

INFORMATIVE TRANSLATION OF EXECUTIVE ORDER no 1465, DATED 5
DECEMBER 2016

Please note that this English version is for informational purposes only. Where the wording in the Danish and English versions may conflict, the Danish version prevails.

Order no. 1465 dated 5 December 2016 on the technical compatibility of vehicles with the railway network¹⁾

The following is laid down by virtue of § 56, § 60, paragraph 3, § 64, paragraph 1, and § 102, paragraph 1 of jernbaneloven [the Railways Act] (Act No 686 of 27 May 2015) and by authorisation under § 112, paragraph 1 of said Act:

Scope

§ 1. This Order lays down provisions on technical compatibility requirements for:

- a) vehicles that must be approved for use on the Danish portion of the railway network that is covered by Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community (hereinafter called the Interoperability Directive), with subsequent amendments, as implemented by Order No 1281 of 19 November 2015 on the interoperability of the rail system.
- b) Thermal traction vehicles and vehicles without their own traction that are to run on both the railway network and the 'S-banen'.

Definitions

§ 2. For the purposes of this Order, the terms below shall have the following meanings:

- 1) A-regulation: Other countries' regulations or international standards which are equivalent to the corresponding Danish requirements and which are categorised as an A-regulation by the Interoperability Directive, Article 27, paragraph 1. The A-regulations are made public in, inter alia, the RDD (Reference Document Database).
- 2) Notified bodies: The bodies tasked with assessing conformity or suitability for use of interoperability constituents and with conducting the EC verification procedure for the subsystems.
- 3) First authorisation: An approval in accordance to Danish Transport, Construction and Housing Authority's Executive Order on approval of railway vehicles, where Denmark is the first country where the vehicle will be placed into service.
- 4) Compatibility certificate: The certificate issued by the designated body as documentation that a vehicle is compatible with the network. The compatibility certificate covers all of the vehicle's structural subsystems.

¹ This Order has been notified as a draft in accordance with Directive 2015/1535/EU of the European Parliament and Council (the Information Procedure Directive).

- 5) Vehicle: A rail vehicle with or without motive power and which runs on its own wheels on a railway section. A vehicle consists of one or more structurally or functionally defined subsystems or parts of such subsystems.
- 6) Notified national technical regulations: The national technical regulations which Denmark – pursuant to the Interoperability Directive, Article 17, paragraph 3 – has notified to the European Commission.
- 7) Statement of Cross Acceptance: A statement prepared in conformity with the Memorandum of Understanding, version 1.0, dated 8 March 2016, which is used to document that rules have been applied which are equivalent to Danish rules.
- 8) Additional authorisation: An authorisation issued by the Danish Transport, Construction and Housing Authority, where the vehicle already is authorised in another country, and subsequently shall be placed into service in Denmark.
- 9) Technical compatibility: A vehicle's technical compatibility with the infrastructure at the network level. Route-specific conditions are not included in the verification of technical compatibility.
- 10) CCS TSI 2016/919/EU: Commission Regulation (EU) 2016/919 of 27 May 2016 on the technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union.
- 11) LOC & PAS TSI 2011/291/EU: Commission Decision of 26 April 2011 concerning a technical specification for interoperability relating to the rolling stock subsystem – 'Locomotives and passenger rolling stock' of the trans-European conventional rail system (OJ 2011 L 139, p. 1–151), as implemented by Order No 1190 of 12 December 2011 on locomotives and passenger rolling stock used on the Danish railway network.
- 12) LOC & PAS TSI 1302/2014/EU: Commission Regulation (EU) No 1302/2014 of 18 November 2014 concerning a technical specification for interoperability relating to the 'rolling stock – locomotives and passenger rolling stock' subsystem of the rail system in the European Union.
- 13) WAG TSI 2006/861/EC: Commission Decision of 28 July 2006 concerning the technical specification of interoperability relating to the subsystem 'rolling stock — freight wagons' of the trans-European conventional rail system (2006/861/EC), as subsequently amended.
- 14) WAG TSI 321/2013/EU: Commission Regulation (EU) No 321/2013 of 13 March 2013 concerning the technical specification for interoperability relating to the subsystem 'rolling stock – freight wagons' of the rail system in the European Union and repealing Decision 2006/861/EC.
- 15) Open points: Points that relate to topics that are identified as important, but are not included in a TSI.
- 16) Designated bodies: The bodies tasked with assessing vehicle conformity with notified national technical regulations.

§ 3. In order for a designated body (see § 2, No 16) to issue a compatibility certificate, it must verify that the vehicle or vehicle series in question meets the requirements in Annex 1. The designated body uses the following columns in Annex 1:

- 1) If the vehicle is verified by a notified body according to LOC & PAS TSI 2011/291/EU, then column 1 is used.
- 2) If the vehicle is verified by a notified body according to LOC & PAS TSI 2014/1302/EU, then column 2 is used.
- 3) If the vehicle is verified by a notified body according to WAG TSI 2006/861/EC, then column 3 is used.
- 4) If the vehicle is verified by a notified body according to WAG TSI 321/2013/EU, then column 4 is used.
- 5) If the vehicle is to be verified according to EN 14033-1:2011 on technical requirements for running, then column 5 is used.
- 6) In other cases, column 6 is used.

Paragraph 2. No additional controls of the relevant parameter are to be carried out in cases where either a foreign approval cites A-regulations or a Statement of Cross Acceptance documents compliance with A-regulations for the given Annex 1 parameter.

Paragraph 3. A type examination certificate shall be prepared in accordance with Module SB, or a design examination certificate according to module SH1, as documentation of compliance with the requirements of Annex 1 at the type level. The compatibility certificate must then be prepared on the basis of the type examination certificate cf. Module SD or SF; or on the basis of the design examination certificate cf. module SH1. The modules are described in Commission Decision 2010/713/EU of 9 November 2010 on modules for the procedures for assessment of conformity, suitability for use and 'EC' verification to be used in the technical specifications for interoperability adopted under Directive 2008/57/EC of the European Parliament and of the Council.

