UIC CODE 518-1

1st edition, May 2004

Translation

OR

Supplement to UIC leaflet 518: application to vehicles equipped with a cant deficiency compensation system and/or to vehicles intended to operate with a higher cant deficiency than stated for categories I to III

Complément à la fiche UIC 518 : application aux véhicules munis d'un système de compensation d'insuffisance de dévers et/ou aux véhicules prévus pour circuler avec une insuffisance de dévers supérieure à celle des catégories I à III

Ergänzung zu UIC-Merkblatt 518: Anwendung auf Fahrzeuge, die mit Systemen zum Ausgleich des Überhöhungsfehlbetrags ausgerüstet sind und/oder auf Fahrzeuge, die mit einem über dem in den Kategorien I bis III liegenden Überhöhungsfehlbetrag verkehren sollen

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

Leaflet to be classified in Volumes:

V - Rolling stock

VII - Way and Works

Application:

With effect from 1 September 2003
All members of the International Union of Railways

Record of updates

1st edition, May 2004 First issue

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

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Summary

UIC Leaflet 518-1 is a supplement to *UIC Leaflet 518* regarding acceptance of vehicles equipped with a cant deficiency compensation system and/or vehicles intended to operate with a higher cant deficiency than stated for categories I to III defined in *UIC Leaflet 518, Appendix C*.

Vehicles are accepted on the basis of a code of practice described in *UIC Leaflet 518* to which are added:

- additional conditions of tests (zones with medium-radius curves, transition curve sections of three types, downgraded tilting modes),

- an additional assessment quantity : the overturning criterion,

- the conditions for statistical processing of data,

- the associated limit values.

1 - Scope of the leaflet

UIC Leaflet 518 (see Bibliography - page 22) sets out a standard to be applied when accepting a vehicle for introduction into international traffic.

Vehicles equipped with a cant deficiency compensation system and/or vehicles intended to operate with a higher cant deficiency than stated for categories I to III of *UIC Leaflet 518, Appendix C*, not taken into account in that leaflet, are addressed by the present supplement.

O

2 - Field of application

Same as in *UIC Leaflet 518*.

Implementation conditions for the above systems are given in Appendix A - page 17.

O

3 - Definitions

Same as in *UIC Leaflet 518*.

4 - Symbols et abbreviations

Same as in *UIC Leaflet 518*, with the following supplementary information:

Parameter	Direction for measurements	Symbol	Unit
VEHICLE			
Wheel force Q			
Wheelset i, side A wheel of vehicle	vertical	Q_{iA}	kN
Wheelset i, side B wheel of vehicle	vertical	Q_{iB}	kN
Assessment quantity for safety			
Overturning criterion	vertical	η	
OTHER SYMBOLS			
Uncompensated lateral acceleration toward vehicle physical side A	lateral	- aq	m/s^2
Uncompensated lateral acceleration toward vehicle physical side B	lateral	+ aq	m/s^2

O

5 - General principles

5.1 - Preamble

Same as in *UIC Leaflet 518*, taking into account:

- the operating conditions and the characteristics of test zones on medium-radius curves,

- the overturning criterion in the case of the normal method, which modifies the last paragraph of *UIC Leaflet 518, point 5.1* as follows:

  In order to carry out this test, there is a need to apply a measuring method which is known as:

  - "normal" if the individual wheel/rail interaction forces Y and Q are measured and the Y/Q ratio *and overturning criterion* η *are calculated*,
  - "simplified" if only H forces and/or accelerations on the wheelsets, on the bogie and on the bodyframe are to be measured.

5.2 - Choice of the method to be applied

Same as in *UIC Leaflet 518*.

5.2.1 - Acceptance of a new vehicle

When accepting a new vehicle, the full procedure and the normal measuring method shall be used.

5.2.2 - Extension of acceptance

When an already accepted vehicle:

- is to be operated differently,

- includes revised design features,

an extension of the acceptance may be agreed with the following conditions:

- if $I_{adm} \leq I_{adm}$ of the initial acceptance, application of point 10.2 - page 15,

- if $I_{adm} > I_{adm}$ of the initial acceptance, the full procedure and the normal measuring method shall be applied.

5.3 - Conditions for implementation of the simplified methods

UIC Leaflet 518 shall apply directly, provided that the cant deficiency is the same as the one applied to conventional stock.

