

4th edition, November 2007

Translation

OR

Effects of the application of the kinematic gauges defined in the 505 series of leaflets on the positioning of structures in relation to the tracks and of the tracks in relation to each other

Conséquences de l'application des gabarits cinématiques définis par les fiches 505 sur l'implantation des obstacles par rapport aux voies et des voies entre elles

Auswirkungen der Anwendung der kinematischen Begrenzungslinien nach den UIC-Merkblättern Nr. 505 auf den Abstand fester Gegenstände vom Gleis und auf den Gleisabstand



UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

Leaflet to be classified in Volumes:

V - Rolling Stock

VI - Traction

VII - Way and Works

Application:

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All members of the International Union of Railways

This leaflet applies to standard gauge lines

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4th edition, November 2007	Complete overhaul of leaflet in accordance with PTU 1.1.2

The person responsible for this leaflet is named in the UIC Code

Contents

Summary	1
1 - General.....	2
1.1 - Safety	2
1.2 - Compatibility	2
1.3 - Bi-lateral and multilateral agreements	2
1.4 - Vehicles suitable for running on higher cant deficiencies	2
2 - Scope of application	3
2.1 - Gauges used	3
2.2 - Pantographs	3
2.3 - Platforms.....	3
3 - Definitions.....	4
3.1 - Normal co-ordinates	4
3.2 - Kinematic reference profile	4
3.3 - Projection S	5
3.4 - Roll centre C	5
3.5 - Asymmetry	7
3.6 - Flexibility coefficient s	7
3.7 - Quasi-static movement	7
4 - General information on the method of determining the lineside clearance gauge	8
4.1 - Minimum clearance gauge.....	8
4.2 - Nominal clearance gauge	9
4.3 - Relative positions of various gauges	9
4.4 - Important comments	11

5 - Rules covering the kinematic reference profile to determine the minimum or nominal lineside clearance gauge.....	12
5.1 - Vertical movements	12
5.2 - Lateral movements	12
6 - General information on the method for determining the distance between track centre lines	13
6.1 - Minimum distance between track centre lines	13
6.2 - Nominal distance between track centres	14
6.3 - Illustration of distances between track centre lines	14
7 - Rules covering the kinematic reference profile to determine the minimum and nominal distances between track centres.....	15
8 - Positioning of passenger station platforms	16
9 - Gauges not governed by bi-lateral or multilateral agreements	17
9.1 - Gauge G1	17
9.2 - Space to be reserved for the pantographs and roof mounted equipment of motive power units running on electrified lines	24
10 - Gauges requiring bi-lateral or multilateral agreements with a view to the application of a raised gauge.....	26
11 - Distance between track centres	27
11.1 -Minimum distance between track centres	27
11.2 -Nominal distance between track centres	27
Appendix A - Examples of tolerance calculation methods.....	28
A.1 - Introduction	28
A.2 - Examples of methods recommended by UIC	28
A.3 - Position of fixed installations.....	30
A.4 - Distances between track centres.....	32
List of abbreviations	33
Bibliography	35

Summary

The aim of this leaflet is to set out the rules enabling infrastructure managers (IM) to determine the clearance which must be provided and maintained so that rolling stock dimensioned according to the gauges set out in *UIC Leaflet 505-1* can safely negotiate structures and pass other rolling stock (distance between track centre lines).

1 - General

In the field of infrastructure, the term "gauge" relates to a reference profile and the rules associated with it which govern the positioning of fixed objects and the distance between track centre lines.

In order to define and apply a gauge or a certain distance between track centre lines, the kinematic reference profile of the chosen gauge and the related rules must be known.

The essential requirements cover safety and compatibility as well as the bi-lateral or multilateral agreements to be taken into consideration.

1.1 - Safety

Compliance with the gauge is critical for safety. The design, construction, maintenance and supervision of infrastructure installations must ensure safe train operations, with no risk of vehicles coming into contact with each other or with fixed objects.

1.2 - Compatibility

To allow interoperability, the characteristics of infrastructure installations must be compatible with those of rolling stock authorised for international traffic.

The safety and compatibility conditions for rolling stock are set out in *UIC Leaflet 505-1* (see [Bibliography - page 35](#)).

1.3 - Bi-lateral and multilateral agreements

In the event that the clearance gauge on a given route is not completely in line with that used to build a rolling stock vehicle but the dimensions of the latter are in practice compatible with the infrastructure of the route concerned, bi-lateral or multilateral agreements may be concluded between the RUs and IMs (see [List of abbreviations - page 33](#)).

