



**BSI Standards Publication**

## **Railway applications — Gauges**

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Part 1: General — Common rules for rolling stock and infrastructure

## National foreword

This British Standard is the UK implementation of EN 15273-1:2025. It supersedes BS EN 15273-1:2013+A1:2016, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RAE/1/-/12, Railway applications - Gauging.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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English Version

## Railway applications - Gauges - Part 1: General - Common rules for rolling stock and infrastructure

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Explications de base et règles communes pour matériel  
roulant et infrastructure

Bahnanwendungen - Begrenzungslinien - Teil 1:  
Allgemeines - Gemeinsame Vorschriften für Fahrzeuge  
und Infrastruktur

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## European foreword

This document (EN 15273-1:2025) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2026, and conflicting national standards shall be withdrawn at the latest by April 2026.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document, together with EN 15273-4:2025, will supersede EN 15273-1:2013+A1:2016.

The EN 15273 series, *Railway applications — Gauges*, consists of the following parts:

- EN 15273-1:2025, *General — Common rules for rolling stock and infrastructure* gives the general explanations of gauging and defines the sharing of the space between rolling stock and infrastructure;
- EN 15273-2:2025, *Rolling stock* gives the rules for dimensioning vehicles;
- EN 15273-3:2025, *Infrastructure* gives the rules for positioning the infrastructure;
- EN 15273-4:2025, *Catalogue of defined gauges* includes a non-exhaustive list of reference profiles and parameters to be used by infrastructure and rolling stock;
- CEN/TR 15273-5:2025, *Background, explanation and worked examples*.

The characteristics of the new edition of EN 15273 series are:

- introduction of absolute and comparative gauging process in Parts 1, Part 2, Part 3 and Part 5;
- specific rules given for each defined gauge in EN 15273-2:2025 and EN 15273-3:2025 are replaced by a common general set of basic formulae applicable for all. The applicable reference profile and the specific associated rules are given in part 4;
- a new EN 15273-4:2025 gives the catalogue of gauges and associated rules coming from EN 15273-1:2013+A1:2016;
- a new CEN/TR 15273-5:2025 gives background information coming from EN 15273-1:2013+A1:2016 and worked examples.

In comparison with the previous edition, the following technical modifications have been made:

- the series was fully restructured, from three parts to five parts;
- Clause 3 and Clause 4 now refer to EN 15273-1:2025 where all terms and symbols are defined;
- harmonisation of symbols and index level for all parts of this series of standards;
- grouping in Annex A of the calculation elements specific to all defined templates from the paragraphs of Clause 5, Clause 6, Clause 7 and Clause 8;

- grouping in Annex B of elements specific to the defined kinematic gauge of Clause 5, Clause 6, Clause 7 and Clause 8;
- grouping in Annex C of elements specific to the static gauge defined in Clause 5, Clause 6, Clause 7 and Clause 8;
- improvement and grouping into Annex D of the dynamic gauge specific elements defined in Clause 5, Clause 6, Clause 7 and Clause 8;
- content of 7.3.1.1.3 and 7.3.1.3 moved into CEN/TR 15273-5:2025;
- Annex B, Annex C, Annex D and Annex F moved into EN 15273-4:2025;
- removal of Annex E, Annex I and Annex K;
- reordering of Annex H;
- Annex J moved into CEN/TR 15273-5:2025;
- creation of normative Annex E for the description of the absolute gauging process;
- creation of normative Annex F for the description of the comparative gauging process.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

## Introduction

The aim of this document is to define the rules for the calculation and verification of the dimensions of rolling stock and infrastructure from a gauging perspective.

This document sets out gauging processes taking into account the relative movements between rolling stock and infrastructure as well as the necessary margins or clearances.

EN 15273-1:2025 covers generic explanations and methods of gauging and is used in conjunction with the following parts:

- *Part 2: Rolling stock;*
- *Part 3: Infrastructure;*
- *Part 4: Catalogue of defined gauges;*
- *Part 5: Background, explanation and worked examples.*

## 1 Scope

This document contains:

- the definitions and symbols for all EN 15273 documents;
- the general explanation of various elements and phenomena affecting heavy rail gauging;
- the general explanation of various calculation methods and processes applicable to the heavy rail gauging that allow the dimensioning of the rolling stock and the infrastructure.

This document is applicable to heavy rail vehicles and networks using various track gauges. Other vehicles and networks are outside the scope of this document, but the rules may be applied to them with some adjustments and agreement of the share of responsibility between rolling stock and infrastructure.

This document is not applicable to the gauges “S” and “T” for track gauge 1 520 mm.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes 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.

EN 15273-2:2025, *Railway applications — Gauges — Part 2: Rolling stock*

EN 15273-3:2025, *Railway applications — Gauges — Part 3: Infrastructure*

EN 15273-4:2025, *Railway applications — Gauges — Part 4: Catalogue of defined gauges*

EN 15313:2024, *Railway applications — In-service wheelset operation requirements — In-service and off-vehicle wheelset maintenance*

EN 15663:2017+A2:2024, *Railway applications — Vehicle reference masses*

EN 17343:2023, *Railway applications — General terms and definitions*

EN 50119:2020, *Railway applications — Fixed installations — Electric traction overhead contact lines*

EN 50367:2020, *Railway applications — Fixed installations and rolling stock — Criteria to achieve technical compatibility between pantographs and overhead contact line*

## 3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

NOTE The term heavy rail is defined in EN 17343:2023.

### 3.1

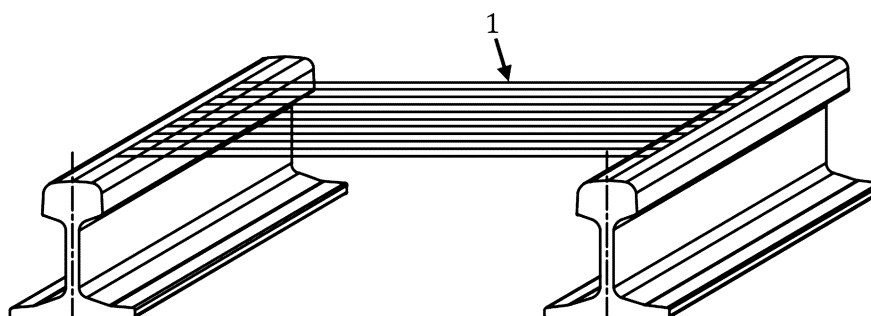
#### gauging process

procedure by means of which the dimensional compatibility of rolling stock and infrastructure is determined

### 3.2

#### running plane

plane tangential to the running surface as defined in EN 17343:2020, 3.1.5.3.2 and as shown in Figure 1



#### Key

- 1 running plane

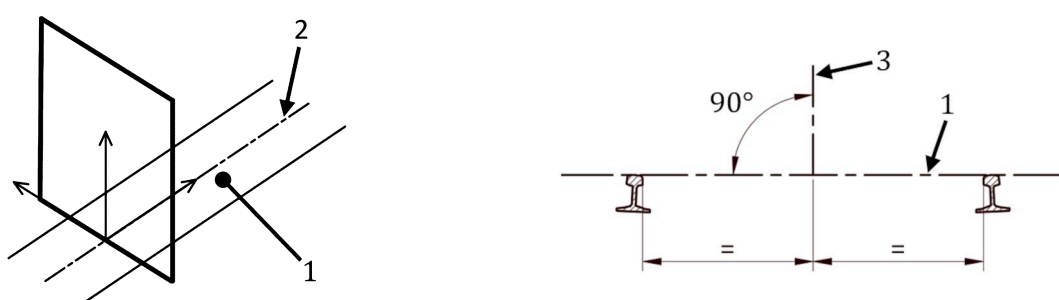
**Figure 1 — Running plane**

### 3.3

#### normal coordinates

coordinates defined in a plane normal to the longitudinal centreline of the rails at a nominal position on a theoretically perfect track

Note 1 to entry: One of these axes is the intersection of the normal plane with the running plane. The other axis, commonly referred to as vertical axis, is perpendicular to the running plane. For calculation purposes, the vertical axis is used as a common reference for infrastructure and rolling stock (see Figure 2).



#### Key

- 1 running plane (X and Y)  
2 longitudinal centreline of the vehicle and of the track (X)  
3 vertical centreline of the vehicle (Z)

**Figure 2 — Normal coordinates**

### 3.4

#### **effective track position**

used during the absolute gauging process, and represents a position that the track could realistically, or with high probability, occupy relative to structures or to an adjacent track at some times within its maintenance cycle

### 3.5

#### **reference vehicle**

theoretical or actual vehicle, the parameters of which are used to establish the rules associated with a reference profile to obtain a gauge

### 3.6

#### **comparator vehicle**

existing rolling stock geometrically compatible with infrastructure and operating on a specified route to be used for the comparative gauging process

### 3.7

#### **defined gauge**

reference profile and its associated rules allowing definition of the outer dimensions of the rolling stock and the space to be cleared by the infrastructure

Note 1 to entry: According to the calculation method applied, the gauge will be a static, kinematic or dynamic.