O

6 - Test conditions

6.1 - Test zones

The table in Appendix A - page 17 (supplement to *UIC Leaflet 518, Appendix C*) gives the value of cant deficiency to be taken into account.

For running on conventional lines, with $70 \leq V \leq 230$ km/h, the permissible cant deficiency (I_{adm}) to be taken into account shall be I_{adm} = 275 mm. Depending on the vehicle's expected behaviour with respect to the acceptance criteria set out in this leaflet, the reference value may be set at I_{adm} = 300 mm.

However, when, a vehicle does not comply with certain limit values on one or more test zones, supplementary analysis shall be made to determine the following :

1. the reduced cant deficiency I_{red} permissible over the whole range of that class of radii,

2. the ranges of radii on which the cant deficiency I_{adm} is practicable.

N.B: Example of a supplementary analysis for determining I_{red}:

On a test zone where the maximum estimated value for an assessment quantity X reaches $X_{lim} + dX$:

- do a linear regression of X as a function of I;
  the regression line so obtained fits the equation: $X = a + bI$
- I_{adm} must be reduced to a value I_{red} allowing to absorb the exceeding amount of dX,
  such that $dX = b(I_{adm} - I_{red})$
  whence it is deduced that: $I_{red} = I_{adm} - dX/b$

6.1.1 - Zone on tangent track and very large-radius curves

Same as in *UIC Leaflet 518*.

6.1.2 - Zone with large-radius curves

Full curve sections

Same as in *UIC Leaflet 518*.

Transition curve sections

Apply point 6.1.5 - page 9.

6.1.3 - Zone with medium-radius curves (600 m < R ≤ 900 m)

The requirements of this subsection shall apply only when the maximum speed is at least 200 km/h.

Full curves shall be processed separately from transition curves :

- Cant deficiency:
  $0{,}75\ I_{adm} \leq I \leq 1{,}10\ I_{adm}$
  tolerance : $\pm\ 0{,}05\ I_{adm}$

Full curve sections

- Number of sections:

  - one-dimensional statistical processing method (see *UIC Leaflet 518, point 9.2*)

    $N_1 \geq 25$ with $0{,}75\ I_{adm} \leq I \leq 1{,}10\ I_{adm}$
    including $N_2 \geq 0{,}2\ N_1$ with $I = 1{,}10\ I_{adm}$
    tolerance : $\pm\ 0{,}05\ I_{adm}$

  - two-dimensional statistical processing method (see *UIC Leaflet 518, point 9.2*)

    $N_1 \geq 25$ with $0{,}75\ I_{adm} \leq I \leq 1{,}10\ I_{adm}$ distributed as evenly as possible over the interval
    including $N_2 = (0{,}20 \pm\ 0{,}05)\ N_1$ with $I = 1{,}10\ I_{adm}$
    tolerance : $\pm\ 0{,}05\ I_{adm}$

- Length of each section: ℓ = 250 m

- 10% tolerance on each section length

- Possibility of several sections in each curve

- Statistical processing (see *UIC Leaflet 518, point 9*).

Transition curve sections

Apply point 6.1.5 - page 9.

6.1.4 - Zone with small-radius curves

Full curve sections

Same as in *UIC Leaflet 518, point 6.1.3*.

Transition curve sections

Apply point 6.1.5 - page 9.

6.1.5 - Transition curve sections

The track configuration distinguishes three types of transition curves:

1. transition curve between a straight line and a full curve,
2. transition curve between reverse curves,
3. transition curve between two full curves in the same direction.

The rules to be observed for data collection are as follows :

- include all three types of transition curves for each category of curve,
- constitute a single section per transition curve,
- state the number of transition curves of each type,
- apply statistical processing (see point 9 - page 13).

If it is not possible to test every type of transition curve in the network for that traffic, this must be stated in the test report.

6.1.6 - Special conditions (recommended)

Same as in *UIC Leaflet 518, point 6.1.4*.

6.2 - Selecting the test section

6.2.1 - Selection of test zones

Running on different special tracks for that type of traffic at the maximum speed and the maximum cant deficiency authorised by each railway.

Apply point 6.1 - page 7.

6.2.2 - Track geometry quality

The track geometry quality to be applied shall be the one given in *UIC Leaflet 518, Appendix D* that corresponds to the maximum commercial speed of the vehicle.

6.2.3 - Geometry of the wheel-rail contact

Same as in *UIC Leaflet 518*.