1.4 - Vehicles suitable for running on higher cant deficiencies

In the event that the theoretical cant deficiency I_c , used in the dimensioning of vehicles, is higher than the actual cant deficiency I_c on the running lines, authorisation to operate tilting or conventional stock with a cant deficiency of $I_p > I_c$ must be regulated based on the actual local conventional cant deficiency I_c on the lines to be operated over.

An I_p value and a corresponding maximum speed should be set to ensure compatibility with local infrastructure dimensioned using the conventional method.

As regards train running in degraded mode, any failure modes that may lead to fouling of the gauge must be studied by the manufacturer and approved by the IM.

2 - Scope of application

2.1 - Gauges used

The gauges used at international level are classified as follows:

- The minimum gauge to be implemented on all lines: G1
This gauge is the international minimum that must be provided on all lines (except in Great Britain, see *UIC Leaflet 503*, see Bibliography - [page 35](#)).
- Enlarged gauges provided by some IMs: G2
G2 gauge is a raised gauge used by different IMs (mostly in eastern Europe) based on the basis of bi-lateral or multilateral agreements (see *UIC Leaflet 505-1*).
- Enlarged gauges necessary for certain well defined routes: GA, GB, GC, GB1 and GB2 (see *UIC Leaflet 506*, see Bibliography - [page 35](#)).

2.2 - Pantographs

The clearance needing to be achieved and maintained to enable pantographs and live roof-mounted equipment to run on electrified lines must comply with the rules in point [9.2 - page 24](#).

2.3 - Platforms

Platforms must be positioned in accordance with the rules in point [8 - page 16](#).

3 - Definitions

3.1 - Normal co-ordinates

The expression "normal co-ordinates" is used for orthogonal axes defined in a plane normal to the longitudinal centreline of the rails in nominal position; one of these axes, sometimes called horizontal, is the intersection of the aforementioned plane and the running surface; the other is the perpendicular to this intersection equi-distant from the rails.

For calculation purposes, this centreline and the vehicle centreline must be considered as coincident in order to be able to compare the vehicle construction gauges and the lineside clearance gauges, both calculated on the basis of the kinematic gauge reference profile which is common to both.

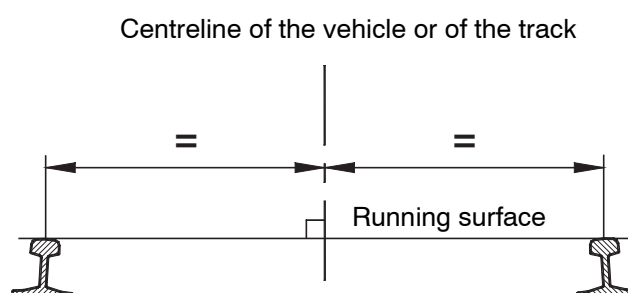


Fig. 1 - Normal coordinates

3.2 - Kinematic reference profile

This profile is related to the normal co-ordinates of the axes and is always associated with rules to determine, in the case of infrastructure, the lineside clearance gauge and the distance between track centre lines.

3.3 - Projection S

This is the permitted projection exceeding the kinematic reference profile when the vehicle runs on a curve and (or) a track with a gauge greater than 1,435 m.

Fig. 2 illustrates the space reserved for projections which must be taken into account when defining the lineside clearance gauge and the distance between track centre lines.

