



BSI Standards Publication

Railway applications — Gauges

Part 3: Infrastructure

National foreword

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

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European foreword

This document (EN 15273-3:2025) 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of an identical text or by endorsement, at the latest by April 2026, and conflicting national standards shall be withdrawn at the latest by April 2026.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 is one of the series EN 15273, *Railway applications — Gauges* as listed below:

- 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*.

This document supersedes EN 15273-3:2013+A1:2016.

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;
- reorganization of clauses from previous editions;
- creation of a new Clause 6 for absolute and comparative gauging process;
- all worked examples moved into the new CEN/TR 15273-5:2025;
- Table B.1 moved into the informative Annex A;
- all reference profiles and basics data from normative Annex C and normative Annex D moved into the new EN 15273-4:2025;
- normative Annex F moved into informative Annex C;
- informative Annex H moved into informative Annex D;
- creation of a new informative Annex F about tilting trains.

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 series EN 15273 is to define the rules for the calculation and verification of the dimensions of rolling stock and infrastructure from a gauging perspective.

This series EN 15273 sets out gauging processes taking into account the relative movements between rolling stock and infrastructure as well as the necessary margins or clearances.

EN 15273-3:2025 covers requirements for infrastructure and is used in conjunction with the following parts:

- *Part 1: General — Common rules for rolling stock and infrastructure;*
- *Part 2: Rolling stock;*
- *Part 4: Catalogue of defined gauges;*
- *Part 5: Background, explanation and worked examples.*

1 Scope

This document:

- lists the formulae and the associated rules needed to calculate the infrastructure gauge;
- lists the various phenomena to be taken into account to determine the infrastructure gauge;
- defines a methodology that may be used to calculate the various profiles from these phenomena;
- lists the rules to determine the distance between the track centres;
- lists the rules to be complied with when building the platforms;
- lists the rules to determine the pantograph gauge;
- provides recommendations for the various profiles needed to install, verify and maintain infrastructure;

and is applicable for various track gauges.

This document is applicable to heavy rail 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 13232-1:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 1: Definitions*

EN 13232-2:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 2: Requirements for geometric design*

EN 13232-3:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 3: Requirements for wheel/rail interaction*

EN 13232-4:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 4: Actuation, locking and detection*

EN 13232-5:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 5: Switches*

EN 13232-6:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 6: Fixed common and obtuse crossings*

EN 13232-7:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 7: Crossings with moveable parts*

EN 13232-8:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 8: Expansion devices*

EN 13232-9:2023, *Railway applications — Track — Switches and crossings for Vignole rails — Part 9: Layouts*

EN 15273-1:2025, *Railway applications — Gauges — Part 1: General – Common rules for Infrastructure and rolling stock*

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

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

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

EN 50367:2020¹, *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 terms and definitions given in EN 15273-1:2025 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/>

4 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in EN 15273-1:2025 apply.

5 Defined gauging

5.1 General

5.1.1 Introduction

For defined gauging, the infrastructure is defined on the basis of a reference profile and its associated rules (see EN 15273-1:2025, EN 15273-4:2025 and 5.2.1) that form an agreement between the Infrastructure Manager and the Railway Undertaking and are therefore inseparable.

This agreement dictates how the various possible displacements of a vehicle on the track are distributed and taken into account.

5.1.2 Gauging methods

There are various calculation methods; more details are given in EN 15273-1:2025. It is essential to specify the method used:

- the kinematic method;
- the dynamic method;
- the static method.

¹ Document impacted by EN 50367:2020/A1:2022 and EN 50367:2020/A2:2025.

5.1.3 Infrastructure gauge types

For each reference profile, listed in EN 15273-4:2025, there are different infrastructure gauge types depending on the required application:

- the infrastructure verification limit gauge only takes into account gauge widening and mandatory allowances that ensure safe operations of traffic after on-site measurements are checked. Considering this type of gauge only represents the current infrastructure condition it can be applied for a short time period which is decided by the Infrastructure Manager. Effects that changes the gauge after these measurements (e.g., wear of rail, maintenance operations) are not taken into account;
- the infrastructure installation limit gauge takes into account the infrastructure verification limit gauge and all the displacements and wear that may occur between two maintenance periods by means of an infrastructure maintenance allowance. Fitting this gauge means that clearance is maintained between the various maintenance and checking operations;
- the infrastructure installation nominal gauge takes into account the infrastructure installation limit gauge and additional infrastructure allowances. This gauge means that clearance is maintained in practically all conditions and allows more possible uses.

5.1.4 Uniform gauge

When the Infrastructure Manager has sufficient space available, they can define a non-variable gauge with a design that permits easier management for the Infrastructure Managers and may allow the passage of exceptional consignments. This gauge, which generally incorporates additional allowances, is a nominal type infrastructure gauge called a uniform gauge.

Uniform gauges are used in Europe by several networks. Their application rules may differ according to the networks.

This approach creates an additional allowance compared to the infrastructure installation nominal gauge used and is only possible if adequate space is available on site.

The Infrastructure Manager shall always check the conditions on which this gauge is based and shall always return to the infrastructure installation nominal gauge when these conditions are not met any longer.

The passage of exceptional consignments shall be agreed with the Infrastructure Manager.

More detailed information can be found in Annex G.

5.1.5 Choice of gauge

5.1.5.1 Introduction

The gauge choice is up to the Infrastructure Managers. For this, the Infrastructure Manager may need to consider:

- the technical specifications for interoperability in force;
- the bilateral or multilateral agreements;
- international technical specifications in force;
- the space available on the lines concerned;
- the specific restrictions imposed by the infrastructure.

The Infrastructure Manager is responsible for the maintenance of the chosen gauge over time.

The calculation method is strongly linked to the gauge choice.

5.1.5.2 Infrastructure gauge type choice

When constructing new lines, the infrastructure installation nominal gauge should be applied. In exceptional circumstances it is permitted for the Infrastructure Manager to apply the infrastructure installation limit gauge.

For all other new installations on existing lines, renewal, upgrading, etc., it is recommended to apply the infrastructure installation nominal gauge. It is permissible for the Infrastructure Manager to apply the infrastructure installation limit gauge.

NOTE 1 The aim will always be to clear the infrastructure installation nominal gauge.

An infrastructure verification limit gauge may need to be defined when the Infrastructure Manager wants to verify the obstacle free running of vehicles on a track in a degraded condition.

NOTE 2 Once selected a particular type of infrastructure gauge for the line or section of a line, it does not imply necessarily that the same gauge type needs also to be considered in the calculation of the distance between tracks, platforms and pantograph gauge.

5.2 General information on all the gauge calculation methods

5.2.1 The reference profile and its associated rules

All types of infrastructure gauges are determined by enlarging the reference profile in the lateral and vertical directions, which are often dealt with separately.

This gauge widening corresponds to the displacements of the reference vehicles that are the basis for defining the gauge considered.

NOTE The quasi-static effects and the displacements due to random phenomena (except T_N and T_{voie}) cause a rotation of the vehicle body in different directions, which translate into vertical and lateral displacements.

The calculation of b_{inf} and h_{inf} described in the different methods for the PT (see Figure 3) point is conservative because all the lateral displacements in the same direction as well as all the vertical upward displacements have been taken into account, which is unrealistic in a real world scenario. Therefore, the Infrastructure Manager is allowed to invert the mathematical signs of the quasi-static effects and the displacements due to random phenomena in the related formulae in order to obtain an optimized gauge.

5.2.2 Lateral gauge widening

5.2.2.1 General

Depending on the gauging method and the infrastructure gauge type, some or all of the following parameters need to be taken into account.

5.2.2.2 Lateral infrastructure gauge variations depending on the local situation

5.2.2.2.1 General

The gauge variations depend on the calculation method used and particularly on the gauge used.

5.2.2.2.2 Lateral projection ($S_{i/a}$)

The lateral projection defines the sum of the following phenomena:

- the geometric effect in the curve of the reference vehicles (S_R);
- the effect of the track gauge widening (S_l);
- F value for static calculation method (see CEN/TR 15273-5:2025).

The general formulations are set forth in EN 15273-1:2025. The specific formulae to be used for calculating each gauge are given in EN 15273-4:2025.