6.3 - Test vehicle condition

6.3.1 - Mechanical characteristics (static and dynamic)

Same as in *UIC Leaflet 518*.

6.3.2 - Loading condition

Same as in *UIC Leaflet 518*.

6.3.3 - Wheel profiles

Same as in *UIC Leaflet 518*.

6.3.4 - Downgraded tilting modes

Failure tests of an active tilt system and its active sub-systems (for instance an integrated hold-off device) must be carried out on track as follows:

- The main failures of the tilting system, as identified by the risk analysis, must be tested.

- The test must be done in a full curve section and with the permissible cant deficiency I_{adm}. The vehicle shall be in a normal load condition. When each defined failure mode is tested, safety quantities $(\Sigma Y)_{2m}$, $(Y/Q)_{2m}$ and η shall be measured and calculated, then the maximum value shall be compared to the corresponding limit values. No statistical processing of the measured quantities is to be carried out.

- The test curve is chosen in the radius group with the smallest margin from the standpoint of the safety criteria.

- The test must be carried out in left and right hand curves.

If the failure may result in a sustained downgraded condition, additional verification may be needed. The extent of the test procedure shall be defined by reference to the risk analysis.

6.4 - Other conditions to be met

Same as in *UIC Leaflet 518*.

The wind conditions during the test runs shall be such that the overturning criterion is not significantly affected.

7 - Quantities to be measured

Same as in *UIC Leaflet 518*.

O

8 - Assessment quantities

8.1 - Normal method

Same as in *UIC Leaflet 518*, adding:

- Overturning criterion η

$$\eta = \frac{\Sigma_{bogie} Q_{iA} - \Sigma_{bogie} Q_{iB}}{\Sigma_{bogie} Q_{iA} + \Sigma_{bogie} Q_{iB}}$$

for each bogie where wheel-rail contact forces are measured.

Signal processing of that quantity is presented in point 9.4 - page 13 and Appendix B - page 18.

8.2 - Simplified methods

Same as in *UIC Leaflet 518*.

Signal processing is that of *UIC Leaflet 518, points F.2 to F.4*.

The overturning criterion is not taken into account.

O

9 - Processing of assessment quantities

9.1 - Statistical processing per section

Same as in *UIC Leaflet 518*.

Appendix B - page 18 specifies for each quantity, the filtering to be used, the classification methods and the statistical parameters for the processing, with groupings of input data to be achieved in connection with various operating conditions.

Values relative to the overturning criterion are processed as presented in point 9.4.

9.2 - Statistical processing per test zone

9.2.1 - Tangent track and full curves

Same as in *UIC Leaflet 518* including for medium-radius curves ($600m < R \leq 900m$).

9.2.2 - Transition curves

For each safety parameter $(\Sigma Y)_{2m}$ and $(Y/Q)_{2m}$, one shall calculate the maximum value of the assessment quantities xi grouped by the categories of curves shown in appendix B - page 18. This maximum value shall be compared with the limit value given in point 10 - page 15.

For transition curves on which the limiting value of $(\Sigma Y)_{2m}$ or $(Y/Q)_{2m}$ is reached or exceeded, additional information (design of the transition, track fault, etc.) shall be given to help find the reasons.

9.3 - Instability criterion

Same as in *UIC Leaflet 518*.

9.4 - Overturning criterion

The risk of overturning of the vehicle in curves shall be assessed for each bogie where wheel-rail forces are measured, on the basis of the overturning criterion:

$$\eta = \frac{\Sigma_{bogie} Q_{iA} - \Sigma_{bogie} Q_{iB}}{\Sigma_{bogie} Q_{iA} + \Sigma_{bogie} Q_{iB}}$$

To take into account a possible asymmetry, the effect of quasi-static accelerations toward the two vehicle sides must be treated separately for each side.

The following procedure is applied:

- Low-pass filtering at 1,5 Hz with an attenuation slope higher or equal to 24 dB/oct.

- Statistical processing by section.

  The statistical processing shall be carried out for each defined section. In curved zones, only full curve sections shall be used. The statistical processing of the test sections is made from data input xi. For each section, the following shall be calculated:

  • the distribution function F(x) for the determination of $xi(F_1)$ with F_1 = 0,15% when due to the curve direction, the vehicle is accelerated toward vehicle side A with a magnitude equal to the resulting uncompensated lateral acceleration (hereafter called -aq) and $xi(F_2)$ with F_2 = 99,85% when due to the curve direction, the vehicle is accelerated toward vehicle side B with a magnitude equal to the resulting uncompensated lateral acceleration (hereafter called +aq);

  • bidimensional analysis of the overturning criterion versus cant deficiency with the following rules. Only one analysis is made after all $xi(F_i)$ of same curve direction have been gathered whatever the radii are.

