
Železniške naprave – Zgornji ustroj – Parametri za projektiranje prog – Tirne širine 1435 mm in več – 1. del: Odprta proga

Railway applications - Track - Track alignment design parameters - Track gauges 1435 mm and wider - Part 1: Plain line

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN 13803-1:2006](https://standards.iteh.ai/catalog/standards/sist/be2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-pren-13803-1-2006)

<https://standards.iteh.ai/catalog/standards/sist/be2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-pren-13803-1-2006>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN 13803-1:2006](https://standards.iteh.ai/catalog/standards/sist/be2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-pren-13803-1-2006)

<https://standards.iteh.ai/catalog/standards/sist/be2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-pren-13803-1-2006>

January 2006

ICS

English Version

**Railway applications - Track - Track alignment design
parameters - Track gauges 1435 mm and wider - Part 1: Plain
line**

Applications ferroviaires - Paramètres de conception du
tracé de la voie - Ecartement 1435 mm et plus large -
Partie 1: Voie courant

Bahnwendungen - Pberbau - Linienführung in Gleisen -
Spurweiten 1 435 mm und grösser - Teil 1: Durchgehendes
Hauptgleis

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

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

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

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

Page

Foreword.....	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	7
4 Symbols and abbreviations	9
5 Requirements	10
5.1 Background	10
5.1.1 Track alignment design parameters	10
5.1.2 Parameter quantification	10
5.1.3 Traffic categories	11
5.2 Recommended limiting values and maximum (or minimum) limiting values for track alignment design parameters	12
5.2.1 Radius of horizontal curve R	12
5.2.2 Cant D	12
5.2.3 Cant deficiency I	13
5.2.4 Cant excess E	16
5.2.5 Rate of change of cant dD/dl	17
5.2.6 Cant gradient dD/dl	19
5.2.7 Rate of change of cant deficiency dI/dl	19
5.2.8 Length of transition curves in the horizontal plane L	21
5.2.9 Length of alignment elements (circular curves and straights) L_i	21
5.2.10 Vertical curves	22
5.2.11 Radius of vertical curve R_v	22
5.2.12 Vertical acceleration a_v	23
Annex A (informative) Supplementary information for track alignment design related to shape and length of alignment elements	25
A.1 Table summarising the properties of different transition curves shapes, compared with the conventional cubic parabola and clothoid which are the bases of the standard	25
A.2 The rolling movement of a vehicle and its relation with minimum length of alignment elements	27
A.3 Further parameters that may be considered for track alignment curve design and a progressive system of design rules	30
A.3.1 Symbols and abbreviations	30
A.3.2 Objectives	31
A.3.3 Progressive track alignment design	31
A.3.4 Application	35
Annex B (informative) Classification of parameters as a function of their influence on safety, comfort and economy	46
B.1 General	46
B.2 Safety	47
B.3 Comfort	49
B.4 Economy	50
Annex C (informative) Track resistance to lateral forces generated by the rolling stock	52
C.1 General	52
C.2 The effect of alignment design components on lateral forces generated by the rolling stock	52
C.2.1 Cant deficiency	52
C.2.2 Cant excess	53
C.3 The lateral strength limit of a track under loading (<i>Prud'homme</i> limit)	53
C.4 Factors influencing the resistance to track lateral displacement	54