### 3.8

#### **reference profile**

##### **CR**

virtual line related to the normal coordinates and used, together with the associated rules, as a common basis to determine infrastructure gauge and the vehicle gauge

Note 1 to entry: Depending on the calculation method used, the corresponding reference profiles can be called up for static, kinematic and dynamic.

### 3.9

#### **upper part**

part of the reference profile as set out in EN 15273-4:2025 for the defined gauges

Note 1 to entry: This corresponds to the upper sector for the absolute and comparative gauging process.

### 3.10

#### **lower part**

part of the reference profile as set out in EN 15273-4:2025

Note 1 to entry: This corresponds to the lower sector for the absolute and comparative gauging process.

### 3.11

#### **bottom line**

line corresponding to the minimum height above the running plane of the reference profile

**3.12****curve overthrow** **$d_g$** 

distance in direction Y or Z between the track and the vehicle in a curve

Note 1 to entry: See details in Figure A.2; Figure E.2 for horizontal curve and Figure A.7 for vertical curve.

Note 2 to entry: “curve overthrow” can also be called “geometric overthrow”.

**3.13****associated rules**

set of rules associated with each reference profile in order to size the infrastructure or rolling stock

**3.14****lateral projection** **$S$** 

sum of these two values:

- $S_R$ , value agreed between Infrastructure Manager and Railway Undertaking based on the lateral curve overthrow of reference vehicles;
- $S_L$ , is the widening of the track gauge.

Note 1 to entry: See CEN/TR 15273-5:2025 for explanation.

Note 2 to entry: Lateral projection is also known as “saillie”.

**3.15****vertical projection** **$S_v$** 

value agreed between Infrastructure Manager and Railway Undertaking based on the vertical curve overthrow of reference vehicles

Note 1 to entry: See CEN/TR 15273-5:2025 for explanation.

Note 2 to entry: Vertical projection is also known as “saillie”.

**3.16****absolute (swept envelope) vehicle gauge**

vehicle gauge which may have multiple swept envelopes associated with it

**3.17****absolute (swept envelope) infrastructure gauge**

absolute (swept envelope) vehicle gauge(s) plus track tolerances and clearance

Note 1 to entry: Absolute (swept envelope) Infrastructure gauges are used to facilitate construction and maintenance of the infrastructure, not compatibility.

**3.18****clearance**

free space or allowance between two elements, in particular, for absolute and comparative gauging processes, the minimum calculated distance between the swept envelope of a vehicle and fixed infrastructure or between swept envelopes of two vehicles on adjacent tracks

### 3.19

#### **absolute gauging process**

set of rules allowing the comparison of the swept envelope of a vehicle with infrastructure profiles on a given route and vehicles on adjacent track

Note 1 to entry: The infrastructure profile is the profile as measured for the specific clearance assessment and is measured perpendicular to the running plane.

### 3.20

#### **comparative gauging process**

set of rules allowing the comparison of the swept envelopes of a candidate vehicle (new) and a comparator vehicle (existing) in order to assess route compatibility

### 3.21

#### **swept envelope**

cross sections perpendicular to the running plane encompassing all the points swept by the vehicle under consideration with its dynamic displacements in any possible position combined with running and operating conditions

Note 1 to entry: Usage of this term alone is not recommended. It is advisable to use it with complementary information to understand what is swept. e.g. vehicle swept envelope.

### 3.22

#### **hybrid gauging process**

combination of various gauging processes applied to a vehicle to assess route compatibility

### 3.23

#### **displacement coefficient**

**A**

correction factor applied to the different terms determining the relative position of the vehicle with respect to the track (e.g. lateral clearance between wheelsets and track, bogie wheel base, lateral projections, etc.)

### 3.24

#### **quasi-static roll**

movement resulting from the inclination of the suspended parts under the influence of gravity (canted track) and/or centrifugal acceleration (curved track) without taking account of any additional dynamic effects

### 3.25

#### **roll centre**

**C**

point C is known as “the roll centre of the vehicle” and its distance  $h_c$  from the running plane is known as “the height of the roll centre”

### 3.26

#### **cant**

**D**

amount by which one running rail is raised above the other running rail, in a track cross section

**3.27****equilibrium cant** **$D_{eq}$** 

cant corresponding to a specific combination of speed and curve radius which gives a resultant force perpendicular to the running plane

**3.28****cant excess**

difference between applied cant and a lower equilibrium cant

Note 1 to entry: See CEN/TR 15273-5:2025 for details.

**3.29****cant deficiency** **$I$** 

difference between applied cant and a higher equilibrium cant

Note 1 to entry: See CEN/TR 15273-5:2025 for details.

**3.30****cross level**

cant measured on the track

**3.31****flexibility coefficient** **$s$** 

ratio of the angle  $\eta$  (angle between the vertical axis of the carbody tilted on its suspensions and the plane perpendicular to the running plane) to the angle  $\delta$  (between the running plane and the horizontal plane) with the vehicle stationary on a canted track

Note 1 to entry: See detailed explanation in Annex A.

**3.32****dissymmetry** **$\eta_0$** 

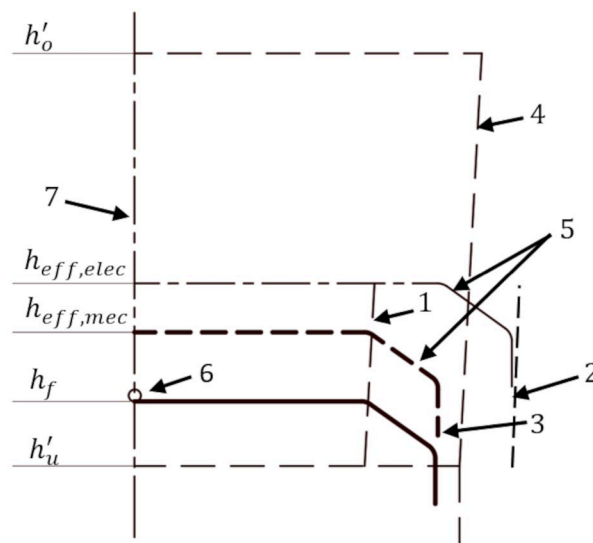
angle  $\eta_0$  between the centreline of the body of a stationary vehicle on a level track and the vertical axis

Note 1 to entry: The dissymmetry may come from construction tolerance or off-centred loading. See detailed explanation in Annex A.

**3.33****defined pantograph gauge**

reference profile with its associated rules which verifies that the raised pantograph head remains within the allocated space

Note 1 to entry: See Figure 3.

**Key**

- 1 electrical pantograph gauge (with insulated horn)
- 2 electrical pantograph gauge (with non-insulated horn)
- 3 pantograph
- 4 pantograph reference profile
- 5 corner according to the form of the pantograph
- 6 contact wire with the pantograph in a collecting position
- 7 track centreline

**Figure 3 — Pantograph gauges**

Note 2 to entry: See Figure B.4. for more details.

**3.34****mechanical pantograph gauge**

reference profile and its associated rules allowing definition of the space to be cleared by all the structures in order to ensure passage of the pantograph in the raised position, taking account of the maintenance allowances and of the displacements considered by the Infrastructure Manager

**3.35****electrical clearance**

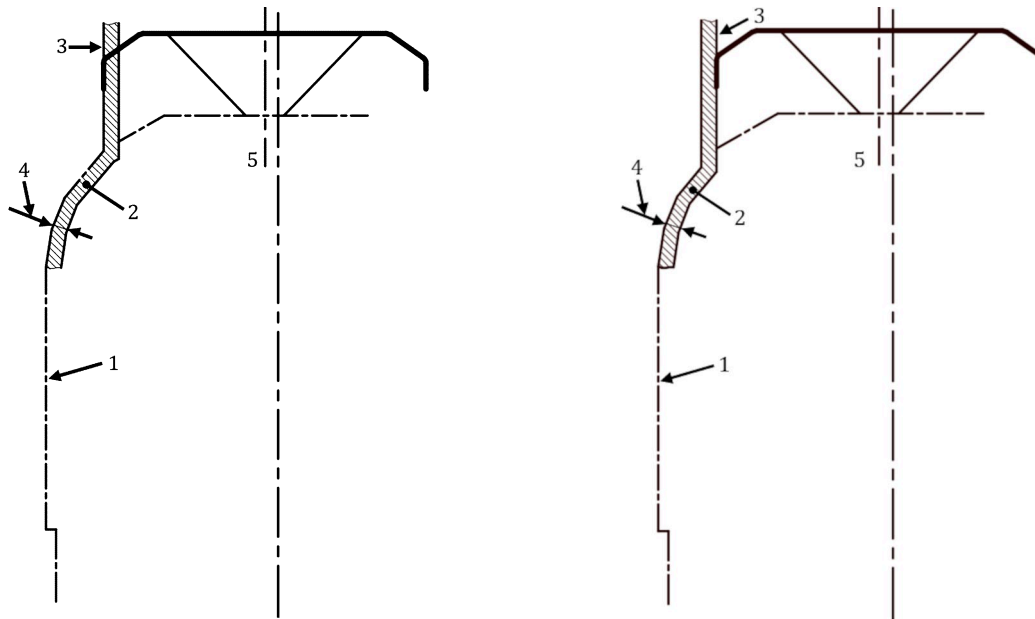
distance to be maintained between two parts at different electrical potentials in given atmospheric conditions in order to ensure electrical insulation