For curve sections, only $xi(F_1)$ is used for -aq and only $xi(F_2)$ is used for +aq. For tangent track and large radii curves (see point 6.1.1 - page 7), both $xi(F_1)$ and $xi(F_2)$ are used.

That means that positive cant deficiencies will correspond to $xi(F_2)$ and negative cant deficiencies will correspond to $xi(F_1)$.

The total mesh is divided into two parts: one for $xi(F_1)$, the other for $xi(F_2)$.

Two trend lines are calculated, one for each mesh:

$$Y_B = a_B + b_B I \quad \text{and} \quad Y_A = a_A + b_A I$$

The standard deviations S_A of the vertical distance from the points $\{xi(F_1), i = 1 \ldots N_1\}$ and S_B of the vertical distance from the points $\{xi(F_2), i = 1 \ldots N_2\}$ to the corresponding trend line are calculated. Two new lines are determined: one for measures corresponding to $xi(F_2)$ (+aq) $Y_P = Y_B + 3S_B$, the other for measures corresponding to $xi(F_1)$ (-aq) $Y_N = Y_A - 3S_A$.

According to point 10.1.1.1 - page 15, Y_P must not be larger than η_{lim} for $I = 1{,}5\ I_{adm}$, Y_N must not be smaller than $-\eta_{lim}$ for $I = -1{,}5\ I_{adm}$.

See Appendix C - page 20 for an example of plot.

O

10 - Limiting values for assessment quantities

10.1 - Acceptance of a new vehicle

10.1.1 - Normal method

10.1.1.1 - Safety

Same as in *UIC Leaflet 518, point 10.1.1.1* adding, after the third paragraph:

4. Overturning

$$\eta_{lim} = 1$$

10.1.1.2 - Track fatigue

Same as in *UIC Leaflet 518*.

10.1.1.3 - Running behaviour

Same as in *UIC Leaflet 518*.

10.1.2 - Simplified methods

(in the case where I_{adm} = that of conventional stock)

Same as in *UIC Leaflet 518*.

10.2 - Extension of acceptance

When a tilting vehicle has already been accepted, an extension of acceptance may be granted if the vehicle's operating conditions or construction are changed.

The extension procedure described here is applicable only if $I_{adm} \leq I_{adm}$ of the initial acceptance.

If $I_{adm} > I_{adm}$ of the initial acceptance, the full procedure and the normal measurement method shall be applied.

Similarly, if there is a modification of the cant deficiency compensation system, the full procedure and the normal measurement method shall be applied.

10.2.1 - Conditions for the implementation

Let λ be the minimum value of the "limit value/estimated maximum value" ratios of the following safety parameters: ΣY, Y/Q and η, the table of Appendix D - page 21 must be applied if $\lambda \geq 1{,}1$ for each test zone.

10.2.2 - Definition of procedure and testing conditions

UIC Leaflet 518, point 10.2.2 must be applied, medium-radius curves included.

O

11 - Presentation of test results

Same as in *UIC Leaflet 518*, adding for safety parameters:

- overturning criterion η , and taking into account:
  - mean-radius curves,
  - downgraded tilting modes,
  - the three types of transition curves.

Appendix A - Implementation conditions and cant deficiency to be taken into account

Supplement to *UIC Leaflet 518, Appendix C*

Train category	Line	Speed (km/h)	I_{adm}[a] (mm)
IV - Vehicle equipped with a cant deficiency compensation system and/ or vehicles for which a greater cant deficiency than that required for Categories I to III may be applied[d]	conventional lines	$V \leq 230$[b]	275 or 300[c]
	high-speed lines	$V \leq 250$	150
		$250 < V \leq 300$	130[e]

a. The values of I_{adm} relate to the standard track gauge of 1 435 mm. For other gauges, the equivalent value must be calculated.

b. See *UIC Leaflet 705* (see Bibliography - page 22).

c. Recommended values, depending on the vehicle's expected behaviour with respect to the acceptance criteria.

d. A vehicle equipped with a cant deficiency compensation system but operated with the same cant deficiency as conventional trains shall be treated according to *UIC Leaflet 518, Appendix C* for the corresponding train category (I to III).

e. For trains using high-speed lines equipped with concrete slab track, the reference value for cant deficiency is I_{adm} = 150 mm.