Closing of open points

Closing of open points in LOC & PAS TSI

§ 4. The Order closes the following open points in LOC & PAS TSI 2011/291/EU (see Annex 1):

- 1) Point 4.2.3.4.3.2 (equivalent conicity).
- 2) Point 4.2.4.8.3 (eddy current brakes).
- 3) Point 4.2.6.2.5 (effect of cross winds).
- 4) Point 4.2.8.2.9.4.2 (contact piece material).

5) Point 4.2.8.2.9.10 (lowering of pantograph).

§ 5. The Order closes the following open point in LOC & PAS TSI 1302/2014/EU (see Annex 1):

1) Point 4.2.4.8.3 (eddy current brakes).

§ 6. The Order closes the following open point in CCS TSI 2016/919/EU (see Annex 1):

1) Point 4.2.1.2, item 1 (reliability and availability).

Commencement provision and transitional provision

§ 7. This Order shall enter into force on 01 January 2017.

Paragraph 2. Order No 1127 of 30 November 2012 on the technical compatibility of vehicles with the railway network is repealed.

Paragraph 3. Compatibility certificates issued prior to the effective date of the Order will remain valid in accordance with their content.

Danish Transport and Construction Agency,

Carsten Falk Hansen

/Leif Funch

Technical compatibility regulations for vehicles used on the rail network

(The designated body checks the requirements in the white boxes)

	1	2	3	4	5	6
Compatibility points named and numbered per the parameter list in Commission Implementing Decision (EU) 2015/2299 of 17 November 2015 amending Decision 2009/965/EC	National regulations for vehicles verified according to LOC & PAS TSI 2011/291/EU	National regulations for vehicles verified according to LOC & PAS TSI 1302/2014/EU	National regulations for freight wagons verified according to WAG TSI 2006/861/EF	National regulations for freight wagons verified according to WAG TSI 321/2013/EU	National regulations for on-track machines by application of EN 14033-1:2011	National regulations for the approval of vehicles that do not fall under columns 1 through 5
1. General documentation						
1.1 General documentation	LOC & PAS TSI 2011/291/EU, Section 4.8.	LOC & PAS TSI 1302/2014/EU, Section 4.8.	WAG TSI 2006/861/EC, Section 4.8.2.	WAG TSI 321/2013/EU, Section 4.8.	There shall be a completed form: "Vehicle characteristics", cf. Annex 2.	There shall be a completed form: "Vehicle characteristics", cf. Annex 2.
2. Structure and mechanical parts						
2.1.2.1 Load conditions and weighted mass	LOC & PAS TSI 2011/291/EU, Section 4.2.2.10.	LOC & PAS TSI 1302/2014/EU, Section 4.2.2.10.	WAG TSI 2006/861/EC, Section 4.2.3.2.	WAG TSI 321/2013/EU, Section 4.2.3.2.	EN 14033-1:2011, Section 7.6.	The vehicle's maximum weight per meter and the setting conditions are to be specified in the technical documentation.
2.1.2.2 Axle load and wheel load	LOC & PAS TSI 2011/291/EU, Section 4.2.3.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.2.	WAG TSI 2006/861/EC, Section 4.2.3.2.	WAG TSI 321/2013/EU, Section 4.2.3.2.	EN 14033-1:2011, Section 7.3, Table 2.	The vehicle's maximum axle load and the setting conditions are to be specified in the technical documentation.
3. Track interaction and gauging						

3.1. Vehicle gauge	LOC & PAS TSI 2011/291/EU, Section 4.2.3.1.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.1.	WAG TSI 2006/861/EC, Section 4.2.3.1.	WAG TSI 321/2013/EU, Section 4.2.3.1.	EN 14033-1:2011, Section 5.1.	The vehicle's kinematic profil may not exceed the kinematic reference line in Annex 3. The kinematic profil shall be calculated according to UIC 505-1, ed, 10 th of May 2006 or EN15273-1:2013, EN15273-2:2013, and EN15273-3:2013.
3.2.1 Running safety and dynamics	LOC & PAS TSI 2011/291/EU, Section 4.2.3.4.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.4.	WAG TSI 2006/861/EC, Section 4.2.3.4.	WAG TSI 321/2013/EU, Section 4.2.3.5.	EN 14033-1:2011, Chapter 8.	Safety against derailment when running on distorted track as well as dynamic properties while running shall be verified. The following standards are accepted: EN 14363:2016 or UIC 518, 4th ed. 2009.
3.2.2 Equivalent conicity	Regulation for open point 4.2.3.4.3.2 in LOC & PAS TSI 2011/291/EU: Equivalent conicity in-service values: For first authorisations, this point shall be documented using the instructions in LOC & PAS TSI 1302/2014/EU, Section 4.2.3.4.3.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.4.3.2.	WAG TSI 2006/861/EC, Section 4.2.3.4.	WAG TSI 321/2013/EU, Section 4.2.3.6.	For first authorisations, this point shall be documented using the instructions in LOC & PAS TSI 1302/2014/EU, Section 4.2.3.4.3.2.	For first authorisations, this point shall be documented using the instructions in LOC & PAS TSI 1302/2014/EU, Section 4.2.3.4.3.2.
3.2.3 Wheel profile and limits	LOC & PAS TSI 2011/291/EU, Section 4.2.3.4.3.1.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.4.3.1.	WAG TSI 2006/861/EC, Section 4.2.3.4.	WAG TSI 321/2013/EU, Section 4.2.3.6.	EN 14033-1:2011, Section 7.4.	Wheel profile limits: Shall comply with EN 13715:2006+A1:2010 or UIC 510-2, 4th ed. 2004.
3.2.4 Track loading compatibility parameters	LOC & PAS TSI 2011/291/EU, Section 4.2.3.4.2.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.4.2.2.	WAG TSI 2006/861/EC, Section 4.2.3.4.	WAG TSI 321/2013/EU, Section 4.2.3.5.2 and Appendix B.	EN 14033-1:2011, Chapter 8.	a) Track forces shall, based on measurements at the type level, comply with the criteria from UIC 518, 4th ed., 2009, or EN 14363:2016. b) Cant deficiency in mm (maximum uncompensated lateral acceleration) for which the vehicle is assessed shall be documented.