5.2.2.2.3 Lateral quasi-static effect ($qs_{i/a}$)

The quasi-static effect gives the reference vehicle body roll in a curve for the upper parts:

In the case of positive cant:

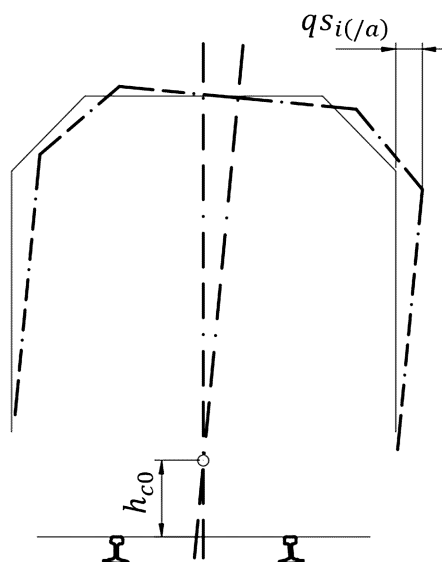
- outside of the curve, under the cant deficiency effect, which becomes maximum at maximum speed;
- inside of the curve, under the effect of cant, which becomes maximum when the vehicle is stationary

In the case of negative cant:

- outside of the curve, under the cant deficiency effect, which becomes maximum at maximum speed;

NOTE 1 With negative cant, the cant deficiency will be higher than equilibrium cant.

- inside of the curve, the effect of cant is neglected ($qs_i = 0$).



Key

- h_{c0} height of the reference roll centre of the vehicle
- qs lateral quasi static effect

Figure 1 — Lateral quasi static effect

It should be noted that, for the kinematic calculation method, the rolling stock domain takes a part of cant deficiency and cant up to values I_0 and D_0 into account and the infrastructure domain takes the remaining part ($I-I_0$) and ($D-D_0$) along with the values s_0 and h_{c0} into account.

In the static calculation method, the complete D or I needs to be taken into account by the Infrastructure Manager.

NOTE 2 Other methods exist for taking the lateral quasi-static effect into account. For example, in the case of the dynamic calculation method, the lateral quasi-static effect is taken into account by the rolling stock domain.

The general formulations are given in EN 15273-1:2025. The specific formulae to be applied for the gauge used are given in 5.3.2.1 for the kinematic gauging method.

For the lower parts (see Annex B), the lateral quasi-static effect is taken into account by the rolling stock domain.

5.2.2.3 Lateral random phenomena

5.2.2.3.1 General

Random phenomena to be considered depend on the gauge method and infrastructure gauge type used.

The following phenomena are considered as the responsibility of the Infrastructure Manager.

5.2.2.3.2 Vehicle oscillations generated by track irregularities (T_{osc})

Irregularities of the track are one of the causes of vehicle oscillations. The amplitude depends mainly on the track condition and suspension characteristics. These phenomena are taken into account by the infrastructure by the value T_{osc} . Depending on the flexibility of the vehicle, they are located at the base of an inclination around the roll centre and thus the following gauge widening (Formula (1)):

$$\Delta b_1 = \frac{s_0}{L} \cdot T_{osc} \cdot (h - h_{c0})_{>0} \quad (1)$$

NOTE Other methods exist for taking this phenomenon into account. For example, in the case of the dynamic calculation method, this phenomenon is taken into account by the rolling stock domain.

In straight track, the value of $T_{osc,a}$ shall be taken into account.

5.2.2.3.3 Track displacement (T_{voie})

T_{voie} is a lateral margin that takes into account the lateral movement of the track. The track position is likely to change between two track maintenance and/or obstacle verifications owing to the traffic loads and to the track maintenance.

When the track design does not allow any movement in relation to the structure, this allowance may be disregarded.

5.2.2.3.4 Cross level variation (T_D)

T_D is a value for the variation of cross level. The cross level of the track can vary in relation to its nominal value due to the maintenance tolerances and to the traffic. This cross level variation T_D has a double effect:

- the reference profile rotates around the track centreline at an angle corresponding to the maximum variation, $\frac{T_D}{L}$ which causes the following gauge widening (Formula (2)):

$$\Delta b_2 = \frac{T_D}{L} \cdot h \quad (2)$$

- the vehicle will tend to roll around the roll centre, affected by the flexibility of its suspension, which will cause an additional gauge widening of parts located above the roll centre (Formula (3)):

$$\Delta b_3 = \frac{s_0}{L} \cdot T_D \cdot (h - h_{c0})_{>0} \quad (3)$$

It shall be noted that the two phenomena are always present simultaneously and are therefore not independent.

NOTE Other methods exist for taking this phenomenon into account. For example, in the case of the dynamic calculation method, only the geometrical effect is taken into account by the Infrastructure Manager, the dynamic effect is taken into account by the rolling stock domain.

5.2.2.3.5 Dissymmetry ($\eta_{0,r}$)

A vehicle will never be perfectly symmetrical; the main reasons for this are as follows:

- poor suspension adjustment resulting in a body roll (T_{susp});
- loading dissymmetry which makes the vehicle body roll which results similarly in a rotation of the vehicle (T_{charge}).

In both cases, the vehicle body rotates around its roll centre C_0 . The sum of the two angles corresponds to the agreed reference angle $\eta_{0,r}$ as shown in Formula (4):

$$\eta_{0,r} = T_{charge} + T_{susp} \quad (4)$$

This will cause additional gauge widenings as shown in Formula (5) and Formula (6):

$$\Delta b_4 = \tan(T_{charge}) \cdot (h - h_{c0})_{>0} \quad (5)$$

and

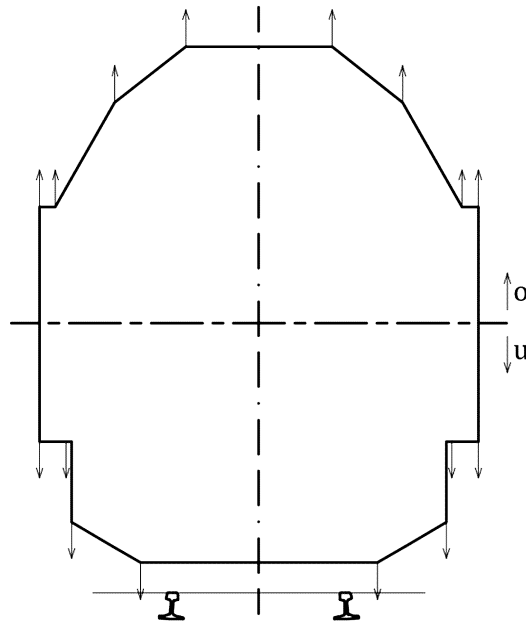
$$\Delta b_5 = \tan(T_{susp}) \cdot (h - h_{c0})_{>0} \quad (6)$$

NOTE Other methods exist for taking this phenomenon into account. For example, in the case of the dynamic calculation method, this phenomenon is taken into account by the rolling stock domain.

5.2.3 Vertical adjustment

5.2.3.1 General

According to the point on the reference profile and the gauge method, some or all the following parameters need to be taken into account, either upward or downward.

**Key**

- O movement in upward direction
- U movement in downward direction

Figure 2 — Vertical adjustment**5.2.3.2 Vertical infrastructure gauge variations depending on the local situation****5.2.3.2.1 General**

The gauge variations depend on the calculation method used and particularly on the gauge used.

5.2.3.2.2 Vertical projection ($S_{v,u/o}$)

The vertical projection has to be taken into account either upward ($S_{v,o}$) or downward ($S_{v,u}$) according to the position of the point on the reference profile.

The downward projection has to be taken into account for points where the width b_{CR} increases with the height (see Figure 2).

The upward projection has to be taken into account for points, where the width b_{CR} decreases with the height (see Figure 2).

The general formulae are set out in EN 15273-1:2025. The specific formulae to be used for calculating each gauge are given in EN 15273-4:2025.

5.2.3.2.3 Vertical quasi-static effect (Δh_{PT})

The roll may generate a vertical movement (Δh_{PT}) of the upper part of the reference profile. This phenomenon shall be taken into account for gauges with a sizable flat in the horizontal upper part) and is advisable to take into account for other gauges and is left to the discretion of the Infrastructure Manager.