**3.36****electrical pantograph gauge**

reference profile and its associated rules allowing the definition of the space to be cleared taking account of the required electrical insulating allowance relative to the live parts of the pantograph in the raised position

**3.37****gauge for live parts mounted on the roof**

reduced gauge relative to the maximum construction gauge taking account of a sufficient insulating clearance to the non-live parts of the infrastructure



a) Pantograph with insulated horns

b) For pantographs fitted with non-insulated horn

**Key**

- 1 maximum construction gauge
- 2 space not to be penetrated by non-insulated parts likely to remain live
- 3 pantograph reference profile
- 4 electrical insulating clearance for rolling stock
- 5 pantograph with its maximum displacements

**Figure 4 — Gauge for non-insulated live parts on vehicle roof**

### 3.38 vehicle profile

outline of the vehicle cross section perpendicular to the running plane on straight and level track

### 3.39 maximum construction gauge of the rolling stock

maximum outline limit used in the defined gauging process

Note 1 to entry: It is expressed as the available space for the constructed vehicle. In gauge processing, It can be represented in 2D (profile) or in 3D to facilitate communication.

Note 2 to entry: See Figure 5.

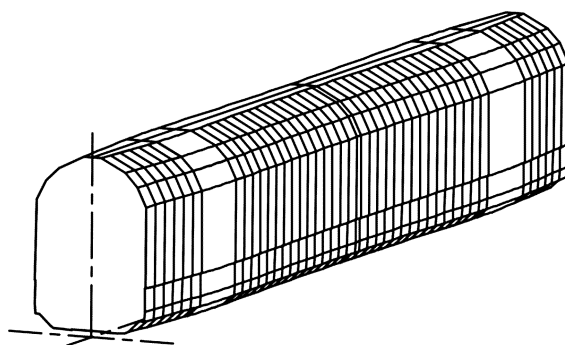


**Figure 5 — 3D representation of the maximum rolling stock construction gauge for a vehicle**

### 3.40

#### **vehicle nominal construction gauge**

maximum rolling stock construction gauge, reduced by the construction tolerances according to the gauging method

### 3.41

#### **infrastructure gauge**

space to be clear of all objects to permit safe operation

Note 1 to entry: The infrastructure gauge is defined on the basis of the reference profile by applying the associated rules.

### 3.42

#### **infrastructure verification limit gauge**

space not to be encroached upon at any time to ensure completely safe passage of traffic

### 3.43

#### **infrastructure installation limit gauge**

space to be clear taking into account a maintenance allowance defined according to the line speed and to the track quality at the time of the infrastructure installation

### 3.44

#### **infrastructure installation nominal gauge**

space to be clear of any obstacle in order to enable train operations and track maintenance by incorporating allowances for safety, maintenance and additional allowances defined by the Infrastructure Manager

### 3.45

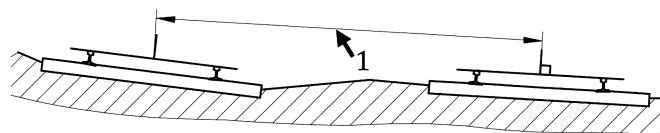
#### **uniform infrastructure gauge**

infrastructure installation nominal gauge of constant cross-section used for the infrastructure

### 3.46

#### **distance between track centres**

**EA**  
distance between the centres of two adjacent tracks, measured parallel to the running plane of the track with the least canted track being the reference

**Key**

1 distance *EA*

**Figure 6 — Distance between track centres**

Note 1 to entry: It is possible to measure the distance between two track centres horizontally but for gauging applications, distance is measured parallel to the running plane of the track with the least cant.

**3.47****verification limit distance between track centres**

minimum distance to be maintained at all times between adjacent tracks to ensure completely safe passage of traffic within the gauge used on the two tracks by avoiding any risk of interference between the vehicles

**3.48****installation limit distance between track centres**

minimum distance between adjacent tracks including maintenance allowances to ensure completely safe passage of traffic within the gauge used on the two tracks by avoiding any interference between the vehicles

**3.49****nominal installation distance between track centres**

distance between two adjacent tracks that generally has a suitable allowance to permit ease of design, laying, monitoring and maintenance, the operation of exceptional consignments or any other aspect (including aerodynamic effects, for example)

**3.50****track fixity**

level of track restraint from movement in any direction, used by absolute gauging

**3.51****construction tolerance**

variation to the design from the nominal due to manufacturing, installation or assembly processes

**3.52****rolling stock domain**

entity responsible for defining the size of the rolling stock from rules agreed between the Infrastructure Manager and Railway Undertaking

**3.53****infrastructure domain**

entity responsible for defining the size of the infrastructure from rules agreed between the Infrastructure Manager and Railway Undertaking

## 4 Symbols and abbreviations

### 4.1 Common symbols

For the purposes of this series of documents, the following symbols and abbreviations given in Table 1 and Table 2 are applicable.

**Table 1 — Common sub- and superscripts**

| Index       | Designation                                                                                                                                                                                                                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| '           | Superscript standing for “pantograph”, unless stated otherwise                                                                                                                                                                                                                                                                       |
| $> 0$       | Subscript designating the value that is taken into account only if it is positive; negative value is regarded as being equal to zero                                                                                                                                                                                                 |
| 0           | Subscript designating “conventional” or “reference value”                                                                                                                                                                                                                                                                            |
| <i>a</i>    | Subscript designating “outside” of a curve or “beyond” bogie pivots or axles                                                                                                                                                                                                                                                         |
| <i>A</i>    | Subscript designating: <ul style="list-style-type: none"> <li>— “motor” bogie or “independent wheelset” on a motor vehicle when used with respect to running gears, or</li> <li>— “leading” bogie or “independent wheelset”, or</li> <li>— “first” bogie or wheelset (the order is selected indifferently – see B below)</li> </ul>  |
| <i>B</i>    | Subscript designating: <ul style="list-style-type: none"> <li>— “trailing” bogie or wheelset on a motor vehicle when used with respect to running gears, or</li> <li>— “trailing” bogie or “independent wheelset”, or</li> <li>— “second” bogie or wheelset otherwise (the order is selected indifferently – see A above)</li> </ul> |
| <i>chr</i>  | Subscript standing for “check rail”                                                                                                                                                                                                                                                                                                  |
| <i>cin</i>  | Subscript standing for “kinematic gauging method”                                                                                                                                                                                                                                                                                    |
| <i>Cro</i>  | Subscript standing for “contact ramp” (also known as “crocodile”)                                                                                                                                                                                                                                                                    |
| <i>CR</i>   | Subscript standing for “reference profile”                                                                                                                                                                                                                                                                                           |
| <i>cnc</i>  | Subscript standing for “concave”                                                                                                                                                                                                                                                                                                     |
| <i>cnv</i>  | Subscript standing for “convex”                                                                                                                                                                                                                                                                                                      |
| <i>cw</i>   | Subscript standing for “contact wire”                                                                                                                                                                                                                                                                                                |
| <i>dat</i>  | Subscript standing for “datum point”                                                                                                                                                                                                                                                                                                 |
| <i>det</i>  | Subscript standing for “detonator”                                                                                                                                                                                                                                                                                                   |
| <i>dyn</i>  | Subscript standing for “dynamic” gauging method                                                                                                                                                                                                                                                                                      |
| <i>elec</i> | Subscript standing for “electrical insulation” and for “electrical pantograph gauge”                                                                                                                                                                                                                                                 |
| <i>fb</i>   | Subscript standing for “ferry boat”                                                                                                                                                                                                                                                                                                  |
| <i>gr</i>   | Subscript standing for “groove”                                                                                                                                                                                                                                                                                                      |
| <i>h</i>    | Subscript standing for “horizontal”                                                                                                                                                                                                                                                                                                  |