3.2.5 Minimum horizontal curve radius, vertical concave curve radius, convex curve radius	LOC & PAS TSI 2011/291/EU, Section 4.2.3.6	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.6.	WAG TSI 2006/861/EC, Section 4.2.	WAG TSI 321/2013/EU, Section 4.2.3.1.	EN 14033-1:2011, Annex B.	The minimum horizontal curve radius that the vehicle must be able to run on is 150 m.
3.3.2 Wheelset (complete)	LOC & PAS TSI 2011/291/EU, Section 4.2.3.5.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.5.2.	WAG TSI 2006/861/EC, Section 4.2.3.3.	WAG TSI 321/2013/EU, Section 4.2.3.6.	EN 14033-1:2011, Chapter 7.	The distance between wheels on a single axle shall be in accordance with UIC 510-2, ed. 4, 2004 or EN 13260:2009+A1:2010 for 1435 mm track gauge.
3.3.6 Bearings on the wheelset	LOC & PAS TSI 2011/291/EU, Section 4.2.3.5.2.1.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.5.2.1.	WAG TSI 2006/861/EC, Annex K.	WAG TSI 321/2013/EU, Section 4.2.3.6.5.	For first authorisations, vehicles shall meet the requirements on establishment of axle bearing temperature limits as set out in LOC & PAS TSI 1302/2014/EU, Section 4.2.3.5.2.1.	For first authorisations, vehicles shall meet the requirements on establishment of axle bearing temperature limits as set out in LOC & PAS TSI 1302/2014/EU, Section 4.2.3.5.2.1.
4. Braking						
4.7.3 Magnetic track brake	LOC & PAS TSI 2011/291/EU, Section 4.2.4.8.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.4.8.2.	Not relevant for freight wagons.	Not relevant for freight wagons.	If magnetic track brakes are fitted, then they must comply with UIC 541-06, 2nd edition, 2013.	If magnetic track brakes are fitted, then they must comply with UIC 541-06, 2nd edition, 2013.
4.7.4 Eddy current rail brake	Regulation for open point 4.2.4.8.3 in LOC & PAS TSI 2011/291/EU: Eddy current brakes may not be used in Denmark. It shall be documented that the system can be disconnected.	Regulation for open point 4.2.4.8.3 in LOC & PAS TSI 1302/2014/EU: Eddy current brakes may not be used in Denmark. It shall be documented that the system can be disconnected.	Not relevant for freight wagons.	Not relevant for freight wagons.	Eddy current brakes may not be used in Denmark. It shall be documented that the system can be disconnected.	Eddy current brakes may not be used in Denmark. It shall be documented that the system can be disconnected.
5. Passenger-related items						
6. Environmental conditions and aerodynamic effects						

6.1.2.1 Effect of cross winds	Regulation for open point 4.2.6.2.5 in LOC & PAS TSI 2011/291/EU: For first authorisations, the requirements for assessment methods in LOC & PAS TSI 1302/2014/EU, Section 4.2.6.2.4 shall be followed.	LOC & PAS TSI 1302/2014/EU, Section 4.2.6.2.4.	No requirements.	No requirements.	No requirements.	For first authorisations, the requirements for assessment methods in LOC & PAS TSI 1302/2014/EU, Section 4.2.6.2.4 shall be followed.
7. External warning, signalling, marking functions and software integrity requirements						
7.2.2.1 Headlights	LOC & PAS TSI 2011/291/EU, Section 4.2.7.1.1.	LOC & PAS TSI 1302/2014/EU, Section 4.2.7.1.1.	Not relevant for freight wagons.	Not relevant for freight wagons.	EN 14033-1:2011, Section 13.2.	For first authorisations, headlights shall meet the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.7.1.1.
7.2.2.2 Marker lights	LOC & PAS TSI 2011/291/EU, Section 4.2.7.1.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.7.1.2.	Not relevant for freight wagons.	Not relevant for freight wagons.	EN 14033-1:2011, Section 13.2.	For first authorisations, marker lights shall meet the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.7.1.2.
7.2.2.3 End-of-train signal	LOC & PAS TSI 2011/291/EU, Section 4.2.7.1.3.	LOC & PAS TSI 1302/2014/EU, Section 4.2.7.1.3.	WAG TSI 2006/861/EC, Section 4.2.7.4.	WAG TSI 321/2013/EU, Section 4.2.6.3.	EN 14033-1:2011, Section 13.2.	For first authorisations, tail lights shall meet the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.7.1.3.
7.2.3 Audible signal systems	LOC & PAS TSI 2011/291/EU, Section 4.2.7.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.7.2	Not relevant for freight wagons.	Not relevant for freight wagons.	EN 14033-1:2011, Section 13.1.	For first authorisations, the audible signal system shall meet the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.7.2. For additional authorisations, a horn installed in accordance with UIC 644, 2nd edition, 1980 are also acceptable.
8. On-board power supply and control systems						

8.2.1.4 Maximum power and maximum train current that is permissible to drawn from the overhead contact line	LOC & PAS TSI 2011/291/EU, Section 4.2.8.2.4.	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.4.	Not relevant for freight wagons.	Not relevant for freight wagons.	Current limiting equipment shall be installed and set such that the vehicle can drawn a maximum of 500 A continuous ($t > 1s$) and a maximum of 80 A when stationary.	Current limiting equipment shall be installed and set such that the vehicle can drawn a maximum of 500 A continuous ($t > 1s$) and a maximum of 80 A when stationary.
8.2.2.2 Pantograph head geometry	LOC & PAS TSI 2011/291/EU, Section 4.2.8.2.9.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.2.	Not relevant for freight wagons.	Not relevant for freight wagons.	For first authorisations, LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.2 shall be applied. For additional authorisations, the pantograph geometry and mechanical construction shall be of type: UIC 608:2003, Appendix D or EN 50367:2012, Fig. A7 (width 1950 mm) or Fig. A6 (1600 mm), and in accordance with EN 50206.	For first authorisations, LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.2 shall be applied. For additional authorisations, the pantograph geometry and mechanical construction shall be of type: UIC 608, 3rd edition, 2003, Appendix D or EN 50367:2012, Fig. A7 (width 1950 mm) or Fig. A6 (1600 mm), and in accordance with EN 50206.
8.2.2.3 Pantograph contact force (including static contact force, dynamic behaviour, and aerodynamic effects)	LOC & PAS TSI 2011/291/EU, Section 4.2.8.2.9.5+6.	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.5+6.	Not relevant for freight wagons.	Not relevant for freight wagons.	For first authorisations, LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.5+6 shall be applied. For additional authorisations, the pantograph dynamic contact force must have an average value of less than 120 N and may not exceed 200 N. It must be possible to set the static contact force to 70 N. The difference between the contact force from several contact paths must lie within $\pm 20\%$. Measurements and validations must be in accordance with EN 50317:2012 or EN 50318:2012.	For first authorisations, LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.5+6 shall be applied. For additional authorisations, the pantograph dynamic contact force must have an average value of less than 120 N and may not exceed 200 N. It must be possible to set the static contact force to 70 N. The difference between the contact force from several contact paths must lie within $\pm 20\%$. Measurements and validations must be in accordance with EN 50317:2012 or EN 50318:2012.

