 6.3.7.5
1382 and 4.4.8 of IEC 62477-1:2012/Amd.1:2016)

1383 Plug and cable DC charging stations shall always be designed such that under normal and
1384 fault conditions any resulting DC component of the current in the protective conductor never
1385 exceed 6 mA.

1386 NOTE Limitation of DC component of the current in the protective conductor can be achieved by:

1387 - double or reinforced insulation of the circuit that can cause a DC leakage current to any other circuit and
1388 protective conductor, or;

1389 - DC leakage detection that disconnects the circuit that causes excessive DC leakage current.

1390

1391 *Compliance is checked by inspecting the construction and documents provided by the*
1392 *manufacturer.*

1393 **8.105.8 Safety requirements for signalling circuits between the DC EV supply**
1394 **equipment and the EV**

1395 Any circuit for signalling, which extends beyond the DC EV supply equipment enclosure for
1396 connection with the EV (e.g. control pilot circuit), shall be extra low voltage (SELV or PELV)
1397 according to IEC 60364-4-41.

1398 **8.105.9 Protective conductor dimension cross-sectional area**

1399 The protective earthing conductor or protective conductor of the secondary circuit of DC EV
1400 supply equipment shall be designed according to 543.1 of IEC 60364-5-54.

1401 NOTE In some countries, the size and rating of the protective earthing conductor is specified in national code and
1402 regulation: US, CA

1403 The minimum diameter of the protective conductor shall be:

1404 – System A: 0,75 mm² (TBD)

1405 – System B: 10 mm² (TBD)

1406 – System C: 35 mm² (TBD)

1407 *Compliance is checked by inspection and measurement.*

1408 **9 Conductive electrical interface requirements**

1409 This clause of Part 1 is applicable except as follows:

1410 **9.1 General**

1411 *Replacement:*

1412 The physical conductive electrical interface requirements between the vehicle and the DC EV
1413 supply equipment are as defined in IEC 62196-3.

1414 **9.2 Functional description of standard accessories**

1415 *Not applicable.*

1416 **9.3 Functional description of the basic interface**

1417 *Not applicable.*

1418 **9.7 Wiring of the neutral conductor**

1419 *Not applicable except the following:*

1420 Wiring instructions shall be provided in the manual (See 17.1).

1421 *Addition:*

1422 **9.101 Avoidance of breaking under load**

1423 For DC charging, the vehicle couplers are rated "not for current interruption." A disconnection
1424 shall not take place under load.

1425 In the case of disconnection under DC load due to a fault, no hazardous condition shall occur.

1426 Avoidance of breaking under load can be achieved by a specific means on the vehicle
1427 connector or a system with interlock.

1428 *Compliance is checked by inspection and operation.*

1429 In addition to latching mechanism defined in 6.3.1.103, in case of unintended disconnection of
1430 the vehicle coupler, the output current of the DC EV supply equipment shall be turned off
1431 within a defined time to contain a possible arc within the vehicle coupler housing. This turn-off

1432 time shall comply with the value specified in Annexes AA, BB and CC, using a speed of
1433 separation of the vehicle connector of $0,8 \pm 0,1$ m/s according to IEC 60309-1.

1434 Disconnection of vehicle coupler can be detected when one of the following occurs:

- 1435 – loss of digital communication;
- 1436 – interruption of interlock circuit(s), e.g. control pilot, proximity circuit, to mitigate electrical
1437 arcing and shock hazards.

1438 *Compliance is checked by the test in 6.3.1.113.3.*

1439 The system specific requirement for breaking capacity and system redundancy are defined in
1440 AA.3.4 and AA.3.6.2 for System A, BB.5 for System B, and CC.4.3 and CC.4.4 for System C.

1441 **10 Requirements for adaptors**

1442 This clause of Part 1 is applicable.

1443 **11 Cable assembly requirements**

1444 This clause of Part 1 is applicable, except as follows.

1445 **11.7 Cable management and storage means for cables assemblies**

1446 *Addition:*

1447 For vehicle connector, a storage means shall be provided to protect the contacts of the
1448 vehicle connector at least IP44. This can be a part of the DC charger or a separately installed
1449 holder for the cable assembly and the vehicle connector.

1450 **11.7.101 Cable breakaway**

1451 The cable shall be connected to the enclosure in such a way that, if the cable anchorage fails,
1452 the conductors break in the following sequence (TBD):

- 1453 - first, the control pilot conductor/conductors;
- 1454 - second, the current carrying conductors;
- 1455 - third, the protective earthing conductor, if any.

1456 *Compliance is checked by inspecting the construction and documents provided by the*
1457 *manufacturer.*

1458 **11.7.101 Preventative maintenance program**

1459 The manufacturer shall establish and implement a preventative maintenance program for the
1460 replacement of the cable assembly following, for example, a predetermined period of time in
1461 service and/or number of charging sessions.

1462 *Compliance is checked by inspection of the program established by the manufacturer.*

1463 **12 EV supply equipment constructional requirements and tests**

1464 This clause of Part 1 is applicable except as follows:

1465 **12.1 General**

1466 *Addition:*

1467 The DC EV supply equipment shall comply with the restrictions/limitations as specified in the
1468 data sheet of the cable assembly manufacturer.