This effect shall be taken into account only for point PT as shown in Figure 3.

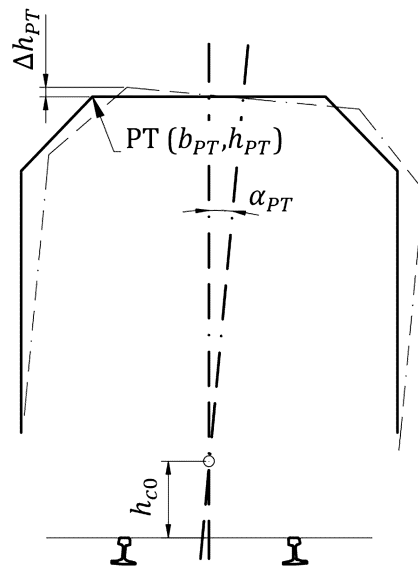


Figure 3 — Vertical quasi static effect

Δh_{PT} is determined by Formula (7):

$$\Delta h_{PT,a} = b_{PT} \cdot \sin \alpha_{PT,a} - (h_{PT} - h_{c0}) \cdot (1 - \cos \alpha_{PT,a}) \cong b_{PT} \cdot \sin \alpha_{PT,a} \quad (7)$$

Where:

$\alpha_{PT,a}$ is the rotation of the gauge due to the quasi-static effect. This value (used in the kinematic calculation method) can differ between the inside of the curve and the outside of the curve. See Formula (36) or Formula (38) in 5.3.2.2.

h_{PT} , b_{PT} are the coordinates of the point considered PT.

The vertical quasi-static effect gives the reference vehicle body roll in a curve for point PT:

In the case of positive cant:

- outside of the curve, under the effect of cant, which becomes maximum when the vehicle is stationary;
- inside of the curve, under the cant deficiency effect, which becomes maximum at maximum speed.

In the case of negative cant:

- inside of the curve, under the cant deficiency effect, which becomes maximum at maximum speed;

NOTE 1 With negative cant, the cant deficiency will be higher than equilibrium cant.

- outside of the curve, the effect of cant is neglected ($\Delta h_{PT,a} = 0$)

It should be noted that, for the kinematic calculation method, the rolling stock domain already takes a part of the cant deficiency and cant into account up to values I_0 and D_0 .

For the lower parts (see Annex B), this phenomenon is taken into account by the rolling stock domain in terms of the train architecture (for example: tilting trains).

NOTE 2 Other methods exist for taking this phenomenon into account. For example, in the case of the dynamic calculation method, this phenomenon is taken into account by the rolling stock domain.

5.2.3.3 Vertical random phenomena

5.2.3.3.1 General

Random phenomena to be considered depend on the gauge method and infrastructure gauge type used. The following phenomena are considered as the responsibility of the Infrastructure Manager.

5.2.3.3.2 Vertical track displacement (T_N)

T_N is a vertical margin that takes into account the vertical displacement of the track. The track position is likely to change between two track maintenances and/or obstacle verifications owing to the traffic loads, track maintenance and environmental conditions. For this parameter, 3 different values can be chosen, according to the phenomena covered:

- $T_{N,o}$ upward movement due to track maintenance (tamping);
- $T_{N,u}$ (for obstacles attached to the track): downward movement due to rail wear;
- $T_{N,u}$ (for obstacles, not attached to the track): downward movement due to rail wear and track settlement.

5.2.3.3.3 Vertical effects for calculating the movement of point PT

5.2.3.3.3.1 General

The following phenomena are generated by roll. As explained in 5.2.3.2.3, these effects have to be taken into account only for point PT.

5.2.3.3.3.2 Vehicle oscillations generated by track irregularities (T_{osc})

Vehicle oscillations due to track irregularities (see 5.2.2.3.2) generate a vertical movement of the upper part of the reference profile which can be expressed by the Formula (8):

$$\Delta h_1 = b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc} \quad (8)$$

By similarities with 5.2.3.2.3, the vertical movement to be considered:

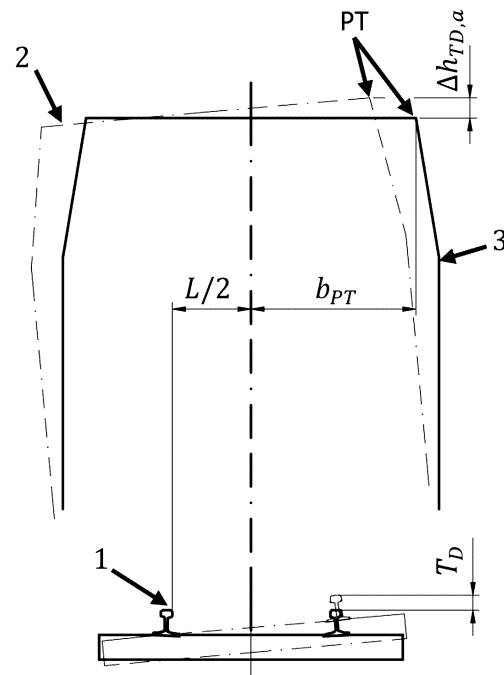
- on the inside of the curve is caused by $T_{osc,a}$;
- on the outside of the curve is caused by $T_{osc,i}$.

NOTE Other methods exist for taking this phenomenon into account. For example, in the case of the dynamic calculation method, this phenomenon is taken into account by the rolling stock domain.

5.2.3.3.3.3 Cross level variation (T_D)

T_D is a value for the variation of cross level. This cross level variation T_D has a double effect: a geometrical effect and an effect due to the vehicle suspension:

- The centre of rotation of the geometrical effect is considered on the lower rail which is the common reference when dealing with cant deviation and creates two different formulae, explained by Figure 4 and Figure 5:



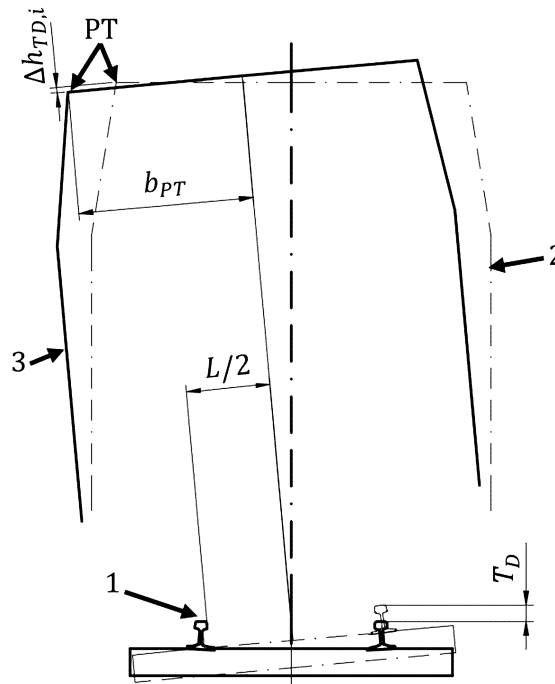
Key

- 1 centre of rotation
- 2 reference profile under effect of T_D (locally increasing cant)
- 3 original reference profile

Figure 4 — Geometrical effect of cross level variation on point PT on the outside of a curve

This effect equals (Formula (9)):

$$\Delta h_{TD,a} = \left(b_{PT} + \frac{L}{2}\right) \cdot \frac{T_D}{L} \quad (9)$$

**Key**

- 1 centre of rotation
- 2 reference profile under effect of T_D (locally decreasing cant)
- 3 original reference profile

Figure 5 — Geometrical effect of cross level variation on point PT on the inside of a curve

This effect equals (Formula (10)):

$$\Delta h_{TD,i} = \left(b_{PT} - \frac{L}{2}\right) \cdot \frac{T_D}{L} \quad (10)$$

On straight track without cant, the maximum of Formulae (9) and (10) shall be applied.

In the case of negative cant, see EN 13803, Formulae (11) and (12) apply:

$$\Delta h_{TD,i} = \left(b_{PT} + \frac{L}{2}\right) \cdot \frac{T_D}{L} \quad (11)$$

$$\Delta h_{TD,a} = \left(b_{PT} - \frac{L}{2}\right) \cdot \frac{T_D}{L} \quad (12)$$

For inside the curve this phenomenon may be neglected if $b_{PT} < \frac{L}{2}$.