C.4.1	Rail profile	54
C.4.2	Type of sleeper	54
C.4.3	Type of fastening	54
C.4.4	Ballast characteristics	54
C.4.5	Running speed	54
C.4.6	Track consolidation after tamping	54
C.4.7	Thermal load in rails	55
C.4.8	Proximity of two axles	55
C.4.9	Oscillatory axle load variation (vehicle ride quality in the vertical plane)	55
Annex D	(informative) Other criteria to be considered for the description of a line classification system	56
Annex E	(informative) Consequences on track resistance, stress and fatigue resulting from tilting body train systems	58
E.1	General	58
E.2	Basic principles applying to tilting body techniques	58
E.2.1	Safety requirements	59
E.2.2	Comfort requirements	61
E.2.3	Economic assessment of the system	62
Annex F	(informative) Rules for converting parameter values for track gauges wider than 1435 mm	64
F.1	Scope	64
F.2	Symbols and abbreviations	64
F.3	Basic assumptions and equivalence rules	65
F.4	Detailed conversion rules	66
F.4.1	Radius of horizontal curve R_1 (5.2.1 of the main body of the standard)	66
F.4.2	Cant D_1 (5.2.2 of the main body of the standard)	66
F.4.3	Cant deficiency I_1 (5.2.3 of the main body of the standard)	67
F.4.4	Cant excess E_1 (5.2.4 of the main body of the standard)	68
F.4.5	Length of transition curves in the horizontal plane L (5.2.8 of the main body of the standard)	69
F.4.6	Rate of change of cant dD_1/dt (5.2.5 of the main body of the standard)	69
F.4.7	Cant gradient $dD_1/d\ell$ (5.2.6 of the main body of the standard)	70
F.4.8	Rate of change of cant deficiency dI_1/dt (5.2.7 of the main body of the standard)	70
F.4.9	Length of the alignment elements (circular curves and straights) L_i (5.2.9 of the main body of the standard)	71
F.4.10	Other parameters	71
Annex G	(normative) Track alignment design parameter values for track gauges wider than 1435 mm	72
G.1	Scope	72
G.2	Requirements for a gauge of 1668 mm	72
G.2.1	Cant D_1	72
G.2.2	Cant deficiency I_1	73
G.2.3	Rate of change of cant dD_1/dt [mm/s]	74
G.2.4	Cant gradient $dD_1/d\ell$	74
G.2.5	Rate of change of cant deficiency dI_1/dt	74
G.2.6	Length of alignment elements (circular curves and straights) L_{i1}	75
G.2.7	Vertical curves	75
G.2.8	Radius of vertical curve R_{v1}	76
G.2.9	Vertical acceleration a_{v1}	76
G.3	Requirements for a gauge of 1524 mm	77
G.3.1	Cant D_1	77
G.3.2	Cant deficiency I_1	78
G.3.3	Rate of change of cant dD_1/dt [mm/s]	79
G.3.4	Cant gradient $dD_1/d\ell$	79
G.3.5	Rate of change of cant deficiency dI_1/dt	79
G.3.6	Length of alignment elements (circular curves and straights) L_{i1}	80
G.3.7	Vertical curves	80
G.3.8	Radius of vertical curve R_{v1}	81
G.3.9	Vertical acceleration a_{v1}	81

Annex H (informative) Constraints and risks associated with the use of maximum (or minimum) limiting values	82
Annex I (informative) Recapitulation of the work carried out by the ORE B 55 Committee - Maximum permissible cant	83
I.1 Introduction	83
I.2 Criteria for safety against derailment at low speed through wheel-climbing	83
I.3 Limiting values for track twist	84
I.4 Rules applicable to the design of and checks performed on new vehicles with regard to their capability of coping with track twist values	85
I.5 List of reports published by the ORE B 55 Committee	85
Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 96/48/EC on the interoperability of the trans-European high-speed rail system	86

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN 13803-1:2006](https://standards.iteh.ai/catalog/standards/sist/be2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-pren-13803-1-2006)
<https://standards.iteh.ai/catalog/standards/sist/be2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-pren-13803-1-2006>

Foreword

This document (prEN 13803-1:2006) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the following EU Directives:

- Council Directive 96/48/EC of 23 July 1996 on the interoperability of the European high-speed network¹
- European Parliament and Council Directive 2004/17/EC of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors²
- Council Directive 91/440/EEC of 29 July 1991 on the development of the Community's railways³

For relationship with EU Directive 96/48/EC, see informative Annex ZA, which is an integral part of this document.

EN 13803 "Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider" consists of the following parts:

- Part 1: Plain line
- Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of the curvature

ITeH STANDARD PREVIEW
(standards.iteh.ai)

oSIST prEN 13803-1:2006
<https://standards.iteh.ai/catalog/standards/sist/bc2112c6-94c1-4c75-ab2f-0a5e130aa17a/osist-pren-13803-1-2006>

¹ Official Journal of the European Communities N° L 235 of 1996-09-17

² Official Journal of the European Communities N° L 134 of 2004-04-30

³ Official Journal of the European Communities N° L 237 of 1991-08-24

1 Scope

This European Standard specifies the track alignment design parameters, the rules and the values that shall be used to determine the maximum operating speed for both new and existing lines. Alternatively, for a given specified speed, it defines the track alignment design parameters either for a new line or an upgraded line.