| Index       | Designation                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------|
| <i>i</i>    | Subscript designating “inside” of a curve, or of two concentric tracks, or “between” bogie pivots or axles |
| <i>inf</i>  | Subscript designating “infrastructure”                                                                     |
| <i>lim</i>  | Subscript standing for “limit” value                                                                       |
| <i>max</i>  | Subscript standing for “maximum value”                                                                     |
| <i>mec</i>  | Subscript standing for “mechanical parts of the pantograph”                                                |
| <i>min</i>  | Subscript standing for “minimum value”                                                                     |
| <i>mh</i>   | Subscript standing for “marshalling hump”                                                                  |
| <i>nez</i>  | Subscript standing for “platform edge”                                                                     |
| <i>nom</i>  | Subscript standing for “nominal” value                                                                     |
| <i>o</i>    | Subscript standing for “upper”                                                                             |
| <i>osc</i>  | Subscript standing for “oscillation”                                                                       |
| <i>p</i>    | Subscript standing for “tilting”                                                                           |
| <i>PT</i>   | Subscript standing for “point PT”                                                                          |
| <i>q</i>    | Subscript standing for “platform”                                                                          |
| <i>r</i>    | Subscript standing for “reference vehicle”                                                                 |
| <i>rl</i>   | Subscript standing for “actual” value                                                                      |
| <i>SE</i>   | Subscript standing for “swept envelope”                                                                    |
| <i>St</i>   | Subscript standing for static gauging method                                                               |
| <i>Stl</i>  | Subscript standing for “static loading”                                                                    |
| <i>u</i>    | Subscript standing for “lower”                                                                             |
| <i>v</i>    | Subscript standing for “vertical”                                                                          |
| <i>veh</i>  | Subscript standing for “vehicle”                                                                           |
| <i>voie</i> | Subscript standing for “track”                                                                             |
| <i>wag</i>  | Subscript standing for “wagon”                                                                             |
| <i>whe</i>  | Subscript standing for “wheel”                                                                             |

For the purposes of this document, in cases of combined subscripts the different components are separated by commas (e.g.  $M_{2,a}$ ), unless stated otherwise by the list of symbols.

Symbols and abbreviations not explicitly defined in Table 2 are either defined where used in the document or composed using symbols and abbreviations found in Table 1 and Table 2.

Table 2 — Symbols and abbreviations

| Symbol      | Designation                                                                                                                                                         | Unit |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| $a$         | Distance between bogie pivots or between axles of a vehicle without bogies                                                                                          | m    |
| $A$         | Displacement coefficient                                                                                                                                            | —    |
| $Abt$       | Adjustment value of the pantograph displacement                                                                                                                     | m    |
| $Aff$       | Downward suspension displacement value including spring tolerances                                                                                                  | m    |
| $AR$        | Distance between wheel backs                                                                                                                                        | m    |
| $b$         | “Semi-width”: distance of a point on a carbody section or on an infrastructure section, measured with respect to the track centre and parallel to the running plane | m    |
| $b_j$       | Suspension semi-width:<br>$j = 1$ standing for primary suspension,<br>$j = 2$ standing for secondary suspension                                                     | m    |
| $ba$        | Distance between the external face of the wheel and the guidance face inside of the rail (running edge)                                                             | m    |
| $bchr$      | Gap between rail and check-rail                                                                                                                                     | m    |
| $bfr$       | Width to be cleared for the ejection of collector shoes                                                                                                             | m    |
| $b_G$       | Half lateral distance between side bearers                                                                                                                          | m    |
| $bi$        | Distance between the inner wheel face and the inner rail face                                                                                                       | m    |
| $bq$        | Distance of the platform relative to the track centre line, measured parallel to the running plane                                                                  | m    |
| $b'q$       | Distance of the platform relative to the inside edge of the closest rail, measured parallel to the running plane.                                                   | m    |
| $br_j$      | Semi-width of reference vehicle $j = 1, \dots, n$                                                                                                                   | m    |
| $bsl$       | Semi-width of left pantograph head support                                                                                                                          | m    |
| $bsr$       | Semi-width of right pantograph head support                                                                                                                         | m    |
| $b_{Step1}$ | Semi-width of the first step level                                                                                                                                  | m    |
| $b_{Step2}$ | Semi-width of the second step level                                                                                                                                 | m    |
| $b_{veh j}$ | Semi-width of vehicle $j = 1, \dots, n$                                                                                                                             | m    |
| $bw$        | Pantograph semi-width                                                                                                                                               | m    |
| $c$         | Calculation constant                                                                                                                                                | —    |
| $c_{elec}$  | Insulating distance for rolling stock according to voltage of power supply system                                                                                   | m    |
| $cw$        | Pantograph insulating horn width                                                                                                                                    | m    |

| Symbol       | Designation                                                                                                      | Unit |
|--------------|------------------------------------------------------------------------------------------------------------------|------|
| $C$          | Roll centre of the vehicle                                                                                       | —    |
| $CR$         | Reference profile                                                                                                | —    |
| $d$          | Distance between wheel flanges at wear limit measured 10 mm below the wheel tread (see EN 15313)                 | m    |
| $dg$         | Geometric overthrow of the vehicle in a horizontal curve<br>( $dg_v$ in vertical curve)                          | m    |
| $dl$         | Lateral deviation of the contact wire (including any side wind loading)                                          | m    |
| $D$          | Cant                                                                                                             | m    |
| $D'$         | Intermediate cant value between 0 and $D$                                                                        | m    |
| $D_{eq}$     | Equilibrium cant                                                                                                 | m    |
| $D_L$        | Minimum limit value for $D$ used in the calculation of the lateral clearances                                    | m    |
| $D_{sup}$    | Additional cant to be taken into account according to the track quality for dynamic method                       | m    |
| $D_{pl}$     | Displacement                                                                                                     | m    |
| $D_{max}$    | Maximum value for cant used by the Railway Undertaking for the quasi-static effect calculation                   | m    |
| $e$          | Vertical reduction of the reference profile                                                                      | m    |
| $e_p$        | Offset of the pantograph due to the vehicle characteristics                                                      | m    |
| $ev$         | Lowering of track components                                                                                     | m    |
| $E$          | Lateral reduction relative to the reference profile<br>( $E_v$ in vertical direction)                            | m    |
| $Ea, a$      | Lateral reduction from the reference profile relative to the outside face of the wheel, beyond axles             | m    |
| $Ea, i$      | Lateral reduction from the reference profile relative to the outside face of the wheel, between axles            | m    |
| $Ei, i$      | Lateral reduction from the reference profile relative to the inside face of the wheel, between axles             | m    |
| $E_{fr}$     | Width to be cleared for removing brake shoes (scotches)                                                          | m    |
| $E_{chr, a}$ | Lateral reduction with respect to the check rail, beyond the wheelsets                                           | m    |
| $E_{chr, i}$ | Lateral reduction with respect to the check rail relative to the inside face of the wheel, between the wheelsets | m    |
| $EA$         | Distance between the centre lines of two adjacent tracks                                                         | m    |
| $Ev$         | Vertical reduction of the reference profile for the lower parts                                                  | m    |
| $f$          | Vertical deflection of the pantograph                                                                            | m    |
| $fc$         | Vertical displacement of a point on a carbody section due to camber or sag under maximum load conditions         | m    |

| Symbol      | Designation                                                                                                                              | Unit             |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| $f_{cr}$    | Deflection due to creep (ageing) of suspension components                                                                                | m                |
| $f_s$       | Raising of the contact wire                                                                                                              | m                |
| $f_{so}$    | Raising of the contact wire at the lowest temperature, measured relative to its position for the mean temperature                        | m                |
| $f_t$       | Vertical displacement of a point on a carbody section due to camber or sag under tare load conditions                                    | m                |
| $f_{tol}$   | Suspension setup tolerance                                                                                                               | m                |
| $f_v$       | Contact wire sag. Initial sag including the sag between the droppers                                                                     | m                |
| $f_w$       | Contact wire sag at the highest temperature, measured relative to its position for the mean temperature                                  | m                |
| $f_{wa}$    | Pantograph frame rise due to the contact strip wear                                                                                      | m                |
| $f_{ws}$    | Pantograph skew generated by the offset contact point                                                                                    | m                |
| $f_z$       | Vertical suspension static displacement under maximum load conditions                                                                    | m                |
| $F$         | Fixed value taken into account in the lateral projection                                                                                 | m                |
| $Flc$       | Structure deformation of the carbody due to the static loading, called “body sag” between the bogie pivots and “body camber” beyond them | m                |
| $F_w$       | Maximum sum of the traction forces at the wheel-rail contact of the considered wheelset                                                  | N                |
| $gap$       | Distance between the platform edge and the step nose or door sill                                                                        | m                |
| $g$         | Acceleration due to gravity                                                                                                              | m/s <sup>2</sup> |
| $G$         | Centre of gravity of the carbody                                                                                                         | —                |
| $h$         | Height of a point measured from the running plane                                                                                        | m                |
| $h_{det}$   | Lower limit of the parts located outside the end axles (guard irons (lifeguards), sanders etc.) for passing over detonators              | m                |
| $h_{dat}$   | Height above rail level of the datum point for vehicle movements due to suspension displacements                                         | m                |
| $h_c$       | Vehicle roll centre height                                                                                                               | m                |
| $h_{c0}$    | Conventional value of the roll centre height                                                                                             | m                |
| $h_{eff}$   | Effective height of the raised pantograph                                                                                                | m                |
| $h_f$       | Nominal height of the contact wire without any influence of the pantograph in collecting position or other effects                       | m                |
| $h_{minCR}$ | Minimum height of the reference profile taken into account for the platform installation                                                 | m                |
| $h_p$       | Height of the body tilt centre of a tilting vehicle                                                                                      | m                |