8.2.2.4 Working range of pantographs	LOC & PAS TSI 2011/291/EU, Section 4.2.8.2.9.1.	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.1.	Not relevant for freight wagons.	Not relevant for freight wagons.	The pantograph is to at minimum be designed for contact wire heights from 4,9 to 6,0 m.	The pantograph is to at minimum be designed for contact wire heights from 4,9 to 6,0 m.
8.2.2.8 Pantograph lowering	Regulation for open point 4.2.8.2.9.10 in LOC & PAS TSI 2011/291/EU: The pantograph shall be designed such that it is automatically lowered in case of pantograph head failure, in accordance with the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.10, points 4 and 5.	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.10.	Not relevant for freight wagons.	Not relevant for freight wagons.	For first authorisations, the pantograph shall be designed such that it is automatically lowered in case of pantograph head failure, in accordance with the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.10, points 4 and 5.	For first authorisations, the pantograph shall be designed such that it is automatically lowered in case of pantograph head failure, in accordance with the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.10, points 4 and 5.
8.2.2.9 Running through phase or system separation sections	LOC & PAS TSI 2011/291/EU, Section 4.2.8.2.9.8.	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.8.	Not relevant for freight wagons.	Not relevant freight wagons.	The vehicle's energy consumption from the overhead contact line is to be able to be brought to 0 before passing the neutral section.	The vehicle's energy consumption from the overhead contact line is to be able to be brought to 0 before passing the neutral section.

8.2.3.2 Contact strip material	<p>Regulation for open point 4.2.8.2.9.4.2 in LOC & PAS TSI 2011/291/EU:</p> <p>The contact strip material shall meet the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.4.2.</p>	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.4.2.	Not relevant for freight wagons.	Not relevant for freight wagons.	<p>For first authorisations, the contact strip material shall meet the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.4.2.</p> <p>For additional authorisations: If materials are used other than those specified in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.4.2, then the materials' fitness for use must be verified with the CV verification module or by referring to the reference system in operation in Denmark.</p>	<p>For first authorisations, the contact strip material shall meet the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.4.2.</p> <p>For additional authorisations: If materials are used other than those specified in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.9.4.2, then the materials' fitness for use must be verified with the CV verification module or by referring to the reference system in operation in Denmark.</p>
8.3.1 Energy consumption measurement	LOC & PAS TSI 2011/291/EU, Section 4.2.8.2.8.	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.8.	Not relevant for freight wagons.	Not relevant for freight wagons.	The vehicle must be fitted with equipment for the measurement of energy consumption accurate within +/- 2 %.	The vehicle must be fitted with equipment for the measurement of energy consumption accurate within +/- 2 %.
8.3.4 Earthing	LOC & PAS TSI 2011/291/EU, Section 4.2.8.4.	LOC & PAS TSI 1302/2014/EU, Section 4.2.8.4.	WAG TSI 2006/861/EC, Section 4.2.7.3.	WAG TSI 321/2013/EU, Section 4.2.6.2.	EN 14033-1:2011, Section 15.1.	Metal parts must be earthed in accordance with the requirements in UIC 533, 3rd edition, 2011 or EN 50153:2014.
8.4 Electromagnetic compatibility						
8.4.2.1.1 Rail return current	The requirements in Annex 4 shall be met for electric vehicles.	The requirements in Annex 4 shall be met for electric vehicles.	Not relevant for freight wagons.	Not relevant for freight wagons.	The requirements in Annex 4 shall be met for electric vehicles.	The requirements in Annex 4 shall be met for electric vehicles.

8.4.2.1.4 Harmonic characteristics and related overvoltages on the overhead contact line	For additional authorisations: The requirements for system energy disturbances for ac systems, in LOC & PAS TSI 291/2011/EU, Section 4.2.8.2.7, shall be met for electric vehicles.	For additional authorisations: The requirements for system energy disturbances for ac systems, in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.7, shall be met for electric vehicles.	Not relevant for freight wagons.	Not relevant for freight wagons.	The requirements for system energy disturbances for ac systems, in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.7, shall be met for electric vehicles	The requirements for system energy disturbances for ac systems, in LOC & PAS TSI 1302/2014/EU, Section 4.2.8.2.7, shall be met for electric vehicles
8.4.2.2.1 Electro-magnetic fields/Induced voltages in the track/under the vehicle	LOC & PAS TSI 2011/291/EU, Section 4.2.3.3.1.2.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.3.1.2.	WAG TSI 2006/861/EC, Section 4.3.2.	WAG TSI 321/2013/EU, Section 4.2.3.3.	Vehicles that are to be detectable by means of axle counters shall meet the requirements of EN 14033-1:2011, Section 11.2.	Vehicles that are to be detectable by means of axle counters shall meet the requirements in LOC & PAS TSI 1302/2014/EU, Section 4.2.3.3.1.2, point 9 and 10 or WAG TSI 321/2013/EU, Section 4.2.3.3.
9. Staff facilities, interfaces and environment						
10. Fire safety and evacuation						

