

**norm****NEN-EN 50591**

Specification and verification of energy consumption for railway rolling stock

Publicatie uitsluitend voor commentaar

Spoorwegen en soortgelijk geleid vervoer - Bepaling en verificatie van het energieverbruik door rollend materieel

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Voorbeeld  
Preview

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English Version

## Specification and verification of energy consumption for railway rolling stock

Spécification et vérification de la consommation d'énergie pour le matériel roulant ferroviaire

Spezifikation und Überprüfung des Energieverbrauchs von Schienenfahrzeugen

This draft European Standard is submitted to CENELEC members for enquiry.  
Deadline for CENELEC: 2018-04-06.

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.

This draft European Standard was established by CENELEC in three official versions (English, French, German).  
A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

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Orbis  
 Preview

## 124 European foreword

125 This document (prEN 50591:2017) has been prepared by CLC/TC 9X "Electrical and electronic  
126 applications for railways" with contribution of UNIFE-UIC TECREC 100\_001.

127 This document is currently submitted to the CEN Enquiry.

128 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   |
| — latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | dor + 12 months  |
| — latest date by which the national standards conflicting with this document have to be withdrawn   | (dow) | dor + 36 months<br>(to be confirmed or modified when voting) |

129 This document will supersede CLC/TS 50591:2013.

130 Main changes in this standard compared to CLC/TS 50591:2013 are the adoption of existing CLC/TS  
131 50591 enquiry comments, harmonisation with results from European Lighthouse Project Roll2Rail and  
132 the inclusion of an HVAC energy quantification method. Since separate methods for traction and  
133 HVAC energy quantification are described, the document structure had to be revised.

134 This document has been prepared under a mandate given to CENELEC by the European Commission  
135 and the European Free Trade Association, and supports essential requirements of EU Directive(s).

136 For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this  
137 document.

## 138 1 Scope

139 The main purpose of this standard is the support of rolling stock procurement, especially in light of life  
140 cycle cost (LCC) assessment.

141 This European Standard is applicable to the specification and verification of energy consumption of  
142 railway rolling stock. It establishes a criterion for the energy consumption of rolling stock to calculate  
143 the total net energy consumed, either at current collector or from the fuel tank, over a predefined  
144 service profile, in order to ensure that the results are directly comparable or representative of the real  
145 operation of the train. For this purpose, this document takes into account the energy consumed and  
146 regenerated by the rolling stock.

147 This European Standard provides the framework that gives guidance on the generation of comparable  
148 energy performance values for trains and locomotives on a common basis and thereby supports  
149 benchmarking and improvement of the energy efficiency of rail vehicles.

150 This European Standard does not cover specification for comparison of energy consumption with  
151 other modes of transportation, or even for comparison between diesel and electric traction, covering  
152 only the energy consumption of the railway rolling stock itself.

## 153 2 Normative references

154 The following documents are referred to in the text in such a way that some or all of their content  
155 constitutes requirements of this document. For dated references, only the edition cited applies. For  
156 undated references, the latest edition of the referenced document (including any amendments)  
157 applies.

158 EN 13129:2016, *Railway applications — Air conditioning for main line rolling stock — Comfort*  
159 *parameters and type tests*

160 EN 15663:2017, *Railway applications — Vehicle reference masses*

161 EN 50163:2004, *Railway applications — Supply voltages of traction systems*

162 EN 50463-1:2013, *Railway applications — Energy measurement on board trains — Part 1: General*

163 EN 50463-2:2013, *Railway applications — Energy measurement on board trains — Part 2: Energy*  
164 *measuring*

165 EN 50463-3:2013, *Railway applications — Energy measurement on board trains — Part 3: Data*  
166 *handling*

167 EN 50388:2012, *Railway Applications — Power supply and rolling stock — Technical criteria for the*  
168 *coordination between power supply (substation) and rolling stock to achieve interoperability*

## 169 3 Terms, definitions and abbreviations

### 170 3.1 Terms and definitions

171 For the purposes of this document, the following terms and definitions apply.

172 Note 1 to entry: When possible, the following definitions have been taken from the relevant chapters of the  
173 International Electrotechnical Vocabulary (IEV), IEC 60050. In such cases, the appropriate IEV reference is given.  
174 Certain new definitions or modifications of IEV definitions have been added in this standard in order to facilitate  
175 understanding. Expression of the performance of electrical and electronic measuring equipment has been taken  
176 from EN 60359:2002.