| Symbol         | Designation                                                                                                                                                                                                                                                                                                                                                 | Unit |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| $h_{u \min}$   | Height of the lower horizontal line of the reference profile<br>NOTE 1 This minimum height is specified for the vertical geometric displacements of the rolling stock below the reference profile according to the vertical curve of the track.                                                                                                             | m    |
| $h_{u \min 1}$ | Height of the lower horizontal line between rails of the special reference profile of the lower parts for vehicles having to pass over marshalling humps and rail brakes<br>NOTE 2 This minimum height is specified for the vertical geometric displacements of the rolling stock below the reference profile according to the vertical curve of the track. | m    |
| $h_{u \min 2}$ | Height of the lower horizontal line outside rails of the special reference profile of the lower parts for vehicles having to pass over marshalling humps and rail brakes<br>NOTE 3 This minimum height is specified for the vertical geometric displacements of the rolling stock below the reference profile according to the vertical curve of the track. | m    |
| $h_s$          | Height of the step                                                                                                                                                                                                                                                                                                                                          | m    |
| $h_t$          | Installation height of the lower pantograph joint relative to the running plane                                                                                                                                                                                                                                                                             | m    |
| $h_{whe}$      | Minimum height for vehicle parts near the wheel                                                                                                                                                                                                                                                                                                             | m    |
| $I$            | Cant deficiency                                                                                                                                                                                                                                                                                                                                             | m    |
| $I'_c$         | Intermediate cant deficiency value between 0 and $I_c$                                                                                                                                                                                                                                                                                                      | m    |
| $I'_p$         | Intermediate cant deficiency value taken into account for tilting body vehicles                                                                                                                                                                                                                                                                             | m    |
| $I_c$          | Maximum cant deficiency in conventional vehicles used by the Infrastructure Manager for his routes                                                                                                                                                                                                                                                          | m    |
| $I_{eq}$       | Equivalent cant deficiency                                                                                                                                                                                                                                                                                                                                  | m    |
| $I_L$          | Minimum limit value for $I$ used in the calculation of the lateral clearances                                                                                                                                                                                                                                                                               | m    |
| $I_{\max}$     | Fixed cant deficiency value used by the Railway Undertaking for the maximum quasi-static effect calculation                                                                                                                                                                                                                                                 | m    |
| $I_{\sup}$     | Additional cant deficiency to be taken into account according to the track quality for dynamic method                                                                                                                                                                                                                                                       | m    |
| $j$            | Minimum vertical reference clearances at the level of the side bearers                                                                                                                                                                                                                                                                                      | m    |
| $J$            | Vertical clearance at the level of the side bearers                                                                                                                                                                                                                                                                                                         | m    |
| $JP$           | Joint at the switch toe end of the stock rail                                                                                                                                                                                                                                                                                                               | —    |
| $k$            | Safety factor                                                                                                                                                                                                                                                                                                                                               | —    |
| $k_h$          | Coefficient used to take into account the influence of the height                                                                                                                                                                                                                                                                                           | —    |
| $K$            | Coefficient used in the calculation of $qs$ value                                                                                                                                                                                                                                                                                                           | —    |
| $l$            | Track gauge, actual distance between the rail running edges                                                                                                                                                                                                                                                                                                 | m    |
| $l_b$          | Width of wheel                                                                                                                                                                                                                                                                                                                                              | m    |

| Symbol       | Designation                                                                                                                               | Unit |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------|------|
| $l_{chr}$    | Position distance of the check rail relative to the non-adjacent rail running edge                                                        | m    |
| $l_{orn}$    | Flange-way clearance                                                                                                                      | m    |
| $L$          | Conventional distance between the contact points of the wheels on the rails of the same track (the values are set out in EN 15273-4:2025) | m    |
| $m_d$        | Lateral allowance outside of the gauge, authorised for an open door                                                                       | m    |
| $m_s$        | Lateral allowance outside of the gauge, authorised for a deployed step                                                                    | m    |
| $M$          | Margin included in an allowance or a clearance                                                                                            | m    |
| $M_1$        | Mandatory margin                                                                                                                          | m    |
| $M_{1,d}$    | Part of the mandatory margin $M_1$ due to the loading dissymmetry and the suspension adjustment                                           | m    |
| $M_{1,osc}$  | Part of the mandatory margin $M_1$ due to the oscillations                                                                                | m    |
| $M_2$        | Infrastructure maintenance margin                                                                                                         | m    |
| $M_{2,d}$    | Part of the usable margin due to the cross-level variation $T_D$                                                                          | m    |
| $M_{2,voie}$ | Part of the usable margin $M_2$ due to the lateral displacement of the track                                                              | m    |
| $M_3$        | Additional infrastructure margin                                                                                                          | m    |
| $M_e$        | Axle load                                                                                                                                 | kg   |
| $M_{elec}$   | Insulation margin for infrastructure according to the voltage                                                                             | m    |
| $M_{fb}$     | Vertical margin for the passage onto ferries                                                                                              | m    |
| $MP$         | Theoretical positioning point of a switch - mathematical switch toe                                                                       | —    |
| $M_{1,v}$    | Mandatory vertical margin                                                                                                                 | m    |
| $M_{2,v}$    | Maintenance vertical margin                                                                                                               | m    |
| $M_{3,v}$    | Additional vertical margin                                                                                                                | m    |
| $n$          | Distance from an axle or a pivot to the cross-section under consideration.                                                                | m    |
| $p$          | Bogie wheelbase                                                                                                                           | m    |
| $P$          | A critical point on the reference profile used to determine the distance between track centres                                            | —    |
| $P'$         | Value used to verify the pantographs                                                                                                      | m    |
| $P_{orn}$    | Flange-way gap allowing for passage of the wheel flange.                                                                                  | m    |
| $PT$         | End lateral point of the reference profile upper face                                                                                     | —    |
| $PT'$        | Point reached by point PT during its upward vertical movement                                                                             | —    |
| $q$          | Lateral clearance between wheelset and bogie frame, or wheelset and body for vehicles not fitted with bogies                              | m    |
| $qs$         | Displacement due to the quasi-static roll taken into account by the infrastructure                                                        | m    |
| $Q$          | Displacement due to the complete quasi-static roll                                                                                        | m    |

| Symbol       | Designation                                                                                                    | Unit        |
|--------------|----------------------------------------------------------------------------------------------------------------|-------------|
| $r$          | Reserve value                                                                                                  | m           |
| $reb$        | Vehicle rebound                                                                                                | m           |
| $R$          | Curve radius                                                                                                   | m           |
| $R_c$        | Critical curve radius                                                                                          | m           |
| $R_{minTB}$  | Minimum horizontal curve radius in presence of track brakes                                                    | m           |
| $R_p$        | Minimum curve radius, below which the tilting vehicle speed shall be reduced                                   | m           |
| $R_{th}$     | Theoretical curve radius of junction work                                                                      | m           |
| $s$          | Flexibility coefficient                                                                                        | —           |
| $s_d$        | Flange width                                                                                                   | m           |
| $s_{eq}$     | Flexibility coefficient equivalent value                                                                       | —           |
| $s_n$        | Flexibility coefficient of the pantograph carrying structure                                                   | —           |
| $S$          | Projection outside the reference profile                                                                       | m           |
| $S_f$        | Fixed value introduced in the calculation of overthrows                                                        | m           |
| $S_l$        | Part of the lateral projection due to the effect of the track gauge widening                                   | m           |
| $Supl$       | Supplementary value determined by the Infrastructure Manager for the infrastructure installation nominal gauge | m           |
| $S_R$        | Part of the lateral projection due to the geometric overthrow in a curve of radius $R$                         | m           |
| $t$          | Flexibility index of the pantograph head raised to $h'_0$ under the influence of a lateral force of 300 N      | m           |
| $t_{gr}$     | Groove depth                                                                                                   | m           |
| $T_b$        | Construction tolerance of the rolling stock in the lateral direction                                           | m           |
| $T_{charge}$ | Angle of dissymmetry, considered in $\eta_{0,r}$ for the case of uneven load distribution                      | deg         |
| $T_D$        | Cross-level variation between two maintenance intervals                                                        | m           |
| $T_N$        | Margin taking into account the vertical displacement of the track                                              | m           |
| $T_{osc}$    | Margin taking into account the vehicle oscillations due to track irregularities                                | m           |
| $T_q$        | Platform installation tolerance                                                                                | m           |
| $T_{susp}$   | Angle of dissymmetry, considered in $\eta_{0,r}$ for uneven suspension adjustment                              | deg         |
| $T_{voie}$   | Lateral displacement of the track between two periods of maintenance                                           | m           |
| $Usr$        | Maximum allowed wheel wear                                                                                     | m           |
| $V_{line}$   | Line speed                                                                                                     | m/s or km/h |

