

SLOVENSKI STANDARD oSIST prEN 50546:2019

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Železniške naprave - Vozna sredstva - Trifazni (zunanji) napajalni sistem in konektorji za železniška vozila

Railway applications - Rolling Stock - Three phase shore (external) supply system and connectors for rail vehicles

Bahnanwendungen - Fahrzeuge - Dreiphasige Fremdeinspeisung für Eisenbahnfahrzeuge

Applications ferroviaires - Matériel roulant - Systèmes d'alimentation triphasée (externe) de quai pour les véhicules ferroviaires

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ICS:

29.120.30 Vtiči, vtičnice, spojke Plugs, socket-outlets,

couplers

45.060.01 Železniška vozila na splošno Railway rolling stock in

general

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English Version

Railway applications - Rolling Stock - Three phase shore (external) supply system and connectors for rail vehicles

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This draft European Standard is submitted to CENELEC members for enquiry. Deadline for CENELEC: 2019-06-28.

It has been drawn up by CLC/SC 9XB.

If this draft becomes a European Standard, CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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European Committee for Electrotechnical Standardization Comité Européen de Normalisation Electrotechnique Europäisches Komitee für Elektrotechnische Normung

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European foreword

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- 254 This document [prEN 50546:2019] has been prepared by CLC/SC 9XB, "Electrical, electronic and electromechanical material on board rolling stock, including associated software".
- 256 This document is currently submitted to the Enquiry.
- 257 The following dates are proposed:
 - latest date by which the existence of this document has to be announced at national level
- (doa) dor + 6 months

(dop)

dor + 12 months

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement
 - latest date by which the national standards conflicting with this document have to be (to be confirmed or withdrawn modified when voting)
- 258 This document will supersede CEN/TS 50546:2013.
- prEN 50546:2019 includes the following significant technical changes with respect to CEN/TS 50546:2013:
- 260 a) Revision of Clause 1, Scope;
- 261 b) Revision of Clause 2, Normative references;
- 262 c) Revision of Clause 3, Terms, definitions and abbreviations, with reorganization of definitions;
- d) Revision of Clause 4, General requirements, to include reference to connectors and associated shore side requirements;
- 265 e) Introduction of new Clause 5, Classification;
- 266 f) Introduction of new Clause 6, Connector requirements;
- 267 g) Introduction of new Clause 7, Tests;
- 268 h) Introduction of the following mandatory Annexes:
- 269 1) Annex A, Connector design 63 A/ 125 A;
- 270 2) Annex B, Connector design 600 A;
- 271 i) Bibliography, revised and corrected.
- This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directives(s).
- For the relationship with Directive 2008/57/EC amended by Commission Directive 2011/18/EU, see informative Annex ZZ, which is an integral part of this document.

Introduction

This standardization project was derived from the EU-funded Research project MODTRAIN (MODPOWER). It is part of a series of standards, referring to each other. The hierarchy of the standards is intended to be as set out in Figure 1:

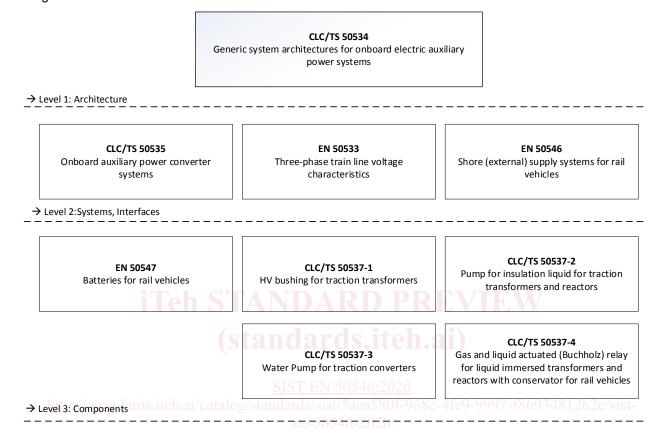


Figure 1 — Overview on the technical framework CLC/TS 50534 defines the basis for other dependent standards

The shore supply system is used within depots and sidings for providing power to the auxiliary electrical supply (which may include battery charging) when the primary power supply is not available, and the train is static (0 km/h). This document defines connectors that are intermateable to provide interoperability for rolling stock to run across borders and be charged in locations other than their normal depot or sidings location.