- 177 **3.1.1**  
 178 **traction auxiliaries**  
 179 equipment needed to operate the traction equipment and the train in normal operation mode, but not  
 180 producing tractive or dynamic braking efforts themselves (e.g. cooling fans, oil and water pumps,  
 181 compressor, air supply for brakes, HVAC for the leading driver's cabin, TCMS and signalling  
 182 equipment)
- 183 **3.1.2**  
 184 **comfort systems**  
 185 all equipment consuming energy for passenger comfort belonging neither to the traction equipment  
 186 nor to traction auxiliaries, mainly for the provision of a comfortable environment (e.g. lighting, heating,  
 187 air conditioning, toilets, information and entertainment systems, laptop supplies)
- 188 Note 1 to entry: Comfort systems are split in two groups for use in this standard: Heating, Ventilation and Air  
 189 Conditioning (HVAC) and Other comfort functions.
- 190 **3.1.3**  
 191 **consist**  
 192 group of vehicles which are not separated during normal operation or a single vehicle
- 193 **3.1.4**  
 194 **contact line**  
 195 **CL**  
 196 conductor system for supplying electric energy to a traction unit through current-collecting equipment
- 197 [SOURCE: IEC 60050-811:1991, 811-33-01:1991, modified]
- 198 **3.1.5**  
 199 **diesel multiple unit**  
 200 **DMU**  
 201 train having a fixed composition powered by one or several diesel engines having a fixed composition
- 202 **3.1.6**  
 203 **hybrid vehicle**  
 204 vehicle that can store energy in an on-board energy storage system (ESS) and is driven by using the  
 205 stored energy as well as power from a primary power source
- 206 **3.1.7**  
 207 **primary power source**  
 208 **PPS**  
 209 subsystem in a hybrid system the primary purpose of which is to supply energy to other subsystems in  
 210 the hybrid system by either consuming the fuel stored on-board or taking in energy from external  
 211 sources
- 212 **3.1.8**  
 213 **state of energy**  
 214 **SoE**  
 215 remaining energy to be discharged, normally expressed as a percentage of full energy
- 216 [SOURCE: EN 62864-1:2016, modified]
- 217 **3.1.9**  
 218 **energy storage system**  
 219 **ESS**  
 220 physical system which is comprised of energy storage technologies such as batteries, double-layer  
 221 capacitors, flywheel, etc. and other equipment to connect the storage technologies to traction  
 222 equipment, including control, cooling and monitoring systems
- 223 [SOURCE: EN 62864-1:2016, modified]

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- 224 **3.1.10**  
 225 **electric traction system**  
 226 railway electrical distribution network (infrastructure) used to provide energy for rolling stock
- 227 **3.1.11**  
 228 **electric multiple unit**  
 229 **EMU**  
 230 train having a fixed composition and getting its traction power from an electric traction system
- 231 **3.1.12**  
 232 **heating, ventilation and air conditioning**  
 233 **HVAC**  
 234 system to help maintain good indoor air quality through adequate ventilation with filtration and  
 235 providing thermal comfort
- 236 **3.1.13**  
 237 **infrastructure**  
 238 fixed installations of the railway system (e.g. tracks, power supply, signalling, communication)
- 239 **3.1.14**  
 240 **net energy**  
 241 difference between the energy taken (consumed) from the contact line, fuel tank and/or energy  
 242 storage system by the traction unit, and the energy fed back (regenerated) into the contact line or  
 243 energy storage system (ESS) by the traction unit. For ESS, the difference in state of energy (SoE) is  
 244 used and it is defined, under which conditions, recharging of the energy storage system is performed  
 245 after the service profile
- 246 **3.1.15**  
 247 **rolling stock**  
 248 general term covering all railway vehicles or consist of vehicles
- 249 Note 1 to entry: Rolling stock may be fitted with traction equipment.
- 250 **3.1.16**  
 251 **service profile**  
 252 outline of the expected range and variation in the mission with respect to parameters such as time,  
 253 loading, speed, distance, stops, tunnels, etc., in the commercial exploitation of the train
- 254 **3.1.17**  
 255 **single-train run**  
 256 run of one train over a part of infrastructure, without inclusion of effects of other trains
- 257 **3.1.18**  
 258 **traction equipment**  
 259 equipment on-board of the train directly needed to produce tractive or dynamic braking effort (e.g.  
 260 transformers, converters, motors, gearboxes, internal combustion engines, fuel cells, energy storage  
 261 systems)
- 262 **3.1.19**  
 263 **traction unit**  
 264 railway vehicle or a fixed composition of vehicles with traction ability (e.g. locomotive, multiple traction  
 265 unit)
- 266 **3.1.20**  
 267 **train**  
 268 consist with traction unit ready for in-service operation