| Symbol          | Designation                                                                                                                                                                                | Unit        |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| $V$             | Vehicle speed                                                                                                                                                                              | m/s or km/h |
| $V_c$           | Non-tilting vehicle maximum speed                                                                                                                                                          | m/s or km/h |
| $V_p$           | Tilting vehicle maximum speed                                                                                                                                                              | m/s or km/h |
| $V'_c$          | Intermediate value of a non-tilting train speed                                                                                                                                            | m/s or km/h |
| $V'_p$          | Intermediate value of the tilting train speed                                                                                                                                              | m/s or km/h |
| $VF$            | Fixed value used for pantograph gauge calculation                                                                                                                                          | m           |
| $VF_{I_0}$      | Fixed value considered at the upper verification point of the pantographs for a cant deficiency $I_0$                                                                                      | m           |
| $VF_{I_{\max}}$ | Fixed value considered at the upper verification point of the pantographs for a cant deficiency $I_{\max}$                                                                                 | m           |
| $w$             | Lateral clearance between bogie and body                                                                                                                                                   | m           |
| $w_{\infty}$    | Lateral clearance between bogie and body on a straight track                                                                                                                               | m           |
| $w_{(R)}$       | Lateral clearance between bogie and body varying according to the track curve radius                                                                                                       | m           |
| $X$             | Distance between points A and B used for the calculation of $e_v$                                                                                                                          | m           |
| $y$             | Distance between the theoretical centre and the geometric centre of the bogie                                                                                                              | m           |
| $Y$             | Residual lateral clearance for stationary vehicle                                                                                                                                          | m           |
| $y_P$           | Pantograph movement due to the re-centring system                                                                                                                                          | m           |
| $y_q$           | Vertical coordinate of the platform edge in a locally defined {x-y} coordinate system                                                                                                      | m           |
| $z$             | Part of the quasi-static roll taken into account by the Railway Undertaking                                                                                                                | m           |
| $z'$            | Difference between the lateral roll based on the calculation and the actual roll of the upper verification point of the pantograph                                                         | m           |
| $z''$           | Difference between the lateral roll based on the calculation and the actual roll of the lower verification point of the pantograph                                                         | m           |
| $z_0$           | Fixed value available to the Railway Undertaking on the outside of the static reference profile                                                                                            | m           |
| $z'_p$          | Difference between calculated lateral roll and actual roll at the upper verification point of the pantograph mounted on a vehicle with a tilting body or which is submitted to $I_p > I_c$ | m           |
| $z'_p'$         | Difference between calculated lateral roll and actual roll at the lower verification point of the pantograph mounted on a vehicle with a tilting body or which is submitted to $I_p > I_c$ | m           |

| Symbol                | Designation                                                                                                                                                            | Unit             |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| $\alpha$              | Additional angle of roll of the body due to the clearance to the side bearers                                                                                          | deg              |
| $\alpha_{\text{osc}}$ | Angle corresponding to the value $T_{\text{osc}}$                                                                                                                      | deg              |
| $\alpha_{\text{p}}$   | Pantograph tilting angle                                                                                                                                               | deg              |
| $\alpha'$             | Angle of the inclined part of the pantograph head relative to the horizontal                                                                                           | deg              |
| $\alpha''$            | Angle made by the ramp between the pier and the ferry                                                                                                                  | deg              |
| $\beta$               | Switch entry angle of switches and crossings                                                                                                                           | rad              |
| $\beta_{\text{p}}$    | Carbody tilting angle relative to the bogie                                                                                                                            | deg              |
| $\gamma$              | Centrifugal acceleration                                                                                                                                               | m/s <sup>2</sup> |
| $\gamma_{\text{D}}'$  | Centripetal acceleration due to the cant                                                                                                                               | m/s <sup>2</sup> |
| $\gamma_{\text{I}}'$  | Centrifugal acceleration resulting from the cant deficiency                                                                                                            | m/s <sup>2</sup> |
| $\Sigma_v \lambda$    | Allowance corresponding to the optimised sum of the values of margins taken into account by the infrastructure in the vertical direction                               | m                |
| $\lambda$             | Angle made by the straight line joining the centre of gravity at the roll centre with the vertical                                                                     | deg              |
| $\mu$                 | Rail-wheel adhesion coefficient                                                                                                                                        | —                |
| $\eta$                | Angle of roll of the vehicle relative to the running plane                                                                                                             | deg              |
| $\eta_0$              | Angle of dissymmetry of a vehicle due to construction tolerances, to suspension adjustment and to unequal load distributions                                           | deg              |
| $\eta_0'$             | Angle of dissymmetry of a vehicle for which the clearance to the side bearers does not exceed $j$                                                                      | deg              |
| $\eta_{0,\text{r}}$   | Reference angle $\eta_0$ taken into account in the agreement                                                                                                           | deg              |
| $\theta$              | Angle resulting from the suspension adjustment tolerances                                                                                                              | rad              |
| $\tau$                | Pantograph construction and installation tolerance: deviation tolerated between the carbody centreline and the middle of the pantograph head without any lateral force | m                |

## 4.2 Specific symbols for absolute and comparative gauging processes

For the purposes of this document, the following symbols and abbreviations given in Table 3 are also applicable.

**Table 3 — Symbols and abbreviations**

| Symbol         | Description                                                                                                  | Unit |
|----------------|--------------------------------------------------------------------------------------------------------------|------|
| $b_{obstacle}$ | Semi-width of a point on the infrastructure                                                                  | m    |
| $b_{SE,D,V}$   | Semi-width of a point on the swept envelope at a given cant excess and train speed                           | m    |
| $b_{SE,I,V}$   | Semi-width of a point on the swept envelope at a given cant deficiency and train speed                       | m    |
| $b'_e$         | Semi-width of highest point on pantograph head                                                               | m    |
| $\delta_{dg}$  | Addition to overthrow calculated at centreline, to account for vehicle width                                 | m    |
| $Dpl_y$        | Time history of vehicle lateral displacement due to suspension movements                                     | m    |
| $Dpl_{y(1)}$   | Time history of vehicle lateral displacement due to suspension movements over leading bogie pivot            | m    |
| $Dpl_{y(2)}$   | Time history of vehicle lateral displacement due to suspension movements over trailing bogie pivot           | m    |
| $Dpl_{y(3)}$   | Time history of vehicle lateral displacement due to suspension movements at vehicle longitudinal centreline  | m    |
| $Dpl_{y,D,V}$  | Vehicle lateral displacement due to suspension movements at a given cant excess and train speed              | m    |
| $Dpl_{y,I,V}$  | Vehicle lateral displacement due to suspension movements at a given cant deficiency and train speed          | m    |
| $Dpl_{y,w}$    | Lateral displacement due to wheelset movement                                                                | m    |
| $Dpl_{y,w(1)}$ | Lateral displacement due to wheelset movement for leading bogie                                              | m    |
| $Dpl_{y,w(2)}$ | Lateral displacement due to wheelset movement for trailing bogie                                             | m    |
| $Dpl_{y,w,R}$  | Lateral displacement due to wheelset movement at a given horizontal curve radius                             | m    |
| $Dpl_z$        | Time history of vehicle vertical displacement due to suspension movements                                    | m    |
| $Dpl_{z(1)}$   | Time history of vehicle vertical displacement due to suspension movements over leading bogie pivot           | m    |
| $Dpl_{z(2)}$   | Time history of vehicle vertical displacement due to suspension movements over trailing bogie pivot          | m    |
| $Dpl_{z(3)}$   | Time history of vehicle vertical displacement due to suspension movements at vehicle longitudinal centreline | m    |
| $Dpl_{z,D,V}$  | Vehicle vertical displacement due to suspension movements at a given cant excess and train speed             | m    |
| $Dpl_{z,I,V}$  | Vehicle vertical displacement due to suspension movements at a given cant deficiency and train speed         | m    |