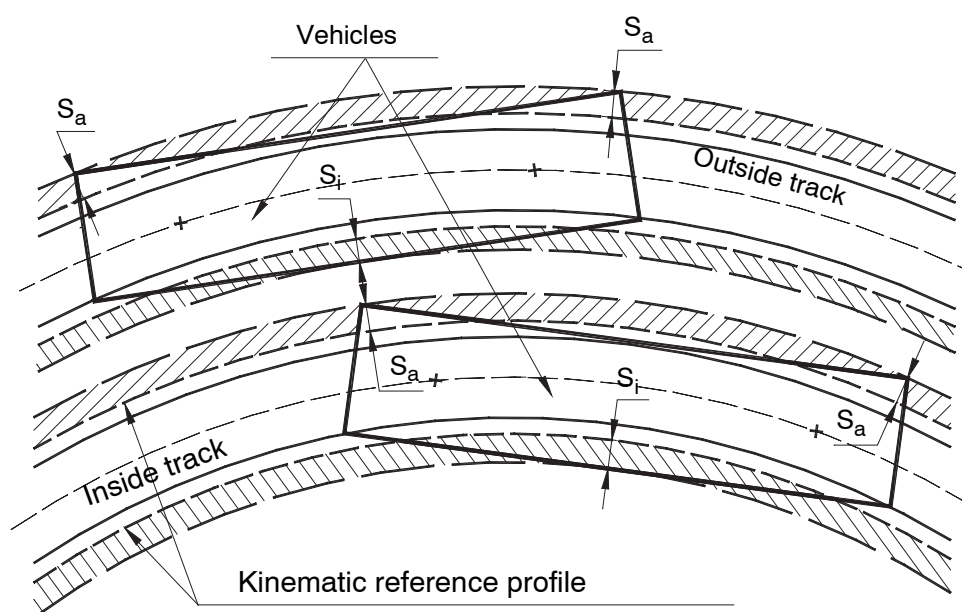


Fig. 2 - Projection S

3.4 - Roll centre C

When the vehicle body is subject to a lateral force parallel to the running surface (gravity component, see Fig. 3 - page 6, or centrifugal force, see Fig. 4 - page 6), it tilts on its suspension.

Should the lateral play of the vehicle and the effect of its dampers reach their limits, the XX' centre line of the vehicle body cross-section takes up a position $X_1X'_1$ in that tilt.

In routine cases of vehicle lateral movement, the position of point C is independent of the lateral force involved.

Point C is known as the "vehicle roll centre" and its distance h_c from the running surface is known as the "roll centre height".

When calculating the lineside clearance gauge and the distance between track centre lines, the value of the height h_c is conventionally taken as 0,5 m.