1469 *Compliance is checked by inspection.*

1470 **12.3 Clearances and creepage distances**

1471 *Replacement of the 1st paragraph:*

1472 The clearance and creepage distances in the EV supply equipment, installed as intended by
1473 the manufacturer, shall be in accordance with the requirements specified in IEC 62477-1.

1474 *Addition:*

1475 The output circuit of a DC EV supply equipment shall be designed according to a rated
1476 impulse voltage of at least 2 500 V.

1477 *Compliance is checked according to IEC 61851-1:2017, 12.7.*

1478 *Addition:*

1479 **12.3.101 Components bridging insulation**

1480 **12.3.101.1 General**

1481 Components bridging insulation shall comply with the requirements of the level of insulation
1482 (e.g. basic, reinforced or double) they are bridging.

1483 **12.3.101.2 Isolating transformers**

1484 Isolating transformers (excluding safety isolating transformers used for signalling) shall
1485 comply with the requirements of G.5.3 of IEC 62368-1, or IEC 61558-1 and IEC 61558-2-4.

1486 *Compliance is checked by inspection.*

1487 **12.4 IP degrees**

1488 *Addition:*

1489 For the DC EV supply equipment of stationary type, the test conditions can be defined in
1490 accordance with installation conditions.

1491 **12.5 Insulation resistance**

1492 *Addition:*

1493 Insulation resistance does not include components bridging insulation according to 1.5.6 and
1494 1.5.7 of IEC 60950-1:2005.

1495 NOTE The test is made without an insulation monitoring system.

1496 **12.6 Touch current**

1497 *Replacement:*

1498 This subclause defines the measurement of current through networks simulating the
1499 impedance of the human body (touch current).

1500 *Addition:*

1501 **12.6.101 Touch-current limit**

1502 The touch current between any AC supply network poles and the accessible metal parts
1503 connected with each other and with a metal foil covering insulated external parts shall not
1504 exceed the values indicated in Table 1 of Part 1.

1505 The test shall be made when the DC electric vehicle supply equipment is functioning with an
1506 artificial load according to Figure 123 at rated output power.

1507 For permanently connected Class I DC EV supply equipment, if the test touch current exceeds
1508 3.5 mA, 12.6.103 is applicable.

Circuitry which is connected through a fixed resistance or referenced to protective conductor (for example, EV connection check) should be disconnected before this test.

Compliance is checked by the test in 12.6.102.

12.6.102 Test

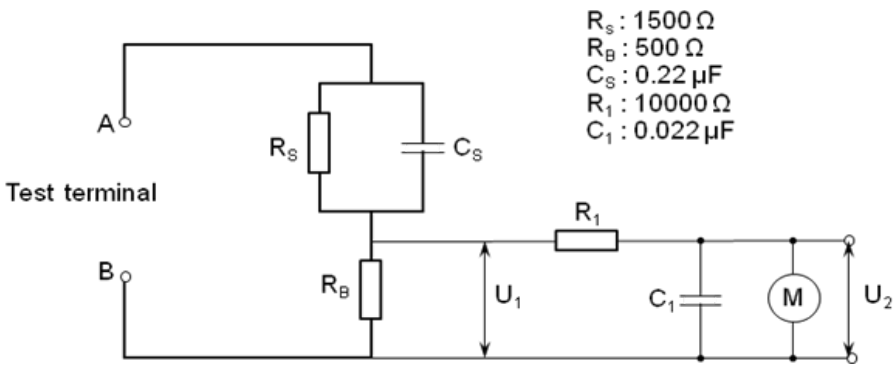
12.6.102.1 Test configuration

Test configurations for measurement of leakage current shall be according to 5.4.1 of IEC 60990:1999.

12.6.102.2 Application of measuring network

The measuring network is defined in Figure 115. Terminal A of the measuring network is connected to each conductive or unearthed accessible surface in turn. For each application of the terminal A electrode, the terminal B electrode is applied to earth, then to each of the other accessible parts in turn. All accessible conductive or unearthed surfaces are to be tested for touch currents. Figure 115 is from Figure 4 of IEC 60990:1999.

For an accessible non-conductive part, the test is made to metal foil having dimensions of 100 mm by 200 mm in contact with the part.



Key

A	terminal of the measuring network	U_1, U_2	output voltage
B	terminal of the measuring network	R_1, R_B, R_S	resistor
C_1, C_S	capacitor		measuring instrument

Figure 115 - Measuring network of touch current weighted for perception or reaction

12.6.102.3 Test condition

The touch current shall be measured after the damp heat test, with the DC EV supply equipment connected to AC supply network in accordance with clause 6 of IEC 60990:1999. The supply voltage shall be 1,1 times the nominal rated voltage.

Measurements shall be made with each of the applicable fault conditions in accordance with 6.2.2 of IEC 60990:1999.

12.6.102.4 Test measurements

The r.m.s. value of the voltage, U_2 , shall be measured using the measuring instrument in Figure 113. Formula (3) shall be used to calculate the touch current:

$$\text{TOUCH CURRENT(A)} = U_2 / 500 \tag{3}$$

None of the values measured in accordance with 12.6.102.3 shall exceed the relevant limits specified in 12.6.101.