| Symbol         | Description                                                                                                    | Unit |
|----------------|----------------------------------------------------------------------------------------------------------------|------|
| $Dpl_{zd,D,V}$ | Vehicle vertical downwards displacement due to suspension movements at a given cant excess and train speed     | m    |
| $Dpl_{zd,I,V}$ | Vehicle vertical downwards displacement due to suspension movements at a given cant deficiency and train speed | m    |
| $Dpl_{zu,D,V}$ | Vehicle vertical upwards displacement due to suspension movements at a given cant excess and train speed       | m    |
| $Dpl_{zu,I,V}$ | Vehicle vertical upwards displacement due to suspension movements at a given cant deficiency and train speed   | m    |
| $dg_{CL}$      | Horizontal geometric overthrow ignoring vehicle width                                                          | m    |
| $dg_{v,ARL}$   | Vertical geometric overthrow outboard of the bogie pivots ignoring vehicle height                              | m    |
| $E_s$          | Pantograph head support vertical stiffness                                                                     | N/m  |
| $F_m$          | Pantograph contact force                                                                                       | N    |
| $F_{sl}$       | Force on left pantograph head support                                                                          | N    |
| $F_{sr}$       | Force on right pantograph head support                                                                         | N    |
| $F_\sigma$     | Number of standard deviations of displacements due to dynamic suspension movements                             | —    |
| $h_{obstacle}$ | Height above rail level of a point on the infrastructure                                                       | m    |
| $h_{SE,D,V}$   | Height above rail level of a point on the swept envelope at a given cant excess and train speed                | m    |
| $h_{SE,I,V}$   | Height above rail level of a point on the swept envelope at a given cant deficiency and train speed            | m    |
| $i$            | Number of cant cases                                                                                           | —    |
| $j$            | Number of speed cases                                                                                          | —    |
| $K_p$          | Safety factor on passing clearance                                                                             | —    |
| $L_o$          | Nominal lateral position of overhead contact wire relative to track centreline                                 | m    |
| $l_{actual}$   | Actual track gauge                                                                                             | m    |
| $M_c$          | Clearance                                                                                                      | m    |
| $M_{c,req}$    | Required clearance                                                                                             | m    |
| $n_D$          | Number of test values per cant case                                                                            | —    |
| $n_{B-B}$      | Distance to the nearest pivot of carbody section B-B                                                           | m    |
| $n_{C-C}$      | Distance to the nearest pivot of carbody section C-C                                                           | m    |
| $pv$           | Predicted value                                                                                                | —    |
| $q'_e$         | Encroachment of the pantograph head                                                                            | m    |

| Symbol           | Description                                                                                              | Unit |
|------------------|----------------------------------------------------------------------------------------------------------|------|
| $q_{\theta}$     | Time history of vehicle roll displacement due to suspension movements                                    | rad  |
| $q_{\theta(1)}$  | Time history of vehicle roll displacement due to suspension movements over leading bogie pivot           | rad  |
| $q_{\theta(2)}$  | Time history of vehicle roll displacement due to suspension movements over trailing bogie pivot          | rad  |
| $q_{\theta(3)}$  | Time history of vehicle roll displacement due to suspension movements at vehicle longitudinal centreline | rad  |
| $q_{\theta,D,V}$ | Vehicle roll displacement due to suspension movements at a given cant excess and train speed             | rad  |
| $q_{\theta,I,V}$ | Vehicle roll displacement due to suspension movements at a given cant deficiency and train speed         | rad  |
| $T_{BOD}$        | Carbody build tolerance                                                                                  | m    |
| $T_{POS,y}$      | Carbody measurement datum lateral tolerance relative to track centreline                                 | m    |
| $T_{POS,z}$      | Carbody measurement datum vertical tolerance relative to track centreline                                | m    |
| $T_{e,y}$        | Effective lateral allowance due to track displacements                                                   | m    |
| $T_{e,y,D}$      | Effective lateral allowance due to track displacements when running at cant excess                       | m    |
| $T_{e,y,l}$      | Effective lateral allowance due to track displacements when running at cant deficiency                   | m    |
| $T_{e,z}$        | Effective vertical allowance due to track displacements                                                  | m    |
| $T_{e,z,D}$      | Effective vertical allowance due to track displacements when running at cant excess                      | m    |
| $T_{e,z,l}$      | Effective vertical allowance due to track displacements when running at cant deficiency                  | m    |
| $T_{im}$         | Infrastructure measurement tolerance                                                                     | m    |
| $T_{rm}$         | Vehicle measurement tolerance                                                                            | m    |
| $T_w$            | Maximum allowable uncompensated wheel wear                                                               | m    |
| $T_{y,o}$        | Additional overall vehicle tolerance for other lateral effects                                           | m    |
| $T_{zveh}$       | Total vertical vehicle construction tolerance                                                            | m    |
| $T_{zd}$         | Downwards static vehicle suspension displacement                                                         | m    |
| $T_{zd,o}$       | Additional overall vehicle tolerance for other downwards effects                                         | m    |
| $T_{zd,s}$       | Downwards vehicle suspension height setup tolerance                                                      | m    |
| $T_{zsc}$        | Vertical suspension displacement due to creep of components                                              | m    |
| $T_{zu}$         | Upwards static vehicle suspension displacement                                                           | m    |
| $T_{zu,o}$       | Additional overall vehicle tolerance for other upwards effects                                           | m    |

| Symbol                    | Description                                                                                                        | Unit |
|---------------------------|--------------------------------------------------------------------------------------------------------------------|------|
| $T_{zu,s}$                | Upwards vehicle suspension height setup tolerance                                                                  | m    |
| $T_{\eta_0}$              | Carbody measurement datum roll tolerance relative to track running plane                                           | rad  |
| $tv$                      | Test value                                                                                                         | —    |
| $\delta_{CW}$             | Lateral position of displaced overhead contact wire relative to track centreline                                   | m    |
| $\delta_{dga}$            | Correction term for overthrow formulae based on vehicle centreline outboard of the bogie pivots                    | m    |
| $\delta_{dgi}$            | Correction term for overthrow formulae based on vehicle centreline between the bogie pivots                        | m    |
| $\delta'$                 | Lateral displacement of pantograph head centreline relative to track centreline                                    | m    |
| $\delta_{vsl}$            | Vertical displacement of left pantograph head support                                                              | m    |
| $\delta_{vsr}$            | Vertical displacement of right pantograph head support                                                             | m    |
| $\sigma_{F_m}$            | Standard deviation of the contact force                                                                            | N    |
| $\sigma_{Dpl_y}$          | Standard deviation of lateral displacements due to suspension movement                                             | m    |
| $\sigma_{Dpl_{y,I,V}}$    | Standard deviation of lateral displacements due to suspension movement at a given cant deficiency and train speed  | m    |
| $\sigma_{Dpl_z}$          | Standard deviation of vertical displacements due to suspension movement                                            | m    |
| $\sigma_{Dpl_{z,D,V}}$    | Standard deviation of vertical displacements due to suspension movement at a given cant excess and train speed     | m    |
| $\sigma_{Dpl_{z,I,V}}$    | Standard deviation of vertical displacements due to suspension movement at a given cant deficiency and train speed | m    |
| $\sigma_{q_{\theta,D,V}}$ | Standard deviation of roll displacements due to suspension movement at a given cant excess and train speed         | rad  |
| $\sigma_{q_{\theta,I,V}}$ | Standard deviation of roll displacements due to suspension movement at a given cant deficiency and train speed     | rad  |

## 5 Approaches to gauging

### 5.1 Railway gauging processes

A defined gauging process assures the interoperability of rolling stock on various routes with an independent management of the infrastructure on the one hand and of the rolling stock on the other, based on common rules to share the responsibilities.

Other processes, such as absolute gauging and comparative gauging, can be used for optimising the sizing of the rolling stock using specific infrastructure profiles with appropriate safety clearances.

## 5.2 How to use EN 15273 series

- EN 15273-1:2025 gives general explanations and the common rules for sharing the responsibilities between Railway Undertaking and Infrastructure Manager;
- EN 15273-2:2025 gives the rules for sizing the rolling stock according to a defined gauge and the process to define a swept envelope for absolute and comparative gauging.

The use of defined gauges to build a new vehicle does not need any agreement from the Infrastructure Manager. Depending on the intended compatibility level, the calculation shall be done following a static, kinematic or dynamic defined method.

The use of an absolute gauging process needs an agreement with the Infrastructure Manager.

A comparative gauging process requires consideration of a swept envelope of an existing vehicle already running on the same specific route.

- EN 15273-3:2025 gives the rules for sizing the infrastructure and the necessary margins to obtain appropriate clearances. This applies both to fixed obstacles and to the distance between adjacent tracks.

For defined gauging, the infrastructure gauge is defined on the basis of reference profile and its associated rules coming from an agreement between the Infrastructure Manager and the Railway Undertaking.

- EN 15273-4:2025 gives the reference profiles and the associated values for the defined gauges applied in EN 15273-2:2025 and EN 15273-3:2025 according to the sharing of responsibilities given in EN 15273-1:2025;
- CEN/TR 15273-5:2025 gives some worked examples and a historical background about the origin of the gauging methods.

Figure 7 and Figure 8 give a general overview of the relationship between the various parts of the gauging standard.