The track alignment designer is free to specify the values most appropriate for the various parameters, when considering safety, geographical, engineering, historical and economic constraints. These values are defined in the contract document. However, the choice should be such that the selected values are no worse than the maximum (or minimum) limiting values for the safety-related parameters.

Whenever necessary, the track alignment designer should take into account any specific requirements of the appropriate national standards.

The designer should endeavour to comply with the recommended limiting values specified in this European Standard and avoid unnecessary use of the maximum (or minimum) limiting values.

This European Standard applies to main lines with track gauges 1435 mm and wider with mixed or dedicated passenger traffic, running at operating speeds between 80 km/h and 300 km/h. Annex F (informative) describes the conversion rules which can be applied for tracks with gauges wider than 1435 mm. Annex G has a normative character and is applied for corresponding specific national conditions.

However, the values and conditions stated for this speed range can also be applied to lines where operating speeds are less than 80 km/h, but in this case, more or less restrictive values may need to be used and should be defined in the contract.

This European Standard does not apply to urban and suburban lines.

This European Standard also considers the possibility of increasing the performance of line operation, without major alignment modifications, by means of particular rail vehicle types, such as:

- vehicles with a low axle mass;
- vehicles with a low suspension roll coefficient;
- vehicles equipped with tilting body systems to compensate for cant deficiency (active or passive systems).

For tilting trains, certain alignment parameters may prove to be sensitive, depending in particular on the tilt control system used. Such special requirements and the corresponding limiting values are described, if necessary, within this part of the European Standard. Annex E draws the attention of the designer to the consequences of track resistance, stress and fatigue due to the operation of such vehicles.

2 Normative references

The following referenced documents are indispensable for the application 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.

prEN 13803-2, *Railway applications – Track alignment design parameters – Track gauges 1435 mm and wider – Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature*

ISO 31-1, *Quantities and units – Part 1: Space and time*

UIC 505-5, *Basic conditions common to Leaflets 505-1 and 505-4 – Notes on the preparation and provisions of these leaflets*

3 Terms and definitions

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

3.1

curves

this covers both horizontal and vertical curves and their related transitions. Unless otherwise stated, the curve parameters are defined for the track centreline

3.1.1

circular curve

a curve of constant radius

3.1.2

transition curve

a curve of variable radius.

Transition curves may be found between two circular curves, each of a different radius, and between a circular curve and a straight. The clothoid (or cubic parabola) is normally used for transition curves, giving a linear variation of curvature and cant. In some cases, cant and or curvature is smoothed at the ends of the transition.

It is possible to use other forms of transition curve which show a non-linear variation of curvature and cant.

In principle, a transition curve is not used for the vertical alignment.

Annex A gives a detailed account of the alternative types of transitions that may be used in track alignment design

ITeK STANDARD PREVIEW
(standards.iteh.ai)

3.1.3

compound curve

a curve formed by two circular curves of different radii which curve in the same direction.

SIST prEN 13803-1:2006
<https://standards.iteh.ai/catalog/standards/sist/bc2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-pren-13803-1-2006>

The two adjacent curves may be joined by a transition curve

3.1.4

reverse curve

a curve formed by two circular curves which curve in the opposite direction.

The two adjacent curves may be joined by a transition curve

3.2

cant

the amount by which one gauge rail is raised above the other gauge rail.

Cant is positive when the outer rail on curved track is raised above the inner rail and is **negative** when the inner rail on curved track is raised above the outer rail.

Negative cant is unavoidable at switches and crossings on a canted main line where the turnout is curving in the opposite direction to the main line and, in certain cases, on the plain line immediately adjoining a turnout (see prEN 13803-2).