The connectors are dimensioned using standard rolling stock cables as set out in EN 50264-3-1.

This document provides the requirements for compatibility of systems defined and good practice for three phase + Neutral AC 400 V/50 Hz shore (external) supply systems. It focuses on describing the defined interfaces regarding electrical power supply in stations, depots/workshops and stabling points into the rail vehicle.

This document provides recommended characteristics of power supply and the interface drawings for the shore supply connectors. The interface drawings are supplied to provide intermateability and interoperability of connectors. The fixed connector is provided with a protective cover to prevent any ingress when the connector is not in use.

Two connectors have been specified in this document. The first is suitable for either 63 A or 125 A shore supplies. The second is suitable for 600 A shore supplies. The 600 A connector is the existing UK standard three-phase shore supply connector which has a long service history.

The contacts in the connector have each been assigned a phase.

300 **1 Scope**

- 301 The scope of this document is to define requirements for the shore supply system for auxiliaries and pre-
- 302 conditioning and the related intermateable connector pairs.
- 303 Shore supplies to move the rolling stock are outside the scope of this document.

304 2 Normative references

- 305 The following documents are referred to in the text in such a way that some or all of their content constitutes
- 306 requirements of this document. For dated references, only the edition cited applies. For undated references,
- the latest edition of the referenced document (including any amendments) applies.
- 308 EN 45545-2, Railway applications Fire protection on railway vehicles Part 2: Requirements for fire
- 309 behaviour of materials and components
- 310 EN 50122 (all parts), Railway applications Fixed installations Electrical safety, earthing and the return
- 311 circuit
- 312 EN 50124-1:2017, Railway applications Insulation coordination Part 1: Basic requirements Clearances
- 313 and creepage distances for all electrical and electronic equipment
- 314 EN 50125 (all parts), Railway applications Environmental conditions for equipment
- 315 EN 50153, Railway applications Rolling stock Protective provisions relating to electrical hazards
- 316 EN 50160, Voltage characteristics of electricity supplied by public electricity networks
- 317 EN 50264-3-1, Railway applications Railway rolling stock power and control cables having special fire
- 318 performance Part 3-1: Cables with crosslinked elastomeric insulation with reduced dimensions Single core
- 319 cables
 - https://standards.iteh.ai/catalog/standards/sist/5aea580f-968c-4fe9-9997-f86934812b2c/sist
- 320 EN 50467:2011, Railway applications Rolling stock Electrical connectors, requirements and test methods
- 321 EN 50533:2011¹, Railway applications Three-phase train line voltage characteristics
- 322 EN 60512-1-4, Electromechanical components for electronic equipment Basic testing procedures and
- 323 measuring methods Part 1: General Section 4: Test 1d: Contact protection effectiveness (scoop-proof)
- 324 (IEC 60512-1-4)
- 325 EN 60512-1-100, Connectors for electronic equipment Tests and measurements Part 1-100: General –
- 326 Applicable publications (IEC 60512-1-100)
- 327 EN 60529, Degrees of protection provided by enclosures (IP Code) (IEC 60529)
- 328 EN 61373:2010, Railway applications Rolling stock equipment Shock and vibration tests (IEC 61373:2010)
- 329 EN ISO 4892-2, Plastics Methods of exposure to laboratory light sources Part 2: Xenon-arc lamps
- 330 (ISO 4892-2)
- 331 ISO 1431-1, Rubber, vulcanized or thermoplastic Resistance to ozone cracking Part 1: Static and dynamic
- 332 strain testing

¹ Currently impacted by EN 50533:2011/A1:2016.