<p>10.1 Fire protection concept and protection measures</p>	<p>LOC & PAS TSI 2011/291/EU, Section 4.2.10.</p>	<p>LOC & PAS TSI 1302/2014/EU, Section 4.2.10.</p>	<p>WAG TSI 2006/861/EC, Section 4.2.7.2.</p>	<p>WAG TSI 321/2013/EU, Section 4.2.6.1.</p>	<p>EN14033-3+A1:2011 Section 5.24.2 on material requirements and Section 5.24.5 on handheld fire extinguishers.</p>	<p>Vehicles used in tunnels longer than 1 km shall:</p> <ol style="list-style-type: none"> 1) Comply SRT TSI <ul style="list-style-type: none"> • 2008/163 or • 1303/2014, <p>And be classified in one or more of the following fire safety categories:</p> <ol style="list-style-type: none"> 1. Category A passenger train 2. Category B passenger train 3. Freight locomotives 4. On-track machines <p>Or alternative,</p> <ol style="list-style-type: none"> 2) The proposer use CSM-RA to assess whether, and under what conditions, the safety level in the relevant tunnels can be accepted. The accredited assessor's safety assessment report can then be used as documentation for the vehicle's fire properties and communication equipment for running in tunnels, if maintenance of the safety level can be accepted. If this method is used, the Debo (designated body) shall verify that the Danish Transport and Construction Agency has accepted the safety assessment report. <p>Or for on-track machines,</p> <ol style="list-style-type: none"> 3) For uncategorised OTMs cf. SRT TSI, documented fulfilment of the following requirements is sufficient: <ol style="list-style-type: none"> 1. EN14033-3:2009+A1:2011 Section 5.24.2 on material requirements 2. EN14033-3:2009+A1:2011 Section 5.24.5 on handheld fire extinguishers.
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10.2.3 Passenger alarm	LOC & PAS TSI 2011/291/EU, Section 4.2.5.3.	LOC & PAS TSI 1302/2014/EU, Section 4.2.5.3	Not relevant for freight wagons.	Not relevant for freight wagons.	Not relevant for on-track machines.	Vehicles with a cab that is to be used for passenger transport in tunnels shall be equipped with a locomotive driver operated override for all emergency brake devices in the passenger areas (Danish acronym: 'NBO').
11. Servicing						
12. On-board control command and signalling						
12.2 On-board signalling						
12.2.2 STM requirements	Verification of Danish STM is handled in accordance with verification instructions for DK-STM BL3, BDK doc. ID IN 655.00 Q4236.	Verification of Danish STM is handled in accordance with verification instructions for DK-STM BL3, BDK doc. ID IN 655.00 Q4236.	Not relevant for freight wagons.	Not relevant for freight wagons.	Verification of Danish STM is handled in accordance with verification instructions for DK-STM BL3, BDK doc. ID IN 655.00 Q4236.	Verification of Danish STM is handled in accordance with verification instructions for DK-STM BL3, BDK doc. ID IN 655.00 Q4236.
12.2.3 Transitions	For vehicles, not fitted with ETCS baseline 3, SRS version 3.6.0 or higher, and is to be used on cross-border ETCS lines, the mobile equipment shall fulfil the requirements in SRS 3.6.0, chapter 3.5.2.4.	For vehicles not fitted with ETCS baseline 3, SRS version 3.6.0 or higher, and is to be used on cross-border ETCS lines, the mobile equipment shall fulfil the requirements in SRS 3.6.0, chapter 3.5.2.4.	Not relevant for freight wagons.	Not relevant for freight wagons.	For vehicles not fitted with ETCS baseline 3, SRS version 3.6.0 or higher, and is to be used on cross-border ETCS lines, the mobile equipment shall fulfil the requirements in SRS 3.6.0, chapter 3.5.2.4.	For vehicles not fitted with ETCS baseline 3, SRS version 3.6.0 or higher, and is to be used on cross-border ETCS lines, the mobile equipment shall fulfil the requirements in SRS 3.6.0, chapter 3.5.2.4.
12.2.4 Compatibility of rolling stock with CCS Trackside						

12.2.4.5 Compatibility with fixed installations of CCS	LOC & PAS TSI 2011/291/EU, Section 4.2.3.3.1.	LOC & PAS TSI 1302/2014/EU, Section 4.2.3.3.1.	WAG TSI 2006/861/EC, Section 4.3.2.	WAG TSI 321/2013/EU, Section 4.2.3.3.	<p>The maximum distance from the first axle to the buffer head may not exceed 4 200 mm.</p> <ol style="list-style-type: none"> 1) Vehicles that are to be detectable by means of track circuits shall meet the requirements of EN 14033-1:2011, Section 11.1, however, the maximum distance between the adjacent axles may not exceed 20 metres. 2) Vehicles that are to be detectable by means of axle counters shall meet the requirements of EN 14033-1:2011, Section 11.2. 	<p>The following are accepted for first and additional authorisations: LOC & PAS TSI 1302/2014/EU, Section 4.2.3.3.1. and WAG TSI 321/2013/EU, Section 4.2.3.3. For additional authorisations of vehicles that are to be detectable by means of track circuits, UIC 512, 8th edition, 1-1 83 can also be used. In that context, the requirements in Section 1.3 are mandatory.</p>
12.2.5 ETCS cab signalling system						
12.2.5.1 Level crossing functionality	For vehicles, not fitted with ETCS baseline 3, SRS version 3.6.0 or higher, and is to be used on ETCS lines , the on-board control command and signalling system shall be able to issue a MAR (Movement Authority Request) for SvL (Supervised Location) when such is more restrictive than EoA (End of movement Authority).	For vehicles, not fitted with ETCS baseline 3, SRS version 3.6.0 or higher, and is to be used on ETCS lines , the on-board control-command and signalling system shall be able to issue a MAR (Movement Authority Request) for SvL (Supervised Location) when such is more restrictive than EoA (End of movement Authority).	Not relevant for freight wagons.	Not relevant for freight wagons.	For vehicles, not fitted with ETCS baseline 3, SRS version 3.6.0 or higher, and is to be used on ETCS lines , the on-board control-command and signalling system shall be able to issue a MAR (Movement Authority Request) for SvL (Supervised Location) when such is more restrictive than EoA (End of movement Authority).	For vehicles, not fitted with ETCS baseline 3, SRS version 3.6.0 or higher, and is to be used on ETCS lines , the on-board control-command and signalling system shall be able to issue a MAR (Movement Authority Request) for SvL (Supervised Location) when such is more restrictive than EoA (End of movement Authority).