When the speed of a vehicle negotiating a curve is such that the resultant of the gravitational force of the vehicle and the effect of centrifugal force is perpendicular to the plane of the rails, the vehicle is not subjected to unbalanced lateral force and is said to be in equilibrium. Obtaining this condition on curved track implies raising one gauge rail above the level of the other gauge rail by a designed amount. This amount is known as the **equilibrium cant**

3.3

cant excess

when the arranged cant is higher than equilibrium cant, there will be an unbalanced lateral force. The resultant force will move towards the inner rail of the curve. The difference between arranged cant and equilibrium cant is known as **cant excess**. Cant on a straight track results in cant excess, generating a force towards the low rail

3.4

cant deficiency

when the arranged cant is lower than equilibrium cant, there will be an unbalanced lateral force. The resultant force will move towards the outer rail of the curve. The difference between equilibrium cant and arranged cant is known as **cant deficiency**

3.5

cant gradient

the amount by which the cant is increased or decreased in a given transition length

3.6

rate of change of cant

the rate at which cant is increased or decreased relative to the speed of a vehicle negotiating a transition curve, for example 35 mm per second means that a vehicle travelling at the specified speed will experience a change in cant of 35 mm in each second

3.7

rate of change of cant deficiency

the rate at which cant deficiency is increased or decreased relative to the speed of a vehicle negotiating a transition curve, for example 35 mm per second means that a vehicle travelling at the specified speed permitted will experience a change in cant deficiency of 35 mm in each second

3.8

maximum permissible speed

maximum speed permitted on a curve with associated transitions when radius, cant, cant deficiency and rates of change of cant and cant deficiency and other parameters have been taken into consideration

3.9

line speed

maximum speed at which vehicles are allowed to run on a line or branch or on sections of a line or branch.

The line speed limit is usually established after taking into consideration the incidence of permanent speed restrictions on the line or branch. On mixed traffic lines, several different line speed limits may exist at the same time due to the different types of traffic categories

3.10

recommended limiting values

values to be applied by the designer for the design of new railway lines or sections of such lines, or for the upgrading of existing lines. Such values ensure maintenance costs of the track are kept at a reasonable level, except where particular conditions of poor track stability may occur, without compromising passenger comfort

3.11

maximum (or minimum) limiting values

extreme but permissible values used at maximum speed for most railway vehicles. As these values are extreme, it is essential that the use of maximum (or minimum) limiting values is as infrequent as possible on any given line.

Annex H describes the constraints and risks associated with the use of maximum (or minimum) limiting values

4 Symbols and abbreviations

No.	Symbol	Designation	Unit
1	a_q	non-compensated lateral acceleration in the track plane	m/s^2
2	da_q/dt	rate of change of non-compensated lateral acceleration	m/s^3
3	a_i	quasi-static lateral acceleration parallel to the vehicle floor	m/s^2
4	da_i/dt	rate of change of quasi-static lateral acceleration parallel to the vehicle floor	m/s^3
5	a_v	quasi-static vertical acceleration on vertical curve	m/s^2
6	D	cant	mm
7	D_e	cant limit	mm
8	dD/dt	rate of change of cant	mm/s
9	$dD/d\ell$	cant gradient	mm/m
10	E	cant excess	mm
11	e	distance between wheel treads of an axle (e.g. 1500 mm for gauge 1435 mm)	mm
12	h_g	height of the centre of gravity	mm
13	l	cant deficiency	mm
14	dl/dt	rate of change of cant deficiency	mm/s
15	L	length of transition curve and/or cant transition	m
16	L_i	length of alignment elements (circular curves and straights)	m
17	R	radius of horizontal curve	m
18	R_v	radius of vertical curve	m
19	s	roll flexibility coefficient according to UIC 505-5	-
20	t	time	s
21	V	line speed	km/h
22	V_{max}	maximum curving speed of fast trains	km/h
23	V_{min}	minimum curving speed of slow trains	km/h
24	g	acceleration due to gravity: 9,81 m/s^2	m/s^2
25	lim	limiting value (index)	-
26	Δa_q	overall variation of non-compensated lateral acceleration along a transition curve between straight track and plain curve or between two adjacent curves of different radii	m/s^2
27	Δl	overall cant deficiency variation along a transition curve, between straight track and circular curve or between two adjacent circular curves of different radii	mm
28	ΔD	overall cant variation along a cant transition, between straight track and circular curve or between two adjacent circular curves of different radii	mm
29	Q	dynamic wheel load	N
30	Q_N	nominal wheel load	N
31	ΔQ	overall wheel load variation	N
32	Y	guiding force at the wheel rail contact	N

5 Requirements

5.1 Background

The following technical normative rules assume that standards for acceptance of vehicle, track construction and maintenance cover the conditions defined in the cited informative annexes.