269 **3.1.21**  
 270 **vehicle**  
 271 smallest part in a train, intended as a single vehicle (e.g. freight wagons, passenger coaches,  
 272 locomotives)

## 273 **3.2 Abbreviations**

274 For the purposes of this document, the following abbreviations apply.

275 All the abbreviations are listed in alphabetical order:

AC	Alternating Current
DC	Direct Current
DMU	Diesel Multiple Unit
EMU	Electric Multiple Unit
ESS	Energy Storage System
HVAC	Heating, Ventilation and Air Conditioning System
LCC	Life Cycle Cost

## 276 **4 General**

277 Energy is an integral quantity. This means that the cumulated energy is the decisive factor. Realistic  
 278 train operation always has to take place under the constraints of infrastructure and operational  
 279 requirements.

280 The following train modes are used in the standard.

### 281 — **In-service mode with commercial operation**

282 This mode covers the normal operation of a train, including several passenger loads or a  
 283 locomotive hauling a trailer, consist of freight wagons. The train is moving or at standstill with  
 284 passengers and the HVAC system is running in its normal operation mode.

### 285 — **In-service mode without commercial operation**

286 In this mode the train is at standstill, the HVAC system is in operation as for commercial operation  
 287 and there is no passenger in the train. This situation is quite frequent, for example when the train  
 288 is waiting between two commercial runs.

### 289 — **Parking mode**

290 A train is in parking mode when it is stationary in depot areas, with active power supply, without  
 291 staff or passengers being on board. Usually, the HVAC system runs with reduced settings for  
 292 temperature and airflow.

293 In this standard the preconditioning (pre-heating or pre-cooling) and cleaning are not considered  
 294 separately. The corresponding hours shall be counted in the In-service mode without commercial  
 295 operation.

296 The train is switched OFF the remaining time of each day, therefore without any energy consumption.

297 In order to keep different characteristics, requirements and procedures manageable, the energy  
 298 consumption of the whole train is subdivided into the following three different energy categories, which  
 299 are handled separately:

- 300 1) Traction and Auxiliaries (in service mode with commercial operation, without HVAC);
- 301 2) Traction and Auxiliaries (in service mode without commercial operation and in parking mode,  
 302 without HVAC);

303 3) HVAC.

304 This European Standard incorporates infrastructure and operational conditions into so-called “service  
305 profiles” for the train. The service profile for traction and auxiliaries is assessed via train runs along a  
306 line for in service and stationary at the depot for out of service operation, whereas HVAC is assessed  
307 via a reference point matrix for different operational modes.

308 The energy consumption over such service profiles shall be used as an input when assessing LCC.  
309 This requires a well-defined and harmonized methodology for specification and verification of the  
310 energy consumption. The selected approach has two steps:

- 311 a) simulation of the energy consumption of the train for the three energy categories mentioned  
312 above;
- 313 b) verification of the simulation by undertaking measurements.

314 It is important to note that two different sorts of service profiles for traction and auxiliaries may be  
315 chosen:

- 316 1) user defined service profiles based on data from a real railway line, normally one or several lines  
317 out of the railway network where the train will be operated;
- 318 2) standardized service profiles, for the following categories:
- 319 — suburban (passenger service);
- 320 — regional (passenger service);
- 321 — intercity (passenger service);
- 322 — high speed (passenger service);
- 323 — freight mainline service.

324 Definitions of relevant values for the standardized service profiles (2) and their parameters are given in  
325 Annex A and Annex B of this European Standard. The standard service profiles are characterized by  
326 definitions of standard values for the identified service types being typical (i.e. representative) – yet not  
327 real – of the type of railway service.

328 This means that it may not be possible to validate these on a real world track unless some  
329 adjustments of the verification results are undertaken to take into account the differences between the  
330 simulation and verification. However, these standardized service profiles are intended to be a common  
331 basis against which various trains can be simulated and simulation results compared.

332 For the assessment of HVAC energy consumption, standard weighting factors for the reference points  
333 are given in Annex C.

## 334 **5 Traction and Auxiliaries (in service with commercial operation, without** 335 **HVAC)**

### 336 **5.1 General**

337 This section is focused on traction energy in service mode on a single train run for a train travelling  
338 from origin to destination location including standstill times on the way by means of the representative  
339 driving cycles. It includes energy related to traction auxiliaries (control, cooling and leading driver’s cab  
340 HVAC which is necessary for safe train driving) and other comfort functions, e.g. as toilets, passenger  
341 infotainment systems, WIFI.

342 It excludes energy related to HVAC for the passenger saloon and for the inactive driver’s cab,  
343 Auxiliary equipment rarely used are also expressly omitted (e.g. windscreen wiper, sanding,  
344 defrosters).

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