333	3	Terms and definitions
334	For	the purposes of this document, the following terms and definitions apply.
335	ISC	and IEC maintain terminological databases for use in standardization at the following addresses:
336	•	IEC Electropedia: available at http://www.electropedia.org/
337	•	ISO Online browsing platform: available at http://www.iso.org/obp
338 339 340 341	per	mped connection manent connection made by the application of pressure inducing the deformation or reshaping of the barrel and the conductor of a cable
342	Not	e 1 to entry: In some cases, the deformation or reshaping of the barrel may affect the form of the conductor.
343	[SC	DURCE: IEC 60050-461:2008, 461-19-01]
344 345 346		nnector ctrical device providing connection and disconnection to a suitable mating component
347	Not	e 1 to entry: A connector has one or more contact elements.
348	Not	e 2 to entry: In this document a connector is a connector without breaking capacity.
349	[SC	DURCE: IEC 60050-581:2008, 581-26-01, modified –Note 2 to entry was added.]
350 351 352 353	CO	nnector without breaking capacity (C (abbreviation) Innector which is not allowed to be engaged or disengaged in normal use when live or under load backsister.
354	[SC	OURCE: IEC 60050-581:2008, 581-27-73]
355 356 357		e connector nnector for attachment to a free end
358	[SC	DURCE: IEC 60050-581:2008, 581-26-10]
359 360 361		ed connector nnector for attachment to a rigid surface
362	[SC	DURCE: IEC 60050-581:2008, 581-26-07]
363 364 365		ore supply connector nnector dedicated to the shore supply system
366 367 368 369	cor	ntact inductive element in a connector (including means for a cable termination) that mates with a corresponding ment to provide an electric path
370	[SC	DURCE: EN 50467:2011, 3.8]

371 372 373	3.8 male contact pin contact
374 375	contact element intended to make electric engagement on its outer surface for mating with the inner surface of another contact element
376	[SOURCE: IEC 60050-581:2008, 581-22-08]
377 378 379 380 381	3.9 female contact socket contact contact element intended to make electric engagement on its inner surface for mating with the outer surface of another contact element
382 383	Note 1 to entry: In English, the term "socket contact" does not imply that socket contacts are always mounted in a socket (151–12–20) nor that sockets have only socket contacts.
384	[SOURCE: IEC 60050-581:2008, 581-22-06]
385	3.10
386 387 388 389	interlock <electrical> device, which prevents the contacts of a connector from becoming live before it is in proper engagement with its counterpart, and which either prevents the connector from being withdrawn while its contacts are live or makes the contact dead before separation</electrical>
390 391	[SOURCE: IEC 60050-581:2008, 581-27-48, modified – specific usage was added and 'either electrical or mechanical' was deleted.]
392	(standards.iteh.ai)
393 394	locking device feature incorporated in certain components to provide mechanical retention of their mating part
395	https://standards.iteh.ai/catalog/standards/sist/5aea580f-968c-4fe9-9997-f86934812b2c/sist- [SOURCE: IEC 60050-581:2008, 581-23-22]50546-2020
396	3.12
397 398	cycle of (connector) operation <mating cycles=""> one insertion and one withdrawal of the connector halves</mating>
399	[SOURCE: IEC 60050-581:2008, 581-21-06]
400	3.13
401 402	clearance shortest distance in air between two conductive parts
403	[SOURCE: IEC 60050-581:2008, 581-27-76]
404	3.14
405 406	creepage distance shortest distance along the surface of a solid insulating material between two conductive parts
407	[SOURCE: IEC 60050-581:2008, 581-21-23]