On straight track without cant, the maximum of Formulas (11) and (12) shall be applied.

The vehicle will tend to roll around the roll centre, affected by the flexibility of its suspension, which will cause an additional vertical movement equal to (Formula (13)):

$$\Delta h_2 = s_0 \cdot b_{PT} \cdot \frac{T_D}{L} \quad (13)$$

NOTE Other methods exist for taking this phenomenon into account. For example, in the case of the dynamic calculation method, only the geometrical effect is taken into account by the Infrastructure Manager. The dynamic effect is taken into account by the rolling stock domain.

It shall be noted that the two phenomena are always present simultaneously and are therefore not independent.

5.2.3.3.4 Dissymmetry ($\eta_{0,r}$)

A vertical margin for vehicle dissymmetry (see 5.2.2.3.5) needs to be taken into account according to Formula (14) and Formula (15):

$$\Delta h_3 = b_{PT} \cdot \tan(T_{charge}) \quad (14)$$

and

$$\Delta h_4 = b_{PT} \cdot \tan(T_{susp}) \quad (15)$$

NOTE Other methods exist for taking this phenomenon into account. For example, in the case of the dynamic gauge, this phenomenon is taken into account by the rolling stock domain.

5.2.4 Additional allowances

In addition to allowances covering random phenomena, the Infrastructure Manager can decide to introduce additional allowances to permit for example:

- speed increases;
- opening of doors and safety of train crew in certain situations (e.g. platforms, holding siding, etc.);
- amendments to the layout or future gauge;
- the definition of a uniform gauge that can be easily managed by the maintenance and monitoring services where the actual allowances are adequate;
- consideration of aerodynamic effects and cross winds.

These allowances can be both vertical and lateral.

5.3 Kinematic gauging method

5.3.1 General

The kinematic gauging method uses a kinematic reference profile (see EN 15273-4:2025) and associated rules, described below.

NOTE In the following, all parameters used are kinematic and therefore the subscript “*cin*” is omitted.

5.3.2 Infrastructure gauge

5.3.2.1 Lateral

5.3.2.1.1 General

The infrastructure gauge shall be calculated, using Formula (16):

$$b_{inf} = b_{CR} + S_{i/a} + qs_{i/a} + \Sigma_j \quad (16)$$

The explanation for the projection $S_{i/a}$ can be found in 5.2.2.2.2 and the formulae are given in EN 15273-4:2025.

The general formulation of the quasi static effect $qs_{i/a}$ is (Formula (17) and Formula (18)):

$$qs_i = \frac{s_0}{L} \cdot (D - D_0)_{>0} \cdot (h - h_{c0})_{>0} \quad (17)$$

$$qs_a = \frac{s_0}{L} \cdot (I - I_0)_{>0} \cdot (h - h_{c0})_{>0} \quad (18)$$

Σ_j is the sum of the allowances to cover the random phenomena (see 5.2.2.3). It can have different values according to the chosen infrastructure gauge type:

- Σ_3 for the infrastructure installation nominal gauge;
- Σ_2 for the infrastructure installation limit gauge;
- Σ_1 for the infrastructure verification limit gauge;

In all cases it can be determined as:

- a fixed value, on the basis of the experience the Infrastructure Manager has on its network;
- or a calculated value, on the basis of maintenance tolerances.

5.3.2.1.2 Calculation of Σ_3 for the Infrastructure installation nominal gauge

Generally, the sum of the allowance Σ_3 is determined on the basis of Formula (19).

$$\Sigma_{3,i/a} = T_{voie} + \frac{T_D}{L} \cdot h + \frac{s_0}{L} \cdot T_D \cdot (h - h_{c0})_{>0} + \tan(T_{susp}) \cdot (h - h_{c0})_{>0} + \tan(T_{charge}) \cdot (h - h_{c0})_{>0} + \frac{s_0}{L} \cdot T_{osc} \cdot (h - h_{c0})_{>0} + Supl \quad (19)$$

This *Supl* is a choice of the Infrastructure Manager and takes into account different phenomena (aerodynamic effects, margin for exceptional consignment, etc.).

In straight track, it is advised to take $\text{MAX} [\Sigma_{3,i} ; \Sigma_{3,a}]$.

5.3.2.1.3 Calculation of Σ_2 for the Infrastructure installation limit gauge

For determining Σ_2 it shall be regarded that the simultaneous occurrence of the extreme values of all the phenomena, listed in 5.2.2.3, is very improbable. This is why the arithmetic sum of the allowances is not appropriate. An acceptable level of certainty can be obtained by using Formula (20):

$$\Sigma_j = k \cdot \sqrt{(\Delta b_{T1})^2 + (\Delta b_{T2})^2 + \dots + (\Delta b_{Tn})^2} \quad (20)$$

Where each Δb_{Tj} is a lateral random phenomenon, explained in 5.2.2.3.

In this method Σ_2 is not determined directly on the basis of Formula (20). In order to optimize the allowances, Σ'_2 and Σ''_2 could be calculated in order to combine the quasi-static effect with the random effects.

More detailed information is given in CEN/TR 15273-5:2025.

$$\Sigma'_{2,i/a} = k \cdot \sqrt{T_{voie}^2 + \left[\frac{T_D}{L} \cdot h + \frac{s_0}{L} \cdot T_D \cdot (h - h_{c0})_{>0} \right]^2 + [\tan(T_{susp}) \cdot (h - h_{c0})_{>0}]^2 + [\tan(T_{charge}) \cdot (h - h_{c0})_{>0}]^2 + \left[\frac{s_0}{L} \cdot T_{osc} \cdot (h - h_{c0})_{>0} \right]^2} \quad (21)$$

Parameters that are not independent are grouped in the arithmetic sum.

It shall be noted that the values for these parameters are generally different for the inside and the outside of the curve.

For the inside of the curve, $\Sigma_{2,i}$ is determined by the Formula (22):

$$\Sigma_{2,i} = \text{Max} [\Sigma'_{2,i} + K \cdot (D - D_0); \Sigma''_2; \Sigma'_{2,a} - K \cdot I_0] - qs_i \quad (22)$$

For the inside of the curve, another method can be applied to resolve the discontinuity between the inside and the outside of the curve without combining the random effects and the quasi static effect. For this, instead of using Formula (22), the result of the Formula (21) will then be taken into account for $\Sigma_{2,i}$.

For the outside of the curve, $\Sigma_{2,a}$ is determined by the following Formula (23):

$$\Sigma_{2,a} = \text{Max} [\Sigma'_{2,a} + K \cdot (I - I_0); \Sigma'_{2,i}] - qs_a \quad (23)$$

Where (Formula (24) and Formula (25)):

$$K = \frac{s_0}{L} \cdot [h - h_{c0}]_{>0} \quad (24)$$

and

$$\Sigma_2'' = k \cdot \sqrt{T_{voie}^2 + \left(\frac{T_D}{L} \cdot h\right)^2} \quad (25)$$

For straight track, it is advised to take $\text{Max} [\Sigma_{2,i} ; \Sigma_{2,a}]$.

Coefficient k determines the degree of safety ($k \geq 1$).

5.3.2.1.4 Calculation of Σ_1 for the Infrastructure verification limit gauge

For determining Σ_1 it shall be regarded that the simultaneous occurrence of the extreme values of all the phenomena, listed in 5.2.2.3, is very improbable. This is why the arithmetic sum of the allowances is not appropriate. An acceptable level of certainty can be obtained by using the Formula (26):

$$\Sigma_j = k \sqrt{(\Delta b_{T1})^2 + (\Delta b_{T2})^2 + \dots + (\Delta b_{Tn})^2} \quad (26)$$

Where each Δb_{Tj} is a lateral random phenomenon, explained in 5.2.2.3

In this method Σ_1 is not determined directly on the basis of the previous Formula. In order to optimize the allowances, Σ_1' and Σ_1'' could be calculated in order to combine the quasi-static effect with the random effects using Formula (27) and Formula (28):

$$\Sigma_{1,i/a}' = k \cdot \sqrt{[\tan(T_{susp}) \cdot (h - h_{c0})_{>0}]^2 + [\tan(T_{charge}) \cdot (h - h_{c0})_{>0}]^2 + \left[\frac{s_0}{L} \cdot (T_{osc}) \cdot (h - h_{c0})_{>0}\right]^2} \quad (27)$$

and

$$\Sigma_1'' = k \cdot \sqrt{[\tan(T_{susp}) \cdot (h - h_{c0})_{>0}]^2 + [\tan(T_{charge}) \cdot (h - h_{c0})_{>0}]^2} \quad (28)$$

It shall be noted that the values for these parameters are generally different for the inside and the outside of the curve.