A good compromise has to be found between train dynamic performance, maintenance of the vehicle and track and construction costs. The choice of alignment elements depends upon the operation requirements, the parameters specified (and their values) and on local conditions. The specified parameters and values within this European Standard may have to be adjusted in consultation with the train operator.

5.1.1 Track alignment design parameters

The following parameters are specified in 5.2:

- radius of horizontal curve R (m) (*S);
- cant D (mm) (*S);
- cant deficiency I (mm) (*S);
- uncompensated (quasi-static) lateral acceleration at track level a_q (m/s^2) (*S);
- cant excess E (mm);
- length of transition curves in the horizontal plane L (m);
- rate of change of cant dD/dt (mm/s);
- cant gradient $dD/d\ell$ (mm/m) (*S);
- rate of change of cant deficiency dI/dt (mm/s);
- length of alignment elements (circular curves and straights) L_i (m);
- radius of vertical curve R_v (m);
- vertical acceleration a_v (m/s^2);
- speed V (km/h) (*S).

Parameters followed by the (*S) note indicate **safety-related parameters**.

Annex B describes an alternative means of classification for the above mentioned parameters, as a function of their relative influence on safety, comfort and cost efficiency of the track/vehicle system.

5.1.2 Parameter quantification

For each of the parameters, two different types of limiting values are specified:

- a recommended limiting value;
- a maximum limiting value which may have two different meanings:

- a) For **safety-related parameters**, it shall be considered as the absolute maximum limit of this parameter; this maximum limit may depend upon the actual track mechanical and geometrical state. See annex B for further information.

It should also be noted that the maximum limiting value is safety-related and may (for some parameters) induce a reduced comfort level : most operators will reduce these values by at least 10%, and refer to the proposed limits as "exceptional" values to be used only under special circumstances or after a specific safety case analysis.

The attention of the operators is drawn to the fact that limiting values are defined with respect to a commercial train operating pattern. If and when running trials are conducted, for example to ascertain the vehicle dynamic behaviour (by continually monitoring of the vehicle responses), exceeding the limiting values (particularly in terms of cant deficiency) shall be permitted and it shall be up to the infrastructure manager to decide any appropriate arrangement. In this context, safety margins are generally reinforced by taking additional steps such as ballast consolidation, monitoring of track geometric quality, etc.

- b) For **non-safety related parameters**, the values shall be considered as the limit above which passenger comfort may be affected and track maintenance significantly increased; however, to cope with special situations, operators may choose values in excess of these specified values, but they should not exceed the safety limits.

NOTE The following parameters for interoperable high speed lines are specified by the Technical Specification for Interoperability:

- cant;
- cant deficiency.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

5.1.3 Traffic categories

A distinction is made between the following traffic categories:

- I mixed traffic lines, with passenger train speeds from 80 km/h to 120 km/h maximum;
- II mixed traffic lines, with passenger train speeds greater than 120 km/h and up to 200 km/h maximum;
- III mixed traffic lines, designed for passenger train speed higher than 200 km/h to 300 km/h;
- IV mixed traffic lines, with passenger train speeds up to 230 km/h (or 250 km/h on upgraded lines) with vehicle incorporating special technical design characteristics (low axle mass, low roll flexibility coefficient, etc.);
- V dedicated passenger lines with speeds between 250 km/h and 300 km/h.

For the purposes of this European Standard, the reference speed is that for conventional trains.

The above classification uses speed as the most relevant criteria to be considered when defining operational conditions for the different traffic categories.

Other criteria may be considered for the production of such a traffic classification, namely, aspects related to safety, comfort and cost efficiency. Further information on such systems of classifications can be found in annex D.