409 410	3.15rated voltage (U)<connector> value of voltage assigned to the connector and to which operation and performance characteristics are referred</connector>
	[SOURCE: IEC 60050-442:2014, 442-09-10, modified – specific usage was added, and 'assigned by the manufacturer to a component, device or equipment' and notes were deleted.]
415 416	3.16 rated impulse voltage (U_{Ni}) <connector> impulse voltage value assigned to the connector, characterizing the specified withstand capability of its insulation against transient overvoltages</connector>
418	Note 1 to entry: U_{Ni} is higher than or equal to the working peak voltage.
	[SOURCE: EN 50124-1:2017, 3.4.7, modified – 'by the manufacturer to the equipment or a part of it' was replaced with 'to the connector'.]
422 423	3.17 impulse withstand voltage highest peak value of impulse voltage of prescribed form and polarity which does not cause breakdown of insulation under specified conditions
425	[SOURCE: IEC 60050-442:2014, 442-09-18]
427 428	3.18 rated (connector) current value of the electric current in a connector used for specification purposes, established for the operating condition in which the electric current is present continuously
431	[SOURCE: IEC 60050-581:2008, 581-21-05, modified – 'and simultaneously in all contacts of the connector being wired with the largest specified conductor, while the ambient temperature near the connector is maintained at 40 °C' and notes were deleted.]
434	3.19 shore supply connection system complete system consists of the fixed connector, the free connector and the associated cables
437 438	3.20 intermateable pertaining to each of two components when they feature identical dimensions for electrical and dimensional interfaces
440	[SOURCE: IEC 60050-581:2008, 581-24-07]
442	3.21 pilot contact control contact specifically made for safety functions
445	3.22 coding contact control contact for the system to know which current is available from the shore (external) supply

4 General requirements

448 4.1 Functional description

- Shore (external) supply systems have the following main functions:
- 450 feed the auxiliary electrical equipment on board railway vehicles from an external power source;
- 451 ensure safety during operation of shore (external) supply systems;
- 452 ensure that the connecting and disconnecting operations take place under conditions of zero current;
- ensure that movement of the rolling stock is not possible when the shore (external) power supply is physically connected.

455 **4.2 System requirements**

456 **4.2.1 General**

- The rolling stock side of the system consists of the fixed connector and the associated controls and protection
- 458 devices

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- The functional requirements of the rolling stock are set out in EN 50533:2011, Clause 5.
- 460 The shore side of the system consists of the free connector, connector stowage location, cable and power
- 461 supply with its associated control and protection devices.
- The functional requirements of the shore (external) supply system are set out in EN 50160.
- 463 4.2.2 Supply voltages for the shore supply system
- 464 Supply voltage range is:
- 465 3 AC + Neutral 400 V/50 Hz voltage range ± 10 % 55000 68624 690 9907 4869348 12626/5151
- 466 Full characteristics of the shore supply are set out in EN 50533:2011, Clause 5, and EN 50160.
- The phases and neutral are assigned to contacts as set out in the connector drawings in Annex A.
- 468 For DC railways, the earthing arrangements as set out in the EN 50122 series shall be considered.
- The installer of the shore side (infrastructure) system shall connect any earths provided on the free connector
- 470 to the earth of the shore side (infrastructure) system.
- 471 4.2.3 Power limitation

472 4.2.3.1 Current ratings for the shore supply system

- 473 The maximum external supply power for one infeed point is limited to the values specified in Table 1.
- 474 NOTE The pilot and control contacts are not rated for these currents.
- The breaking capacity of the pilot contacts shall be 110 V DC, 2 A minimum.

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Table 1 — Shore supply power ratings

Type of socket	Rated operating current (continuous load at an ambient temperature of 20 °C)	Remarks
3 AC 400 V/50 Hz	600 A per phase	400 kW High power system
3 AC + Neutral 400 V/50 Hz	125 A per phase	86 kW Medium power system
3 AC + Neutral 400 V/50 Hz	63 A per phase	44 kW Low power system

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4.2.3.2 Current restriction on the rolling stock system

For the 63 A/125 A connector, the rolling stock shall be able to read the shore supply current through the coding contacts, as set out in 6.8.2.2, and control the onboard systems such that only 63 A is drawn, without damage to the onboard equipment, when only 63 A is available from the shore side (infrastructure) system.