Appendix B - Determination of the statistical quantities - Normal method

Nr	Assessment quantity	Filtering (prior to processing): cut-off frequency	Statistical processing by section		Statistical processing by test zone				
			Calculation method	Percentiles to be used	Grouping of data				Coef. k
					Straight track	Large-radius curves	Medium-radius curves	Small-radius curves	
1	$(\Sigma Y)_{2m}$ wheelsets 1 and 2	$\geq$ 20 Hz (1)	Sliding mean over 2 m	F_1 = 0,15% F_2 = 99,85%	Total for each wheelset of: $\|xi(F_1)\|$ and $xi(F_2)$	Total for each wheelset of: - on right $xi(F_2)$ - on left $\|xi(F_1)\|$			3
2	$\left(\frac{Y}{Q}\right)_{2m}$	$\geq$ 20 Hz (1)	sampling interval of 0,5 m	F_1 = 0,15% F_2 = 99,85%	-	Total, for the outer wheel, of: - on right $xi(F_2)$ - on left $\|xi(F_1)\|$			3
3	$\ddot{y}_s^+$ (4) (5)	10 Hz (1)	-	F_1 = 0,15% F_2 = 99,85%	Total for each wheelset of: $\|xi(F_1)\|$ and $xi(F_2)$	Total for each wheelset of: - on right $xi(F_2)$ - on left $\|xi(F_1)\|$			3
4	$\ddot{y}_s^*$ (4)	6 Hz (1)	-	F_1 = 0,15% F_2 = 99,85%	Total for each end of: $\|xi(F_1)\|$ and $xi(F_2)$	Total for each end of: - on right $xi(F_2)$ - on left $\|xi(F_1)\|$			3
5	η	1,5 Hz (1)	-	F_1 = 0,15% F_2 = 99,85%	$xi(F_1)$ and $xi(F_2)$ (6)	$xi(F_1)$ for $I < 0$ $xi(F_2)$ for $I > 0$ (6)			(6)
6	Q wheels 1, 2, 3, 4	20 Hz (1)	-	F_2 = 99,85%	total $xi(F_2)$ for wheels 1 to 4	$xi(F_2)$ total of outer wheels on curve			2,2
7	Y_{qst} wheels 1, 2, 3, 4	$\geq$ 20 Hz (1)	-	F_0 = 50%	-	-	Total for each wheelset of: - on right $xi(F_0)$ - on left $\|xi(F_0)\|$ of the outer wheel on curve		0
8	Q_{qst} wheels 1, 2, 3, 4	$\geq$ 20 Hz (1)	-	F_0 = 50%	-	-	$xi(F_0)$, total of outer wheels on curve		0

Nr	Assessment quantity	Filtering (prior to processing): cut-off frequency	Statistical processing by section		Statistical processing by test zone				
			Calculation method	Percentiles to be used	Grouping of data				Coef. k
					Straight track	Large-radius curves	Medium-radius curves	Small-radius curves	
9	$\ddot{y}^*_q$ and $\ddot{z}^*_q$ ends I and II	0,4 - 10 Hz (2)	-	F_1 = 0,15% F_2 = 99,85%	Total of $\lvert xi(F_1)\rvert$ and $xi(F_2)$ for each quantity and each end				2,2
				rms values $s\ddot{y}^*_q$ and $s\ddot{z}^*_q$	rms values for each quantity and each end				2,2
10	$\ddot{y}^*_{qst}$ ends I and II	≥ 20 Hz (1)	-	F_0 = 50%	-	Total for each end of: - on right $xi(F_0)$ - on left $\lvert xiF_{(0)}\rvert$			0
11	ΣY wheelsets 1 and 2	$f_0 \pm 2$ Hz (2) (3)	-	-	Sliding rms value calculated over 100 m at 10 m intervals		-		-

(1) Low-pass filter at - 3 dB, attenuation gradient ≥ 24 dB/octave, tolerance of ± 0,5 dB up to the cut-off frequency, ± 1 dB beyond that.

(2) Low-pass filter at - 3 dB, attenuation gradient ≥ 24 dB/octave, tolerance of ± 0,5 dB within the band, ± 1 dB outside the band.