For the inside of the curve, $\Sigma_{1,i}$ is determined by Formula (29):

$$\Sigma_{1,i} = \text{Max} [\Sigma'_{1,i} + K \cdot (D - D_0); \Sigma_1''] - qs_i \quad (29)$$

For the inside of the curve, another method can be applied to resolve the discontinuity between the inside and the outside of the curve without combining the random effects and the quasi static effect. For this, instead of using Formula (29), the result of the Formula (27) will then be taken into account for $\Sigma_{1,i}$.

For the outside of the curve, $\Sigma_{1,a}$ is determined by Formula (30):

$$\Sigma_{1,a} = \text{Max} [\Sigma'_{1,a} + K \cdot (I - I_0); \Sigma_{1,i}'] - qs_a \quad (30)$$

Where (Formula (31)):

$$K = \frac{s_0}{L} \cdot [h - h_{c0}]_{>0} \quad (31)$$

For straight track, it is advised to take $\text{Max} [\Sigma_{1,i}; \Sigma_{1,a}]$.

Coefficient k determines the degree of safety ($k \geq 1$).

5.3.2.2 Vertical

5.3.2.2.1 General

The infrastructure gauge shall be calculated, using Formula (32):

$$h_{inf} = h_{CR} \pm S_{Vu/o} + \Delta h_{PT} \pm \Sigma_{Vj} \quad (32)$$

See Figure 2 for application of this vertical adjustment and this creates two different formulae (see Formula (33) and Formula (34)).

— points where the width b_{CR} decreases with the height (Formula (33)):

$$h_{inf} = h_{CR} + S_{v,o} + \Delta h_{PT} + \Sigma_{Vj} \quad (33)$$

and

— points where the width b_{CR} increases with the height (Formula (34)):

$$h_{inf} = h_{CR} - S_{v,u} - T_{N,u} \quad (34)$$

The explanation for the projection $S_{Vu/o}$ can be found in 5.2.3.2.2 and the formulae are given in EN 15273-4:2025.

The general formulation of the vertical quasi-static effect Δh_{PT} is described in Formula (35) to Formula (38):

— for the inside of the curve:

$$\Delta h_{PT,i} = b_{PT} \cdot \sin \alpha_{PT,i} \quad (35)$$

Where:

$$\sin \alpha_{PT,i} = \frac{s_0}{L} \cdot (I - I_0)_{>0} \quad (36)$$

— for the outside of the curve:

$$\Delta h_{PT,a} = b_{PT} \cdot \sin \alpha_{PT,a} \quad (37)$$

Where:

$$\sin \alpha_{PT,a} = \frac{s_0}{L} \cdot (D - D_0)_{>0} \quad (38)$$

Σ_{Vj} is the sum of the allowances to cover the random phenomena (see 5.2.3.3). It can have different values according to the chosen infrastructure gauge type:

- Σ_{V3} for the infrastructure installation nominal gauge;
- Σ_{V2} for the infrastructure installation limit gauge;

— Σ_{V1} for the infrastructure verification limit gauge;

In all cases it can be determined as:

- a fixed value, on the basis of the experience the Infrastructure Manager has on its network; or
- a calculated value, on the basis of maintenance tolerances.

In order to optimize the allowances as part of the verification of existing structures, all vertical phenomena, including S_V , Δh_{PT} , Σ_V , can be considered together, and be taken into account by a fixed value, defined in accordance with the experience of the infrastructure manager. The value can even be zero for certain points on the reference profile, taking into consideration that there are allowances inherent to the kinematic calculation method.

5.3.2.2.2 Calculation of Σ_{V3} for the Infrastructure installation nominal gauge

Generally, the sum of the allowances Σ_{V3} is determined for point PT on the basis of Formula (39) and Formula (40):

$$\Sigma_{V3,PTa} = \left[(1 + s_0) \cdot b_{PT} + \frac{L}{2} \right] \cdot \frac{T_D}{L} + b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,i} + b_{PT} \cdot \tan(T_{charge}) + b_{PT} \cdot \tan(T_{susp}) + T_N + Supl \quad (39)$$

$$\Sigma_{V3,PTi} = \left[(1 + s_0) \cdot b_{PT} - \frac{L}{2} \right]_{>0} \cdot \frac{T_D}{L} + b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,a} + b_{PT} \cdot \tan(T_{charge}) + b_{PT} \cdot \tan(T_{susp}) + T_N + Supl \quad (40)$$

For the other points of the upper and lower parts, only T_N and $Supl$ needs to be taken into account.

The term $Supl$ is to be determined on the basis of the values that the Infrastructure Manager wishes to take into account. Therefore, the allowances are usually determined on the basis of a fixed value as explained above.

These formulae are only valid for positive cant.

In the case of negative cant (see EN 13803), these formulae become Formula (41) and Formula (42):

$$\Sigma_{V3,PTa} = \left[(1 + s_0) \cdot b_{PT} - \frac{L}{2} \right]_{>0} \cdot \frac{T_D}{L} + b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,i} + b_{PT} \cdot \tan(T_{charge}) + b_{PT} \cdot \tan(T_{susp}) + T_N + Supl \quad (41)$$

$$\Sigma_{V3,PTi} = \left[(1 + s_0) \cdot b_{PT} + \frac{L}{2} \right] \cdot \frac{T_D}{L} + b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,a} + b_{PT} \cdot \tan(T_{charge}) + b_{PT} \cdot \tan(T_{susp}) + T_N + Supl \quad (42)$$

In straight track, the maximum value of $\Sigma_{V3,PTa}$ and $\Sigma_{V3,PTi}$ needs to be taken into account.

5.3.2.2.3 Calculation of Σ_{V2} for the Infrastructure installation limit gauge

Generally, the sum of the allowances Σ_{V2} is determined for point PT on the basis of Formula (43) and Formula (44):

$$\Sigma_{V2,PTa} = k \cdot \sqrt{\left\{ \left[(1 + s_0) \cdot b_{PT} + \frac{L}{2} \right] \cdot \frac{T_D}{L} \right\}^2 + \left(b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,i} \right)^2 + \left(b_{PT} \cdot \tan(T_{charge}) \right)^2 + \left(b_{PT} \cdot \tan(T_{susp}) \right)^2 + T_N^2} \quad (43)$$

$$\Sigma_{V2,PTi} = k \cdot \sqrt{\left\{ \left[(1 + s_0) \cdot b_{PT} - \frac{L}{2} \right]_{>0} \cdot \frac{T_D}{L} \right\}^2 + \left(b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,a} \right)^2 + \left(b_{PT} \cdot \tan(T_{charge}) \right)^2 + \left(b_{PT} \cdot \tan(T_{susp}) \right)^2 + T_N^2} \quad (44)$$

In straight track, the maximum value of $\Sigma_{V2,PTa}$ and $\Sigma_{V2,PTi}$ needs to be taken into account.

For the other points of the upper and lower parts, only T_N needs to be taken into account and $k = 1$.

Therefore, the allowances are usually determined on the basis of a fixed value as explained above.

These formulae are only valid in the case of positive cant.