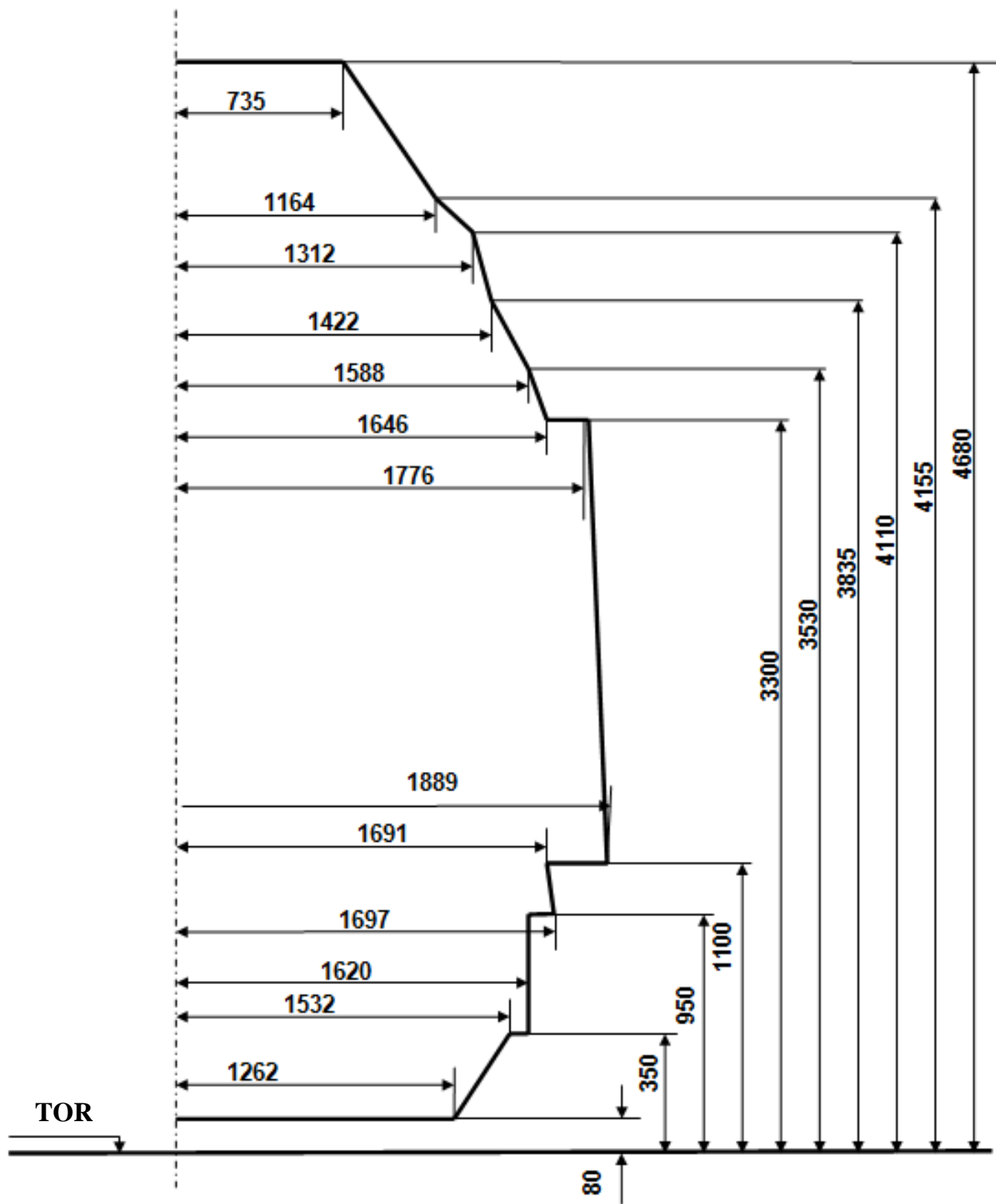
<p>12.2.5.3 Reliability – availability requirements</p>	<p>No requirements for on-track machines.</p> <p>Regulation for open point 4.2.1.2 in CCS TSI 2016/919 applicable to first authorisations of on-board control command:</p> <p>Vehicles with cab equipment that is to be used for freight and/or passenger transport on ETCS lines shall have a calculated value of at least 75 000 for the average number of hours in service between failures in the on-board control command and signalling system requiring disconnection of the control command functions.</p>	<p>No requirements for on-track machines.</p> <p>Regulation for open point 4.2.1.2 in CCS TSI 2016/919 applicable to first authorisations of on-board control command:</p> <p>Vehicles with cab equipment that is to be used for freight and/or passenger transport on ETCS lines shall have a calculated value of at least 75 000 for the average number of hours in service between failures in the on-board control-command and signalling system requiring disconnection of the control-command functions.</p>	<p>Not relevant for freight wagons.</p>	<p>Not relevant for freight wagons.</p>	<p>No requirements for on-track machines.</p>	<p>No requirements for on-track machines.</p> <p>Regulation for open point 4.2.1.2 in CCS TSI 2016/919 applicable to first authorisations of on-board control command:</p> <p>Vehicles with cab equipment that is to be used for freight and/or passenger transport on ETCS lines shall have a calculated value of at least 75 000 for the average number of hours in service between failures in the on-board control-command and signalling system requiring disconnection of the control-command functions.</p>
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Annex 2