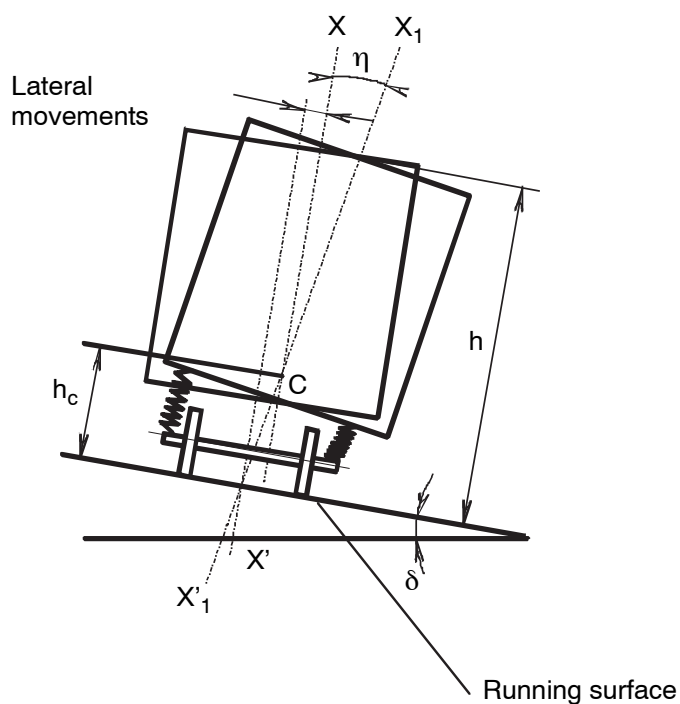


Fig. 3 - Vehicle stationary on canted track

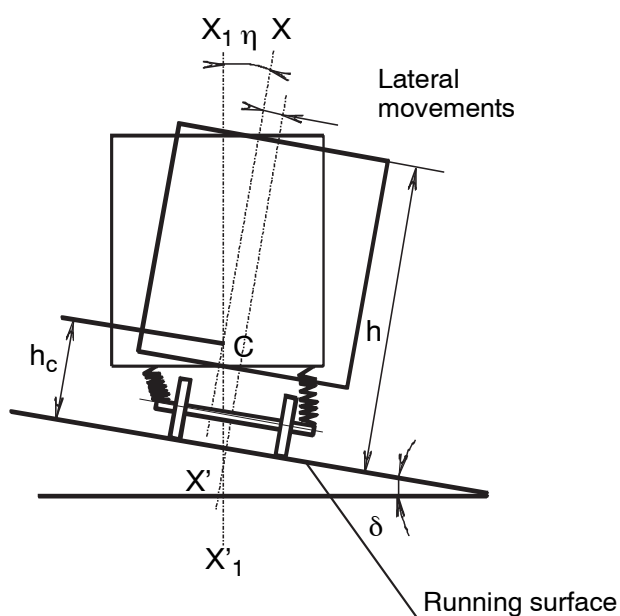


Fig. 4 - Vehicle running on a track with cant deficiency

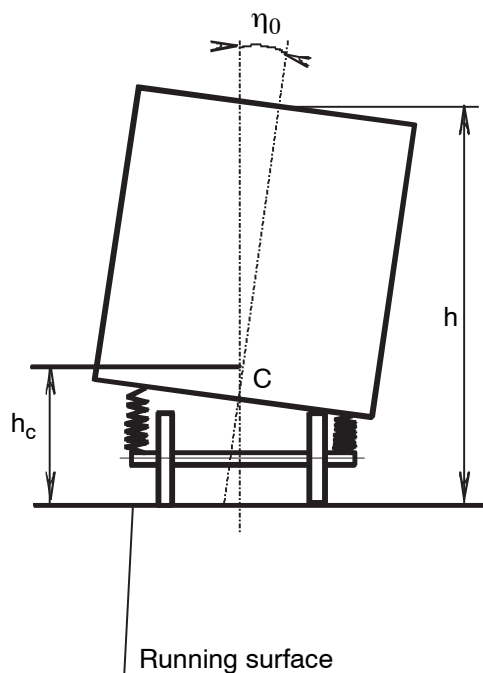


Fig. 5 - Vehicle asymmetry

3.5 - Asymmetry

The asymmetry of a vehicle is defined as the angle η_0 that would be formed between the vertical and the centreline of the body of a stationary vehicle on level track in the absence of friction (see Fig. 5). Asymmetry may result from constructional defects, unevenly set up suspension (adjustment, side bearers, pneumatic levelling valves, etc.) and from an off-centre load.

3.6 - Flexibility coefficient s

Whenever a vehicle is stationary on a canted track whose running surface lies at an angle δ to the horizontal, its body leans on its suspensions and forms an angle η with the perpendicular to the running surface (see Fig. 3 - page 6).

The vehicle flexibility coefficient s is defined as: $s = \frac{\eta}{\delta}$

3.7 - Quasi-static movement

This is the lateral movement of a vehicle body resulting from the technology applied and suspension flexibility (s flexibility coefficient) under the effect of centrifugal force not compensated for by cant or excess cant (see Fig. 3 or 4) and under the effect of asymmetry η_0 (see Fig. 5). This value depends on the height h of the point in question.

4 - General information on the method of determining the lineside clearance gauge

First of all, a distinction must be drawn between the minimum clearance gauge and the nominal clearance gauge.

A clearance gauge is a theoretical space related to the track, defined to take account of the possible kinematic space requirement of a theoretical piece of rolling stock dimensioned to the reference profile of the chosen gauge. The space requirement may result from the movements of the rolling stock due to various parameters intrinsic to it or to the layout and geometry of the track, the speed of travel, and imperfections/elastic distortion of the track. This clearance must therefore be provided and maintained vis-à-vis lineside objects throughout the route under consideration.

It is important to note that it is necessary to carry out maintenance work periodically on ballasted track to ensure safe train operation and passenger comfort. A consequence of this maintenance work is that tracks shift in relation to their original position over time thereby reducing the clearance from fixed objects. Therefore the IM must take account of factors that may reduce the clearance when planning to apply a chosen clearance gauge. The IM must make allowance for margins for track maintenance work to ensure the chosen gauge remains clear over time. When those margins are used, an absolute minimum space will remain which must not be fouled by any object to prevent critical points arising. That space is referred to as the "minimum lineside clearance gauge".

The dimensions of the nominal lineside clearance gauge are more generous than those of the minimum lineside clearance gauge. It should be applied when constructing new lines, making major changes to installations and where the infrastructure permits it.

When actually positioning objects along tracks, IMs must adopt intermediate dimensions, lying between the minimum clearance gauge and the nominal clearance gauge. These dimensions are set by each IM; they are obtained by increasing the minimum clearance gauge dimensions with the margins set by the IM based on its own operating rules, the track laying method and maintenance method.

4.1 - Minimum clearance gauge

This is the minimum space, related to the normal coordinates of the axes of the track, which should not be fouled by an object and must be provided and maintained to ensure safe running of a given type of rolling stock. In general, the minimum clearance gauge is defined to take account of the maximum, horizontal and vertical space requirements of the most protruding parts of the rolling stock in question.

To determine the envelope horizontally, various parameters covered in the associated rules set out in point 5 - page 12 are added to the horizontal dimensions of the half-width of the kinematic reference profile of the gauge in question. Vertically, the IMs must adjust the dimensions of the kinematic reference profile, of the upper and lower horizontal parts, to take account of transition curves on gradients. Account may also be taken of a margin for track maintenance.

In general, the minimum clearance gauge must be chosen, applied and maintained where special circumstances prevail and at particularly awkward points on old lines (tunnels, road bridges, etc.) in order to limit the scale of engineering work and investment costs.