5.2 Recommended limiting values and maximum (or minimum) limiting values for track alignment design parameters

5.2.1 Radius of horizontal curve R

The track alignment designer shall endeavour to use the largest curve radii and transition permitted by track design constraints. This will cater for any future increase of speed. In any event, the track alignment designer shall not use curve radii less than 180 m for new alignments.

The parameters that shall be considered in the determination of the minimum curve radius are:

- the maximum and minimum operating speeds;
- the applied cant;
- the limiting values for cant deficiency and cant excess.

The minimum allowable curve radius for the maximum operating speed, usually with cant deficiency I , shall be calculated using the following equation:

$$R = \frac{11,8}{D+I} V_{\max}^2 \quad [\text{m}]$$

The maximum allowable curve radius for the minimum operating speed, usually with cant excess E , shall be calculated using the following equation:

$$R = \frac{11,8}{D-E} V_{\min}^2 \quad [\text{m}]$$

The curve radius shall be determined such that the values of D , I and E comply with the limits specified in this European Standard and satisfy the following condition:

$$\frac{11,8}{D-E} V_{\min}^2 \geq R \geq \frac{11,8}{D+I} V_{\max}^2 \quad [\text{m}]$$

NOTE 1 Sharp radius curves generally necessitate a widening of the track gauge in order to improve vehicle curving. This widening of the track gauge can be used in conjunction with the installation of a check rail. The installed check rail serves a dual purpose:

- it increases stiffness of the track panel;
- it provides better guidance of the inner face of the wheel and absorption of part of the curving force.

NOTE 2 It is recommended that the radius of tracks alongside platforms should not be less than 500 m. This is to restrict the gap between platform and vehicles to facilitate safe vehicle access and egress by passengers.

5.2.2 Cant D

Cant shall be determined in relation to the following considerations:

- high cant on small-radius curves increases the risk of low-speed freight wagons derailing. Under these conditions, vertical wheel loading applied to the outer rail is much reduced, especially when track twist causes additional reductions (see as reference [ORE B55/Rp 8]);
- cant exceeding 160 mm may cause freight load displacement and the deterioration of passenger comfort when a train makes an unscheduled stop at a location where high cant has been applied. Furthermore, with such high cant, works vehicles and special loads with a high centre of gravity may become unstable;

- high cant increases cant excess values on curves where there are large differences between the speeds of fast trains and slow trains.

Table 1 — Cant D_{lim}

To avoid the risk of derailment of torsionally-stiff freight wagons on sharp radii curve, cant should be restricted to the following limit (see as reference [ORE B 55/Rp 5 and 8]):

$$D_{lim} = \frac{R - 50}{1,5} \quad [\text{mm}]$$

Traffic categories (speed in km/h)	I Mixed traffic lines $80 \leq V \leq 120$	II Mixed traffic lines $120 < V \leq 200$	III Mixed traffic lines designed for passenger train speed $200 < V \leq 300$	IV Mixed traffic lines with passenger train speeds $V \leq 230$ (or 250) (with vehicles incorporating special technical design characteristics)	V High-speed lines with dedicated passenger traffic $250 \leq V \leq 300$
Recommended limiting value [mm]	160	160	160	160	160
Maximum limiting value [mm]	180	180	180	180	200

NOTE It is recommended that cant should be restricted to 110 mm for tracks adjacent to passenger platforms. Some other track features, such as level crossings, bridges and tunnels may also, in certain local circumstances, impose cant restrictions.

<https://standards.iteh.ai/catalog/standards/sist/be2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-prEN-13803-1-2006>

<https://standards.iteh.ai/catalog/standards/sist/be2112eb-74c1-4e75-ab2f-0a5e130aa17a/osist-prEN-13803-1-2006>

5.2.3 Cant deficiency I

For given values of local radius R and cant D , the cant deficiency I shall determine the maximum speed through a full curve such that:

$$I = 11,8 \frac{V_{max}^2}{R} - D \leq I_{lim} \quad [\text{mm}]$$

I_{lim} can be replaced with the value $(a_q)_{lim}$:

$$a_q = \frac{V_{max}^2}{12,96 \cdot R} - \frac{g \cdot D}{1500} = \frac{I}{153} \leq (a_q)_{lim} = \frac{I_{lim}}{153} \quad [\text{m/s}^2]$$