Vehicle characteristics	
Use	
Maximum permissible running speed	[Number] km/h
Geometric characteristics	
Total vehicle length	[Number] m
Vehicle mass with maximum passengers or goods	[Number] kg
Maximum static axle load	[Number] kg
Maximum weight per metre	[Number] kg/m
Minimum in-service limit values for wheel diameter	[Number] mm
Minimum horizontal curve radius	[Number] m
Minimum vertical curve radius – downward direction	[Number] m
Minimum vertical curve radius – upward direction	[Number] m
Detailed vehicle characteristics	
Kinematic gauge	
Allowed cant deficiency	[Number] mm
Maximum distance between consecutive axles	[Number] mm
Minimum distance between axles	[Number] mm
Distance between first and last axle	[Number] mm
Distances from outermost axles to buffer head/foremost point	[Number/number] mm
Minimum static axle load	[Number] kg
Maximum impedance between opposite wheels in wheelset	[Number] Ω
Train detection systems with which the vehicle is compatible	[track circuits and/or axle counters]
Maximum sandig output	[Number] g per 30 second
Braking characteristics	
Maximum deceleration	[Number] m/s^2
Parking brake capacity	[Number] ‰ (mm/m)
Magnetic track brake	[Yes or No]
Vehicle equipment	
ETCS Baseline version	
Class B signalling systems	
GSM-R equipment and EIRENE versions (FRS and SRS version)	
Class B or other radio systems installed	
Other characteristics	
Vehicle fire safety classification	
Pass-by noise	[Number] (dB(A))
Equivalent conicity	[Number]

Annex 3

Kinematic reference line for rolling stock that is to run on the conventional railway.

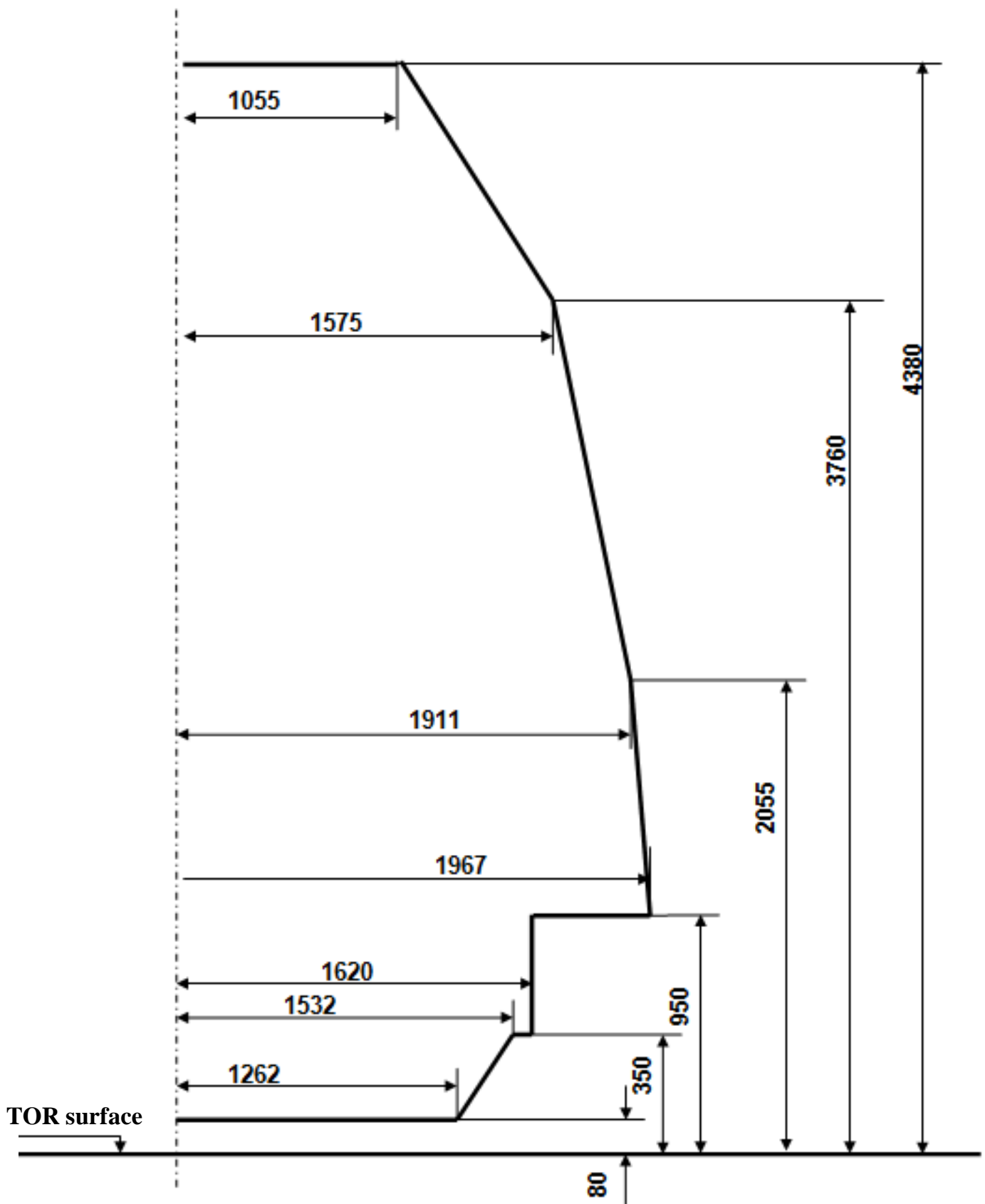


Drawing explanation:

All figures are in mm.

Top of Rail (TOR): A plane through the surface of the railhead.

Kinematic reference line for rolling stock that is to run on 'S-banen'



Drawing explanation:

All figures are in mm.

Top of Rail (TOR): A plane through the surface of the railhead.

Annex 4

EMC (electromagnetic compatibility) specification for vehicles.