NOTE This could be done by including a load shed mode for the shore (external) supply system.

4.2.4 Emergency cut-off switch

All shore (external) supply systems shall be equipped with a clearly visible and readily identifiable emergency cut-off switch to disconnect the power supply. This emergency cut-off switch shall be coloured red.

The emergency cut-off switch shall be part of the shore side (infrastructure) system.

4.2.5 Earth fault system

An earth fault system shall be provided to ensure that:

- when an earth fault is detected on the rolling stock, the system prevents energization of the shore supply via the pilot contacts;
- if energized the shore supply system shall operate the protection on detection of an earth fault on the rolling stock.

NOTE An earth fault can be detected in some cases due to leakage currents caused by EMC filters. Therefore, an adaptive residual current circuit breaker or a short-time suppression of the earth fault detection can be used to avoid this operational condition.

4.2.6 Energization of system

The fixed connector mounted on the vehicle shall not be energized from the onboard auxiliary electrical supply.

4.2.7 Shore side (infrastructure) system

4.2.7.1 Energization conditions

Electrical parts of the free (infrastructure) connector shall be de-energized when the shore (external) supply system is not in use.

- The shore side system shall include a visible indication when the system is live.
- 504 NOTE The indication does not have to be on the connector.

4.2.7.2 Stowage of connector

- The shore side (infrastructure) system shall include a stowage location for the free connector when not in use.
- The stowage system shall provide an indicator that shows when the shore supply is connected and supplying
- 508 power to the rolling stock, when it is not stowed and when it is safely stowed.
- The indicator to show that the shore supply is connected and supplying power to the rolling stock may be the
- same as the one to show that the shore supply system is live.
- 511 The stowage device should be located such that the indicator is visible from the rolling stock connector
- location and the length of cable is minimized.
- 513 It is recommended that the stowage location is mounted at an angle to match the connection to the fixed
- 514 connector and reduce the risk of water ingress.
- 515 4.2.8 Disconnection under load
- 516 The system shall be designed so that pilot contacts (contacts c and d) are last make and first break. The
- 517 system shall only be energized when the pilot contacts are fully mated. The pilot contacts are defined in
- 518 6.8.2.1.

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- The shore supply connectors shall have a locking device using the locking pins as set out in Annex A.
- 520 4.2.9 Overload protection
- Overload protection shall be provided on the shore (external) power supply that considers the inrush current
- and starting characteristics of the railway vehicle auxiliary loads, particularly on high power auxiliary systems.
- 523 4.2.10 Traction and brake interlock
- A system shall be provided to ensure that movement of the rolling stock is not possible when the shore
- 525 (external) power supply is connected.
- 526 **4.2.11 Cables**

- SIST EN 50546:2020
- 527 The cables used shall meet the requirements set out in EN 50264-3-1 for both the rolling stock and shore side
- 528 (infrastructure) system (connection between supply unit and rolling stock).
- 529 This provides performance compatibility and interoperability for the connectors.
- 530 NOTE The connectors are dimensioned based on the sizes of the standard railway cables.
- 531 **4.3 Installation Mounting of fixed connector**
- Where the fixed connector is mounted in location 4, the connector shall be mounted at an angle to prevent
- water ingress.
- 534 It is recommended that the shore supply connector is accessible from track level to allow for interoperability
- with the common shore side (infrastructure) system locations.
- 536 5 Classification
- 537 **5.1 General**
- The shore supply connector shall comply with EN 50467 unless otherwise specified in this document.
- 539 5.2 Intended use of rolling stock
- 540 The shore supply connectors may be used on different rolling stock types for example mass transit
- underground, mass transit and high-speed passenger trains, locomotives, or non-passenger freight trains.