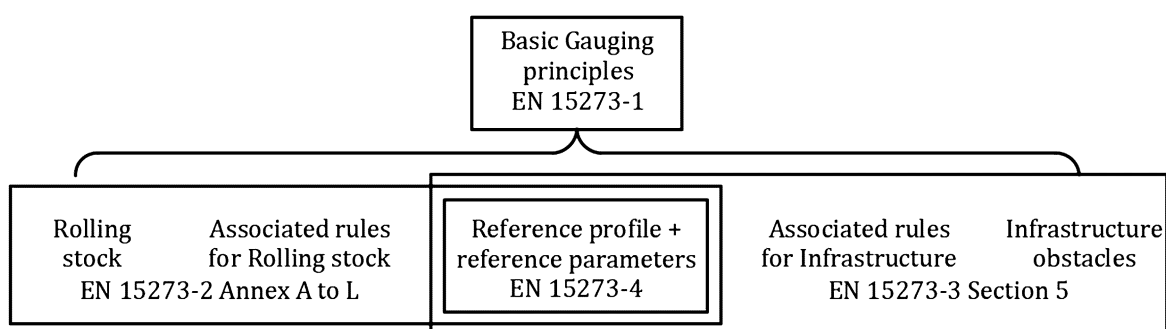


**Figure 7 — Kinematic, static and dynamic defined gauging process**

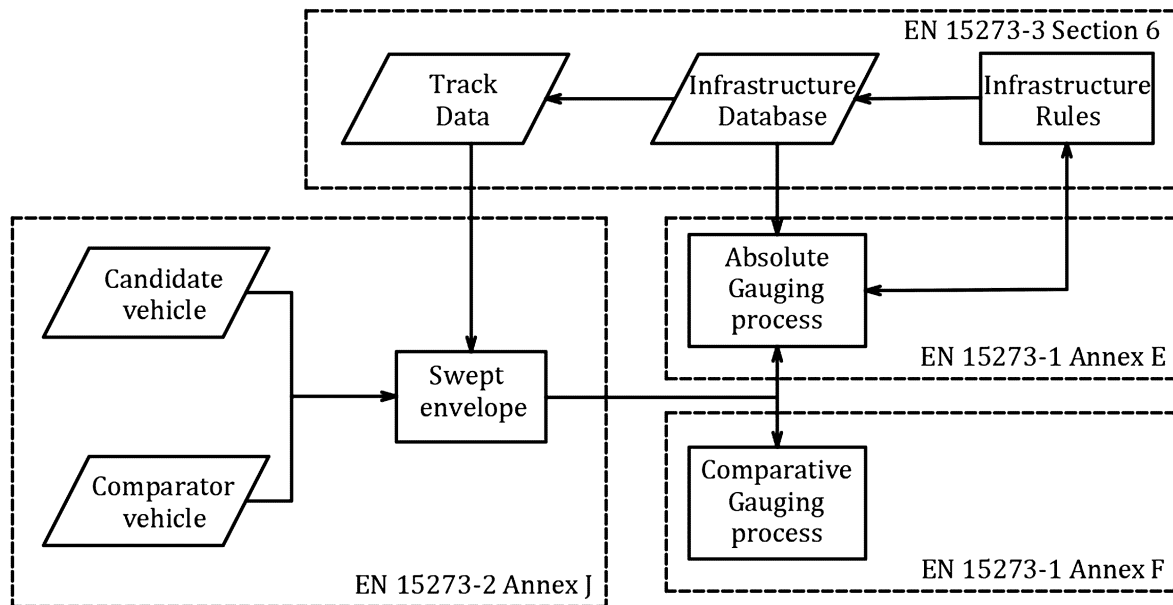


**Figure 8 — Absolute and comparative gauging process**

### 5.3 Choosing a defined gauge or a gauging process

#### 5.3.1 Interoperability between Railway Undertaking and Infrastructure Manager

This document proposes:

- defined gauging methods used for interoperability of the rolling stock on various infrastructure;
- absolute gauging process used for specific routes;
- comparative gauging process used for specific routes.

Choosing a defined gauge or a gauging process depends mainly on the interoperability level to be ensured between rolling stock and the various dedicated infrastructure.

The organisation responsible for the rolling stock shall refer to the Infrastructure Manager to know which process shall be used.

Defined gauges apply for an independent managing of the rolling stock and Infrastructure Manager.

An absolute gauging process may be used where detailed infrastructure data is available for specific routes.

A comparative gauging process may be used where it is possible to use existing rolling stock as a reference.

### 5.3.2 Defined gauging methods

The three following calculation methods are used for defined gauges with common rules for the rolling stock and the infrastructure:

- defined kinematic gauges;
- defined static gauges;
- defined dynamic gauges.

The three calculation methods allow for different degrees of interoperability of rolling stock on independent infrastructure respecting the same gauge:

- defined kinematic gauges are interoperable up to a maximum value of cant  $D_{max}$  or cant deficiency  $I_{max}$ ;
- defined static gauges ensure the compatibility of vehicles for which the flexibility of the suspensions does not exceed a specified limit value  $s_{lim}$  ;
- defined dynamic gauges ensure compatibility of vehicles on infrastructure that complies with the specified track quality.

This standard defines the responsibilities:

- for the Railway Undertaking:
  - compliance with the gauge concerned;
  - maintenance of this compliance over time.
- for the Infrastructure Manager:
  - compliance with the gauge concerned;
  - maintenance of this compliance over time;
  - infrastructure monitoring.

The interoperability of rolling stock using various infrastructure without specific control of compatibility is only assumed by the defined kinematic gauges.

The clauses of the EN 15273 series described in Table 4 apply:

**Table 4 — Clauses of the EN 15273 series**

| Rules                             | Parts                          | Clause or subclause | Description                                                                                                                                   |
|-----------------------------------|--------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Common</b>                     | EN 15273-1:2025<br>(this part) | 6                   | Elements involved in a gauging process                                                                                                        |
|                                   |                                | 7.1                 | Defined gauges by calculation                                                                                                                 |
|                                   |                                | Annex A             | Specific considerations for the classic calculations of defined gauges                                                                        |
|                                   |                                | Annex B             | Defined kinematic gauges                                                                                                                      |
|                                   |                                | Annex H             | Steps for access and egress – Location and gaps with platform                                                                                 |
|                                   |                                | Annex G             | Compatibility between static and kinematic defined gauges                                                                                     |
|                                   | EN 15273-4:2025                | 6                   | Reference profile – Kinematic gauges                                                                                                          |
| <b>Specific for rolling stock</b> | EN 15273-2:2025                | Annex A             | Common rules for defined kinematic gauges                                                                                                     |
|                                   |                                | Annex B             | General principles for passive tilting vehicles and non-tilting vehicles operating with $I = I_p > I_c$ to use with a defined kinematic gauge |
|                                   |                                | Annex C             | General principles for active tilting vehicles and pantograph associated with a re-centring system to use with a defined kinematic gauge      |
|                                   |                                | Annex D             | Graphical method                                                                                                                              |
|                                   |                                | Annex E             | Application of defined kinematic gauges for rolling stock                                                                                     |
|                                   |                                | Annex N             | List of documents for rolling stock gauge assessment applicable for defined kinematic, static and dynamic gauges                              |

| Rules                                          | Parts           | Clause or subclause | Description                                                                  |
|------------------------------------------------|-----------------|---------------------|------------------------------------------------------------------------------|
| <b>Specific for the various infrastructure</b> | EN 15273-3:2025 | 5.2                 | General information on all the gauging methods                               |
|                                                |                 | 5.3                 | Kinematic gauging method                                                     |
|                                                |                 | 5.6.3.3.2.1         | Distance between track centres - Kinematic                                   |
|                                                |                 | 5.7                 | Elements of variable layout                                                  |
|                                                |                 | 5.8.1               | Determination of the free passage gauge of the pantograph - General          |
|                                                |                 | 5.8.2               | Mechanical infrastructure pantograph gauge for the kinematic gauging method  |
|                                                |                 | 5.8.3               | Electrical infrastructure pantograph gauge for the kinematic gauging method  |
|                                                |                 | 5.10.1              | Items of intended close proximity - Rules for installation of platform edges |
|                                                |                 | 5.12                | Tilting trains                                                               |
|                                                |                 | 5.13                | Ferries                                                                      |
|                                                |                 | 5.14                | Verification and maintenance of the gauge                                    |
|                                                |                 | Annex A Table A.1   | Values for calculation of the allowances in defined gauging.                 |
|                                                |                 | Annex B             | Defined gauging - Lower parts                                                |
|                                                |                 | Annex C             | Determination of reference vehicle characteristics                           |
|                                                |                 | Annex D             | Gauge maintenance guideline for defined gauging                              |
|                                                |                 | Annex E             | Calculation example for determination of the gauge in a turnout              |
|                                                |                 | Annex F             | Tilting trains                                                               |
|                                                |                 | Annex G             | Uniform gauge                                                                |

### 5.3.3 Absolute gauging process

The absolute gauging process relates the position of the infrastructure to the vehicle and can be used with static, kinematic or dynamic swept envelopes.