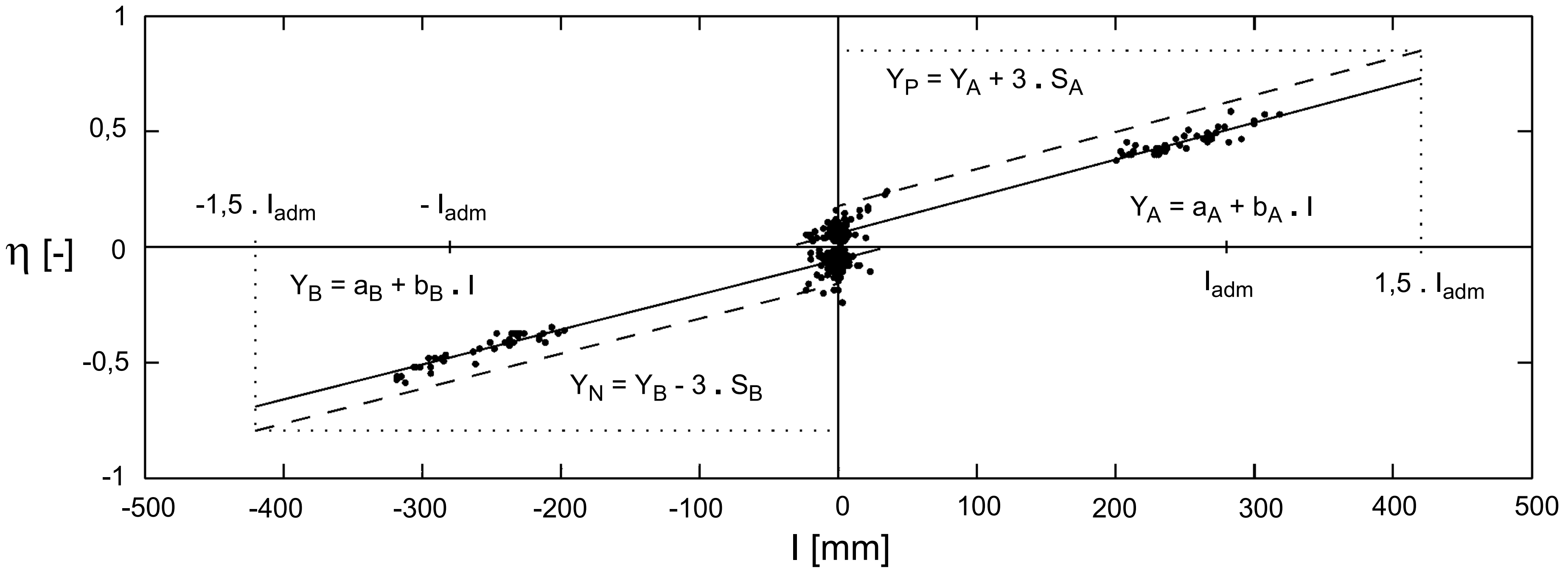
(3) f_0 is the instability (hunting) frequency.

(4) This statistical processing is carried out in view of a subsequent extension of the acceptance using a simplified measuring method.

(5) Solely for bogie vehicles.

(6) Bidimensional analysis (see point 9.4 - page 13).

Appendix C - Example of plot and trend lines for evaluation of the vector intercept overturning criterion



Appendix D - Implementation conditions for the partial acceptance procedure and the simplified method

Vehicles equipped with a cant deficiency compensation system and/or vehicles intended to operate with a higher cant deficiency than stated for categories I to II defined in *UIC Leaflet 518, Appendix C*