In the case of negative cant (see EN 13803), these formulae become Formula (45) and Formula (46):

$$\Sigma_{V2,PTa} = k \cdot \sqrt{\left\{ \left[(1 + s_0) \cdot b_{PT} - \frac{L}{2} \right]_{>0} \cdot \frac{T_D}{L} \right\}^2 + \left(b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,i} \right)^2 + (b_{PT} \cdot \tan(T_{charge}))^2 + (b_{PT} \cdot \tan(T_{susp}))^2 + T_N^2} \quad (45)$$

$$\Sigma_{V2,PTi} = k \cdot \sqrt{\left\{ \left[(1 + s_0) \cdot b_{PT} + \frac{L}{2} \right] \cdot \frac{T_D}{L} \right\}^2 + \left(b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,a} \right)^2 + (b_{PT} \cdot \tan(T_{charge}))^2 + (b_{PT} \cdot \tan(T_{susp}))^2 + T_N^2} \quad (46)$$

In straight track, the maximum value of $\Sigma_{V2,PTa}$ and $\Sigma_{V2,PTi}$ needs to be taken into account.

5.3.2.2.4 Calculation of Σ_{V1} for the Infrastructure verification limit gauge

Generally, the sum of the allowances Σ_{V1} is determined for point PT on the basis of Formula (47) and Formula (48):

$$\Sigma_{V1,PTa} = k \cdot \sqrt{\left(b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,i} \right)^2 + [b_{PT} \cdot \tan(T_{charge})]^2 + [b_{PT} \cdot \tan(T_{susp})]^2} \quad (47)$$

$$\Sigma_{V1,PTi} = k \cdot \sqrt{\left(b_{PT} \cdot \frac{s_0}{L} \cdot T_{osc,a} \right)^2 + [b_{PT} \cdot \tan(T_{charge})]^2 + [b_{PT} \cdot \tan(T_{susp})]^2} \quad (48)$$

For the other points of the upper and lower parts, these phenomena are not to be considered. No vertical allowance should therefore be taken for these points.

In straight track, $\Sigma_{V1,PTi}$ needs to be taken into account.

5.4 Dynamic gauging method

5.4.1 General

The dynamic gauging method uses a dynamic reference profile (see EN 15273-4:2025) and associated rules, described below.

NOTE In the following, all parameters used are dynamic and therefore the subscript “*dyn*” is omitted.

5.4.2 Infrastructure gauge

5.4.2.1 Lateral

5.4.2.1.1 General

The infrastructure gauge shall be calculated, using Formula (49):

$$b_{inf} = b_{CR} + S_{i/a} + \Sigma_j \quad (49)$$

The explanation for the projection $S_{i/a}$ can be found in 5.2.2.2.2 and the formulae are given in EN 15273-4:2025.

Σ_j is the sum of the allowances to cover the random phenomena (see 5.2.2.3). It can have different values according to the chosen infrastructure gauge:

- Σ_3 for the infrastructure installation nominal gauge;
- Σ_2 for the infrastructure installation limit gauge;
- Σ_1 for the infrastructure verification limit gauge;

In all cases it can be determined as:

- a fixed value, on the basis of the experience the Infrastructure Manager has on its network; or

— a calculated value, on the basis of maintenance tolerances.

5.4.2.1.2 Calculation of Σ_3 for the Infrastructure installation nominal gauge

Generally, the sum of the allowance Σ_3 is determined on the basis of Formula (50):

$$\Sigma_3 = T_{voie} + \frac{T_D}{L} \cdot h + Supl \quad (50)$$

This *Supl* is a choice of the Infrastructure Manager and takes into account different phenomena (aerodynamic effects, margin for exceptional consignment, etc.).

5.4.2.1.3 Calculation of Σ_2 for the Infrastructure installation limit gauge

For determining Σ_2 , the simultaneous occurrence of the extreme values of all the phenomena, listed in 5.2.2.3, is very improbable. This is why the arithmetic sum of the allowances is not acceptable. It can be shown that an acceptable level of certainty can be obtained by using Formula (51):

$$\Sigma_2 = k \cdot \sqrt{T_{voie}^2 + \left(\frac{T_D}{L} \cdot h\right)^2} \quad (51)$$

5.4.2.1.4 Calculation of Σ_1 for the Infrastructure verification limit gauge

This parameter equals 0 because all parameters for Σ_1 are taken into account by the rolling stock domain. The infrastructure verification limit gauge is the sum of the semi width of the reference profile and the projection.

5.4.2.2 Vertical

5.4.2.2.1 General

The infrastructure gauge shall be calculated, using Formula (52):

$$h_{inf} = h_{CR} \pm S_{Vu/o} \pm \Sigma_{Vj} \quad (52)$$

See Figure 2 for application of this vertical adjustment and this creates 2 different formulae:

— points where the width b_{CR} decreases with the height Formula (53):

$$h_{inf} = h_{CR} + S_{Vo} + \Sigma_{Vj} \quad (53)$$

and

— points where the width b_{CR} increases with the height Formula (54):

$$h_{inf} = h_{CR} - S_{Vu} - T_{N,u} \quad (54)$$

The explanation for the projection $S_{Vu/o}$ can be found in 5.2.3.2.2 and the formulae are given in EN 15273-4:2025.

Σ_{Vj} is the sum of the allowances to cover the random phenomena (see 5.2.3.3). It can have different values according to the chosen infrastructure gauge:

- Σ_{V3} for the infrastructure installation nominal gauge;
- Σ_{V2} for the infrastructure installation limit gauge;
- Σ_{V1} for the infrastructure verification limit gauge;

In all cases it can be determined as:

- a fixed value, on the basis of the experience the Infrastructure Manager has on its network, or
- a calculated value, on the basis of maintenance tolerances.

5.4.2.2.2 Calculation of Σ_{V3} for the Infrastructure installation nominal gauge

Generally, the sum of the allowance Σ_{V3} is determined for point PT on the basis of Formula (55) and Formula (56):

$$\Sigma_{V3,PTa} = \left(b_{PT} + \frac{L}{2}\right) \cdot \frac{T_D}{L} + T_N + Supl \quad (55)$$

$$\Sigma_{V3,PTi} = \left(b_{PT} - \frac{L}{2}\right)_{>0} \cdot \frac{T_D}{L} + T_N + Supl \quad (56)$$

For the other points of the upper and lower parts, only T_N and $Supl$ needs to be taken into account.

The term $Supl$ is to be determined on the basis of the values that the Infrastructure Manager wishes to take into account. Therefore, the allowances are usually determined on the basis of a fixed value as explained above.

These formulae are only valid in the case of positive cant.

In the case of negative cant (see EN 13803), these formulae become Formula (57) and Formula (58):

$$\Sigma_{V3,PTa} = \left(b_{PT} - \frac{L}{2}\right)_{>0} \cdot \frac{T_D}{L} + T_N + Supl \quad (57)$$

$$\Sigma_{V3,PTi} = \left(b_{PT} + \frac{L}{2}\right) \cdot \frac{T_D}{L} + T_N + Supl \quad (58)$$

In straight track, the maximum value of $\Sigma_{V3,PTa}$ and $\Sigma_{V3,PTi}$ needs to be taken into account.

5.4.2.2.3 Calculation of Σ_{V2} for the Infrastructure installation limit gauge

Generally, the sum of the allowances Σ_{V2} is determined for point PT on the basis of Formula (59) and Formula (60):

$$\Sigma_{V2,PTa} = k \cdot \sqrt{\left[\left(b_{PT} + \frac{L}{2}\right) \cdot \frac{T_D}{L}\right]^2 + T_N^2} \quad (59)$$

$$\Sigma_{V2,PTi} = k \cdot \sqrt{\left[\left(b_{PT} - \frac{L}{2}\right)_{>0} \cdot \frac{T_D}{L}\right]^2 + T_N^2} \quad (60)$$

For the other points of the upper and lower parts, only T_N and $k = 1$ need to be taken into account. Therefore, the allowances are usually determined on the basis of a fixed value as explained above.

These formulae are only valid in the case of positive cant.

In the case of negative cant (see EN 13803), these formulae become Formula (61) and Formula (62):

$$\Sigma_{V2,PTa} = k \cdot \sqrt{\left[\left(b_{PT} - \frac{L}{2}\right)_{>0} \cdot \frac{T_D}{L}\right]^2 + T_N^2} \quad (61)$$

$$\Sigma_{V2,PTi} = k \cdot \sqrt{\left[\left(b_{PT} + \frac{L}{2}\right) \cdot \frac{T_D}{L}\right]^2 + T_N^2} \quad (62)$$

In straight track, the maximum value of $\Sigma_{V2,PTa}$ and $\Sigma_{V2,PTi}$ needs to be taken into account.