Table 1 Limits on interference current. For general exceptions, see notes 1 and 2.			
ID	Frequency/frequency range	Maximum value per train regardless of the number of traction units	Measurement methods and signal processing
A	50 Hz, continuous > 1 second	500 A	Effective value (RMS) of the measured signal (no filtering), integration time 20 ms (IEC 61000-4-30).
B	77 Hz, continuous > 1 second	4 A	Band-pass filter 10th order (2 x 5) Butterworth filter, -3 dB at 70 Hz and 85 Hz, Effective value (RMS) of the measured signal, integration time 130 ms.
C	100 Hz, continuous > 1 second	25 A	Spectrum analysis, integration time 200 ms (IEC 61000-4-7).
D	150 Hz, continuous > 1 second	50 A	Spectrum analysis, integration time 200 ms (IEC 61000-4-7).
E	170 Hz, continuous > 1 second	2 A	Spectrum analysis, integration time 200 ms (IEC 61000-4-7).
F	200 Hz, continuous > 1 second	12 A	Spectrum analysis, integration time 200 ms (IEC 61000-4-7).
G1	231 Hz, continuous > 1 second	4 A	Spectrum analysis, integration time 200 ms (IEC 61000-4-7).
G2	250 Hz, continuous > 1 second	50 A	Spectrum analysis, integration time 200 ms (IEC 61000-4-7).
H	Net harmonic 350-650 Hz (HKT)	10 A	Spectrum analysis, integration time 200 ms (IEC 61000-4-7).
I	Net interharmonic 350-650 Hz (HKT)	1 A	Spectrum analysis, integration time 200 ms (IEC 61000-4-7). Maximum value in the frequency range: 355 – 395 Hz, 405 – 445 Hz, 455 – 495 Hz, 505 – 545 Hz, 555 – 595 Hz, and 605 – 645 Hz.
J1	Information system 720-1000 Hz > 1 second	21 A	Band-pass filter, 10th order (2x5.) Butterworth filter, -3 dB at specified frequencies, Effective value (RMS) of the measured signal, integration time 1 second. The frequency

			range 720-1000 Hz is considered to be within the limits for the psophometric current.																
J2	Information system 1 000 - 2 000 Hz > 1 second	10.5 A	Band-pass filter, 10th order (2x5.) Butterworth filter, -3 dB at specified frequencies, Effective value (RMS) of the measured signal, integration time 1 second.																
J3	Information system 2 000 - 3 000 Hz > 1 second	7.5 A	Band-pass filter, 10th order (2x5.) Butterworth filter, -3 dB at specified frequencies, Effective value (RMS) of the measured signal, integration time 1 second.																
J4	Information system 3 000 - 5 000 Hz > 1 second	4.5 A	Band-pass filter, 10th order (2x5.) Butterworth filter, -3 dB at specified frequencies, Effective value (RMS) of the measured signal, integration time 1 second.																
K1	Train detection system (FTGS) 4,75, 5,25, 5,75, 6,25 kHz	1.4 A	<p>Band-pass filters, 4th order (2x2.) Butterworth filters, -3dB at each $f_c \pm BW/2$ Hz, followed by moving effective value (RMS), time window ≤ 40 ms. Bandwidth of the band-pass filters according to the following table:</p> <p>FTGS 46</p> <table border="1"> <thead> <tr> <th>Centre frequency f_c</th> <th>Bandwidth bw</th> </tr> </thead> <tbody> <tr> <td>4.75 kHz</td> <td>200 Hz</td> </tr> <tr> <td>5.25 kHz</td> <td>206 Hz</td> </tr> <tr> <td>5.75 kHz</td> <td>214 Hz</td> </tr> <tr> <td>6.25 kHz</td> <td>220 Hz</td> </tr> </tbody> </table>	Centre frequency f_c	Bandwidth bw	4.75 kHz	200 Hz	5.25 kHz	206 Hz	5.75 kHz	214 Hz	6.25 kHz	220 Hz						
Centre frequency f_c	Bandwidth bw																		
4.75 kHz	200 Hz																		
5.25 kHz	206 Hz																		
5.75 kHz	214 Hz																		
6.25 kHz	220 Hz																		
K2	Train detection system (FTGS) 9,5, 10,5, 11,5... 16,5 kHz	0.7 A	<p>Band-pass filters, 4th order (2x2.) Butterworth filters, -3dB at each $f_c \pm BW/2$ Hz, followed by moving effective value (RMS), time window ≤ 40 ms. Bandwidth of the band-pass filters according to the following table:</p> <p>FTGS917</p> <table border="1"> <thead> <tr> <th>Centre frequency f_c</th> <th>Bandwidth bw</th> </tr> </thead> <tbody> <tr> <td>9.5 kHz</td> <td>360 Hz</td> </tr> <tr> <td>10.5 kHz</td> <td>380 Hz</td> </tr> <tr> <td>11.5 kHz</td> <td>400 Hz</td> </tr> <tr> <td>12.5 kHz</td> <td>425 Hz</td> </tr> <tr> <td>13.5 kHz</td> <td>445 Hz</td> </tr> <tr> <td>14.5 kHz</td> <td>470 Hz</td> </tr> <tr> <td>15.5 kHz</td> <td>490 Hz</td> </tr> </tbody> </table>	Centre frequency f_c	Bandwidth bw	9.5 kHz	360 Hz	10.5 kHz	380 Hz	11.5 kHz	400 Hz	12.5 kHz	425 Hz	13.5 kHz	445 Hz	14.5 kHz	470 Hz	15.5 kHz	490 Hz
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15.5 kHz	490 Hz																		

			16.5 kHz	510 Hz
M1	DC continuous > 1,5 second	4 A	Low-pass filter, 5th order low-pass with -3dB at 2,5 Hz. There may be compensation for the offset of the measuring equipment.	
M2	Maximum inrush current DC component after 1,5 seconds	< 15 A	Moving average for a 40 ms Hanning window.	

Note:

- 1) The limit values in Table 1 apply per train regardless of the number of traction units in the train. Any breakdown of these values to limits per traction unit must follow the guidelines in the current version of CLC/TS 50238-2 or EN 50238-2.
- 2) Brief, transient non-conformance (brief, transient, non-conformance with the limit values caused by, or directly related to, the following events may be permitted):
 - a. Connection of main switch (applies to all IDs listed in Table 1, except ID M2)
 - b. Disconnection of main switch (applies to all IDs listed in Table 1)
 - c. Pantograph hops (applies to all IDs listed in Table 1).
- 3) The requirements J1, J2, J3 and J4 are applicable as long as HKT is in operation on the S-bane network.
- 4) The requirements K1 and K2 are applicable as long as HKT is in operation on the S-bane network and as long as train detection is functioning on Banedanmarks (Railnet Denmark) infrastructure by means of track circuits.