Parameters modified[1]		**Conditions for waiving the test and applying a simplified method, when $\lambda \geq 1{,}1$**[2]			**Procedure to be applied (full, partial)**					
		Variation range compared to already approved vehicle[3]			Loading conditions		Test sections [4]			
		For dispensation from tests	For simplified method				Straight track	Curves		
			Measurement $\ddot{y}^{+}, \ddot{y}^{*}, \ddot{z}^{*}$	Measurement $H, \ddot{y}^{*}, \ddot{z}^{*}$	Empty	Loaded		Large-radius curves	*Mean-radius curves*	Small-radius curves
Vehicle		**Vehicle**			**Vehicle**					
Vehicle wheel-base		- 5%, + 20%	- 10%, - 5%		YES	NO	YES	NO	*NO*	NO
			+ 20%, + ∞ [7]		*YES*	*NO*	*YES*	NO	*NO*	*YES*
Position of centre of gravity Γ[5]		- 20%, + 10%			YES	*YES*	YES	YES	*YES*	*YES*
Mass	not suspended	± 5%	- 10%, - 5% + 5%, + 10%		YES	NO	YES	YES	*NO*	NO
	with a single suspension level (total mass if the vehicle has **no** secondary suspension)	± 5%	- 10%, - 5% + 5%, + 10%		YES	NO	YES	YES	*NO*	NO
	with two suspension levels	± 10%			YES	YES	YES	YES	*YES*	YES
Moment of inertia of the body relative to the vertical central axis		± 10%			YES	YES	YES	YES	*YES*	YES
Increase in tractive effort		0, + 10%			YES	YES	YES	YES	*YES*	YES
Increase in operating speed *without increase of I_{adm}*			0, + 10 km/h		YES	NO	YES	YES	*NO*	NO
				+ 10 km/h, + 20 km/h	YES	YES	YES	YES	*NO*	NO
Bogie		**Bogie**			**Bogie**					
Wheel-base of bogie		0, + 5%		+ 5%, + 20%	NO	YES	NO	NO	*NO*	YES
			- 5%, 0		YES	NO	YES	YES	*NO*	NO
Nominal wheel diameter		- 10%, + 15%			YES	YES	YES	YES	*YES*	YES
Stiffness of vertical primary suspension [6] (for vehicle **with** secondary suspension only)		± 20%			YES	*YES*	YES	YES	*YES*	*YES*
Stiffness of secondary vertical suspension [6] (or stiffness of primary vertical suspension for vehicles **without** secondary suspension)		± 10%	+ 10%, + 40%		YES	NO	YES	YES	*NO*	NO
Axle-guiding	stiffness	0, + 10%	- 10%, 0		YES	NO	YES	YES	*NO*	NO
	damping, clearances...	± 10%			YES	YES	YES	YES	*YES*	YES
Rotational torque		± 10%	- 20%, - 10%		YES	NO	YES	YES	*NO*	NO
				+ 10%, + 20%	YES	NO	NO	NO	*NO*	YES
Moment of inertia of the bogie relative to the vertical central axis		- 100%, + 5%	+ 5%, + 10%		YES	NO	YES	YES	*NO*	NO
Secondary lateral suspension (stiffnesses, damping, clearances...)		± 10%			YES	YES	YES	YES	*YES*	YES

Explanation of notes

(1) If a changed parameter influencing running behaviour is not mentioned, the normal method and the full procedure should be applied.

(2) By definition,

$$\lambda = \min\left(\frac{\text{limit value}}{\text{maximum estimated value}}\right)$$

taking into consideration the following safety parameters:
- normal method: ΣY, Y/Q, η
- simplified method:

$H, \ddot{y}^{+}, \ddot{y}^{*}$ and $\ddot{z}^{*}$

according to the method used.

(3) Beyond the variation ranges or when the latter are not mentioned, the full procedure should be applied, solely for the test cases shown in the right-hand part of the table.

(4) The test should be carried with one rail inclination only.

(5)

$$\Gamma = \frac{\frac{I_{adm}}{e} h_g + b}{\frac{I_{adm}}{e} h_{g0} + b_0}$$

h_g : height of centre of gravity relative to the top of rail (mm).
e : lateral distance between the contact points of the wheels [mm] (approximately 1 500 mm for standard gauge).
$b = b_{nom} + b_{qst}$ where b_{nom} is the nominal lateral distance of the centre of gravity from the vehicle centre line and b_{qst} is the quasi-static displacement of the centre of gravity due to curving, including effects from suspension displacement, a possible cant deficiency compensating system and any other similar system [mm].
Index 0 indicates the original vehicle with which the proposed vehicle is compared.

(6) Checking the non-bottoming of springs is part of design and shall be set out in a forthcoming document.

(7) ∞ : maximum limiting value authorised.

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Warning

Printed by the International Union of Railways (UIC)
16, rue Jean Rey 75015 Paris - France, May 2004
Dépôt Légal May 2004

ISBN 2-7461-0684-1 (French version)
ISBN 2-7461-0685-X (German version)
ISBN 2-7461-0686-8 (English version)