5.4.2.2.4 Calculation of Σ_{VI} for the Infrastructure verification limit gauge

This parameter equals 0 because all parameters for Σ_{VI} are taken into account by the rolling stock domain. The infrastructure verification limit gauge is the sum of the semi width of the reference profile and the projection.

5.5 Static gauging method

5.5.1 General

The static gauging method uses a static reference profile (see EN 15273-4:2025) and associated rules, described below.

The use of the static gauging method is restricted to a limited flexibility coefficient s_{lim} (see EN 15273-4:2025). When the flexibility coefficient is greater, the kinematic or dynamic gauging method needs to be applied.

NOTE In the following, all parameters used are static and therefore the subscript “st” is omitted.

5.5.2 Infrastructure gauge

5.5.2.1 Lateral

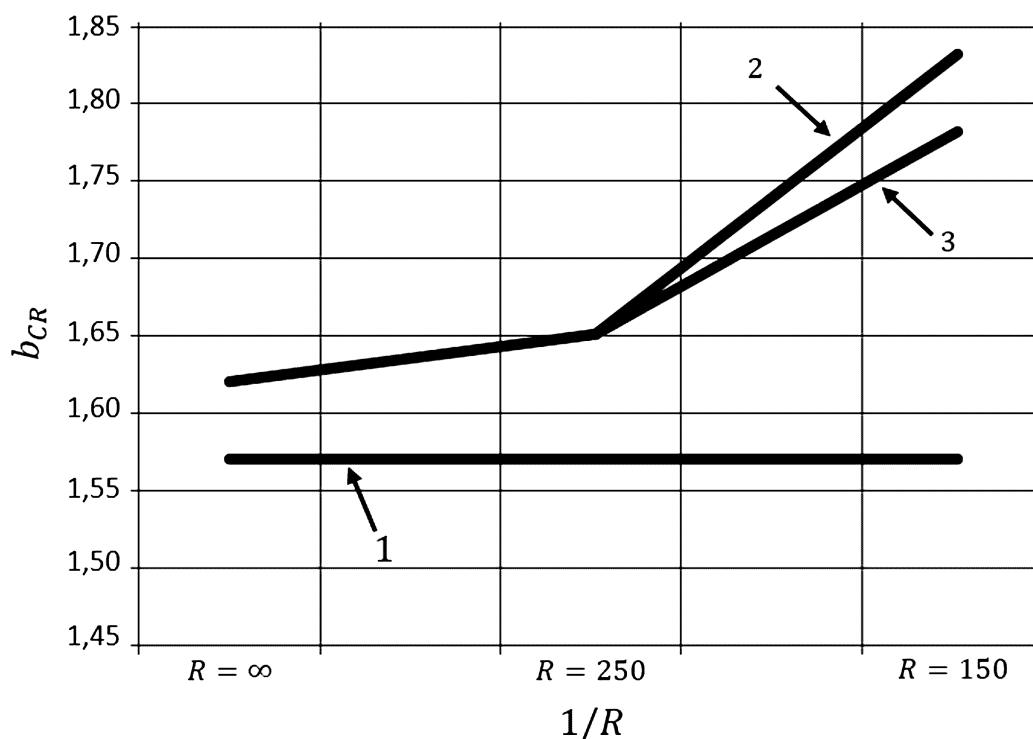
The infrastructure gauge shall be calculated, using Formula (63):

$$b_{inf} = b_{CR} + S_{i/a} + \Sigma_j \quad (63)$$

The lateral projection defines the sum of the following phenomena:

- the geometric effect in the curve of the reference vehicles (S_R);
- the effect of the track gauge widening (S_I);
- a fixed value F (see EN 15273-1:2025).

Figure 6 explains the value (in metres) for the projection:

**Key**

1 $b_{CR,stat} = 1,575$ m (see EN 15273-4:2025)

2 $b_{inf,a}$ outside curve

3 $b_{inf,i}$ inside curve

NOTE Reference vehicle $a = 5,48$ m at $R \geq 250$ m.

Reference vehicle $a = 20$ m, $p = 0$ m at $250 \text{ m} \geq R \geq 150$ m.

Radii < 150 m are excluded in this document

Figure 6 — Lateral widening of the gauge in the static gauging method

Σ_j covers random phenomena and the quasi static effect. In all cases it can be determined as:

- a fixed value, on the basis of the experience the Infrastructure Manager has on its network; or
- a calculated value, on the basis of maintenance tolerances.

The following phenomena need to be taken into account (see Formula (64)):

- the quasi-static effect can be estimated at full D or I with regarding s_{lim} ;
- the margins due to T_{osc} and T_D (see 5.2.2.3);
- η (see 5.2.2.3);
- T_{voie} (see 5.2.2.3).

$$\Sigma_j = T_{voie} + \frac{T_D}{L} \cdot h + \frac{T_D}{L} \cdot s_{lim} \cdot (h - h_{c0})_{>0} + \tan(1^\circ) \cdot (h - h_{c0})_{>0} + \frac{T_{osc}}{L} \cdot s_{lim} \cdot (h - h_{c0})_{>0} + \frac{s_{lim}}{L} \cdot D \text{ or } I \cdot (h - h_{c0})_{>0} \quad (64)$$

The values of T_{osc} , T_D and T_{voie} can be found in Table A1.

For calculating the margins, alternative probability calculations (e.g. as set out in the kinematic gauging method) can also be applied.

5.5.2.2 Vertical

The infrastructure gauge shall be calculated, using Formula (65):

$$h_{inf} = h_{CR} \pm S_{Vu/o} + \Delta h_{PT} \pm \Sigma_{Vj} + Supl \quad (65)$$

The explanation for the projection $S_{Vu/o}$ can be found in 5.2.3.2.2 and the formulae are given in EN 15273-4:2025.

The general formulation of the quasi-static effect is described in Formula (66) to Formula (69):

— For the inside of the curve:

$$\Delta h_{PT,i} = b_{PT} \cdot \sin \alpha_{PT,i} \quad (66)$$

Where:

$$\sin \alpha_{PT,i} = \frac{S_{lim}}{L} \cdot I \quad (67)$$

— for the outside of the curve:

$$\Delta h_{PT,a} = b_{PT} \cdot \sin \alpha_{PT,a} \quad (68)$$

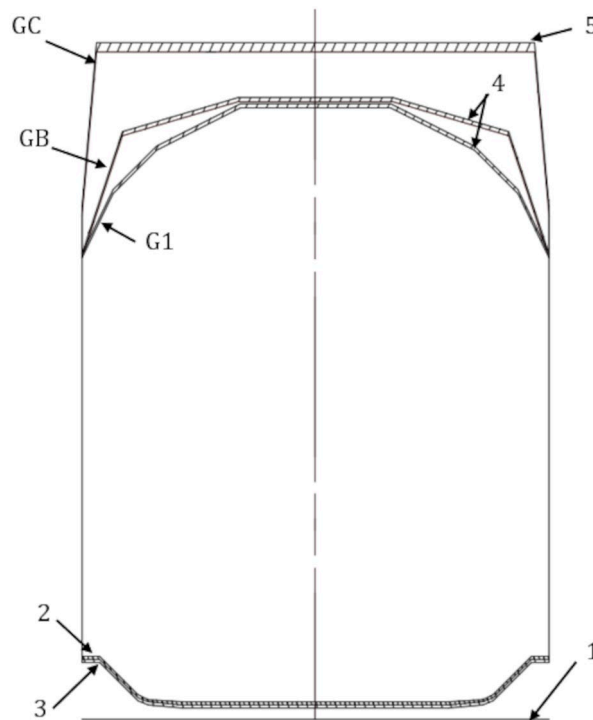
Where:

$$\sin \alpha_{PT,a} = \frac{S_{lim}}{L} \cdot D \quad (69)$$

NOTE In the static method, point PT is only applicable for gauge GC.

Σ_{Vj} is the sum of the allowances to cover the vertical dynamic displacement and equals 30 mm for sprung parts and 15 mm for unsprung parts. These allowances do not include additional margins such as infrastructure degradation and T_N . For these phenomena, no specific rule is defined; the Infrastructure Manager takes into account the necessary margins by experience (*Supl*).

Figure 7 illustrates vertical additions to static reference profiles.



Key

- 1 running plane
- 2 allowed lowering for unsprung parts (- 15 mm)
- 3 lowering due to flexibility of springs for sprung parts (- 30 mm)
- 4 dynamic lift for G1, G2, GA, GB (+ 30 mm)
- 5 dynamic lift for GC (dynamic lift (30 mm) + vertical quasi static effect at $s_{lim} = 0,3$, $h_{c0} = 0,50$ m and D or I)

NOTE The values given are mostly the difference in height between static and kinematic reference profiles.

Figure 7 — Vertical additions to static reference profiles

5.6 Distance between track centres

5.6.1 Introduction

5.6.1.1 General

The distance between track centres (EA) is determined to allow normal, simultaneous traffic on adjacent tracks without restriction. The distance between track centres is established on the basis of the chosen gauging method and takes into account the same phenomena as those taken into account in the actual infrastructure gauge.

In the presence of switches and crossings, it is important to take into account the gauge widening when the vehicles have to run via the turnout route. This necessitates increasing the distance between track centres, on the basis of the lateral projection and the quasi-static effect determined as explained in 5.7.

The Infrastructure Manager can define 3 types of distances between track centres.

5.6.1.2 The nominal installation distance between track centres

Generally, the value of the nominal installation distance between track centres is constant; it is defined for ranges of speed and selected radii in order to facilitate track design, construction and maintenance.

However, there is no common approach for all networks for determining the nominal distance between track centres because it results from different allowances, to be considered or not, according to the requirements of each Infrastructure Manager.

NOTE Providing a nominal installation distance between track centres makes track design and maintenance easier.

The allowances for the nominal distance between track centres may include:

- an allowance to increase the safety level;
- an additional maintenance allowance;
- an allowance to cover aerodynamic phenomena;
- an allowance to facilitate the installation of switches and crossings;
- a reserve for future layout or gauge modifications;
- allowances to obtain a non-variable distance between track centres that is easily manageable for the maintenance and verification services where actual allowances are generous.

Additional allowances for the safety of persons and exceptional consignments are outside the scope of this standard and shall be defined by the authority responsible.

5.6.1.3 The installation limit distance between track centres

The installation limit distance between track centres is determined to prevent the gauge of one track from interfering with the gauge of the adjacent track while taking into account both the reference profiles and associated rules and also a sum of allowances Σ_{EA2} .

Generally, the limit distance between track centres is determined by the upper point of the vertical part of the reference profile, designated by the letter *P* (see Figure 11).

NOTE The installation limit distance between track centres is smaller than the sum of the infrastructure installation limit gauge of both tracks because the sum of the random phenomena is calculated using in a square root (see 5.6.3.3.2.1).

5.6.1.4 The verification limit distance between track centres

The verification limit distance between track centres is determined to prevent the gauge of one track from interfering with the gauge of the adjacent track while taking into account both the reference profiles and associated rules and also a sum of allowances Σ_{EA1} .

Generally, the limit distance between track centres is determined by the upper point of the vertical part of the reference profile, designated by the letter *P* (see Figure 11).

NOTE The verification limit distance between track centres is smaller than the sum of the infrastructure verification limit gauge of both tracks because the sum of the random phenomena is calculated using in a square root (see 5.6.3.3.2.1).

5.6.2 Parameters to take into account when determining the distance between track centres

5.6.2.1 General parameters

The following parameters are to be considered for each of the two tracks:

- the projection $S_{i/a}$;
- the quasi-static effect $qS_{i/a}$;
- the effect of the cant difference between two tracks: $\Delta b_{\delta D}$ (see 5.6.2.2);
- the allowances Σ_j .

NOTE In the case of the dynamic calculation method, $qS_{i/a}$ is taken into account by the rolling stock domain.

The effect of curvature shall always be considered, as explained below (see Figure 8, Figure 9 and Figure 10).

EXAMPLE 1 In the case of two concentric curved tracks, all the phenomena on the inside of the curve are considered for the outside track and the phenomena of the outside of the curve for the inside track.

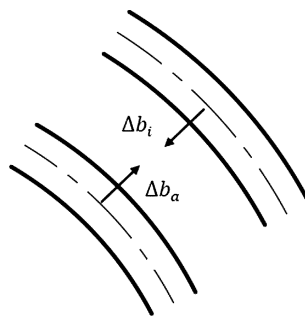


Figure 8 — Distance between 2 concentric tracks

EXAMPLE 2 In the case of two convex tracks, all the phenomena on the outside of each of the two tracks are considered each with its own radius, cant and running speed.

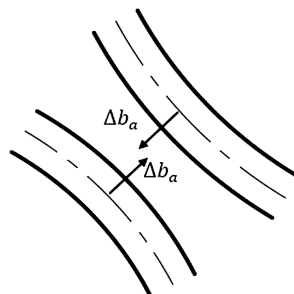


Figure 9 — Distance between 2 convex tracks

EXAMPLE 3 In the case of two convex tracks, all the phenomena on the inside of each of the two tracks are considered each with its own radius, cant and running speed.

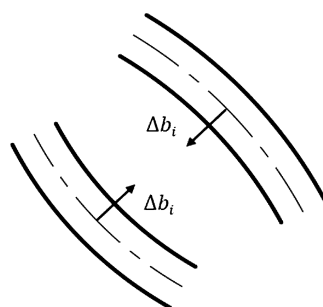
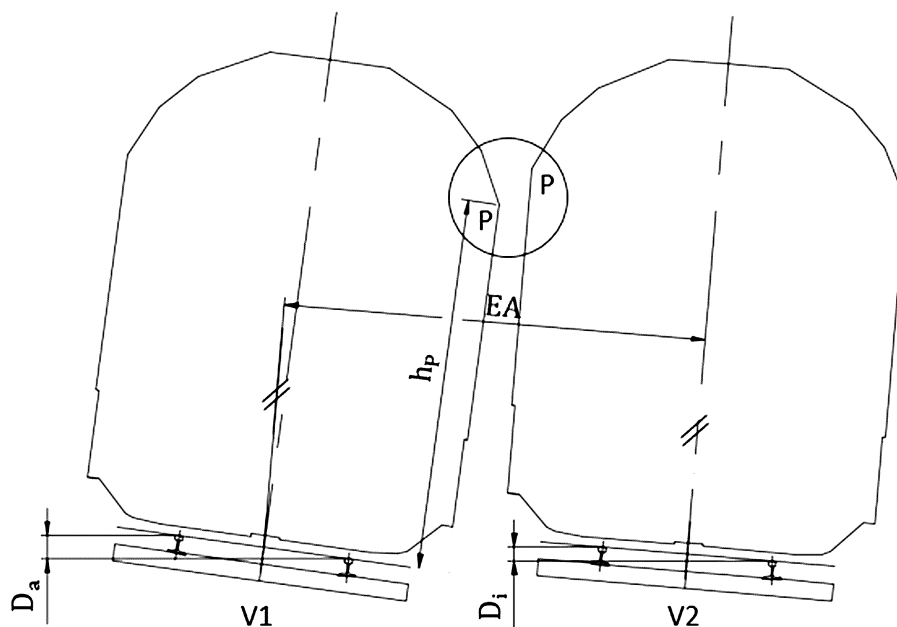


Figure 10 — Distance between 2 concave tracks

5.6.2.2 The effect of cant difference $\Delta b_{\delta D}$

When the two tracks considered have a different cant the distance between track centres, EA , is calculated in the running plane of the track with the lowest cant.



Key

- V_1 track 1
- V_2 track 2
- h_p height of the point P above running plane
- D_a cant of track 1
- D_i cant of track 2
- P critical point on the reference profile

Figure 11 — The distance between track centres in the case of a cant difference

When the two tracks considered have a different cant, the two reference profiles tend to get closer to each other or further away at the top of the vertical part. This has major consequences on the distance between track centres measured at the running plane.