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Translation

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Rules governing application of the enlarged GA, GB, GB1, GB2, GC and GI3 gauges

Règles pour l'application des gabarits agrandis GA, GB, GB1, GB2, GC et GI3

Regeln für die Anwendung der erweiterten Begrenzungslinien GA, GB, GB1, GB2, GC und GI3



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

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All members of the International Union of Railways

This leaflet applies to standard gauge lines

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Overhaul of leaflet.

New G13 gauge, amended GB2 gauge.

New point 5.3.

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

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Summary

By comparison with *UIC Leaflet 505-1 and 505-4*, this leaflet defines the rules for gauges GA, GB, GC, GB1 and GB2 which are larger in the upper part and gauge G13 which is larger in the lower part.

For each gauge this leaflet enables:

- maximum construction gauges for rolling stock to be determined,
- the examination of the structure gauges and track centre distances which must be achieved and maintained.

1 - General

By comparison with the gauge common to *UIC Leaflet 505-1 and 505-4* (see Bibliography - page 55), GA, GB and GC vehicle gauges are larger in the upper part and consequently correspond to the application principles set out in point 2 - page 3.

Since GA, GB and GC vehicle gauges were designed initially to meet loading needs by derogation from *UIC Leaflet 505-1*, the present leaflet first of all defines the rules for static gauges.

NB : The standard loads used for defining GA, GB and GC gauges are given in Appendix B - page 39.

To enable rail vehicles built to the GA, GB and GC enlarged gauges, the leaflet also defines the corresponding kinematic gauges in the same way as in *UIC Leaflet 505-1*.

Loads and vehicles conforming to the GA, GB and GC enlarged gauges shall only be allowed on lines widened to these gauges. The lines concerned are listed in *RIV, Annex 2* (see Bibliography - page 55). Train movements on lines not listed in this Annex shall be treated as special traffic.

Wagons and coaches built to the GA, GB and GC gauges shall be identified by a marking as provided for in the *CUU* (see Bibliography - page 55) and *RIC*.

By comparison with the gauge common to *UIC Leaflet 505-1 and 505-4*, gauge GI3 is larger in the upper part.

Gauge GI3 has been included in the present leaflet on account of its non-obligatory status.

Gauge GI3 was initially defined to enable optimum use to be made of infrastructure, in conjunction with gauge GB1, to enable the transport of semi-trailers on well wagons derogating from the gauge in *UIC Leaflet 505-1*. However, it can be used in conjunction with all other gauges.

Vehicles conforming to the enlarged GI3 gauge shall only be allowed on lines whose lower parts have been enlarged accordingly; routing of such vehicles calls for bi- or multi-lateral agreements.

Vehicles built to gauge GI3 cannot bear the *CUU* or *RIC* markings.

2 - Scope of application

The GA gauge may be implemented in the more or less long term on all railway lines.

The GB gauge, which incorporates the GA gauge, is relevant for short or medium-term projects involving a maximum number of lines in order to develop a cohesive network over a relatively extensive area.

The GC gauge, which incorporates the GA and GB gauges, is relevant for new lines and major rebuilding projects (for example: tunnels) on specially-targeted existing lines.

For the GA and GB gauges, a transitional phase may be allowed during which the standard loads defined in Appendix B - page 39 may be routed under the responsibility of the railway concerned, which should then ascertain, through appropriate calculations, that there exists maximum structure clearance.

NB : Lines accepting such loads may be called GAO and GBO.

The GI3 gauge may be used on existing or future lines. It can be achieved at a lower cost than the gauges for lower parts defined in *UIC Leaflet 505-4* since it primarily encounters occasional obstructions without consequence for larger obstacles such as platforms and structures.

The GB1 and GB2 gauges shown in Appendix C - page 47 are options that involve the upgrading of specific lines when the GB gauge is not appropriate. The GB2 gauge incorporates the GB1 gauge, which in turn incorporates the GB gauge.

3 - GA, GB and GC static gauges (Loading gauges)

3.1 - Reference profiles

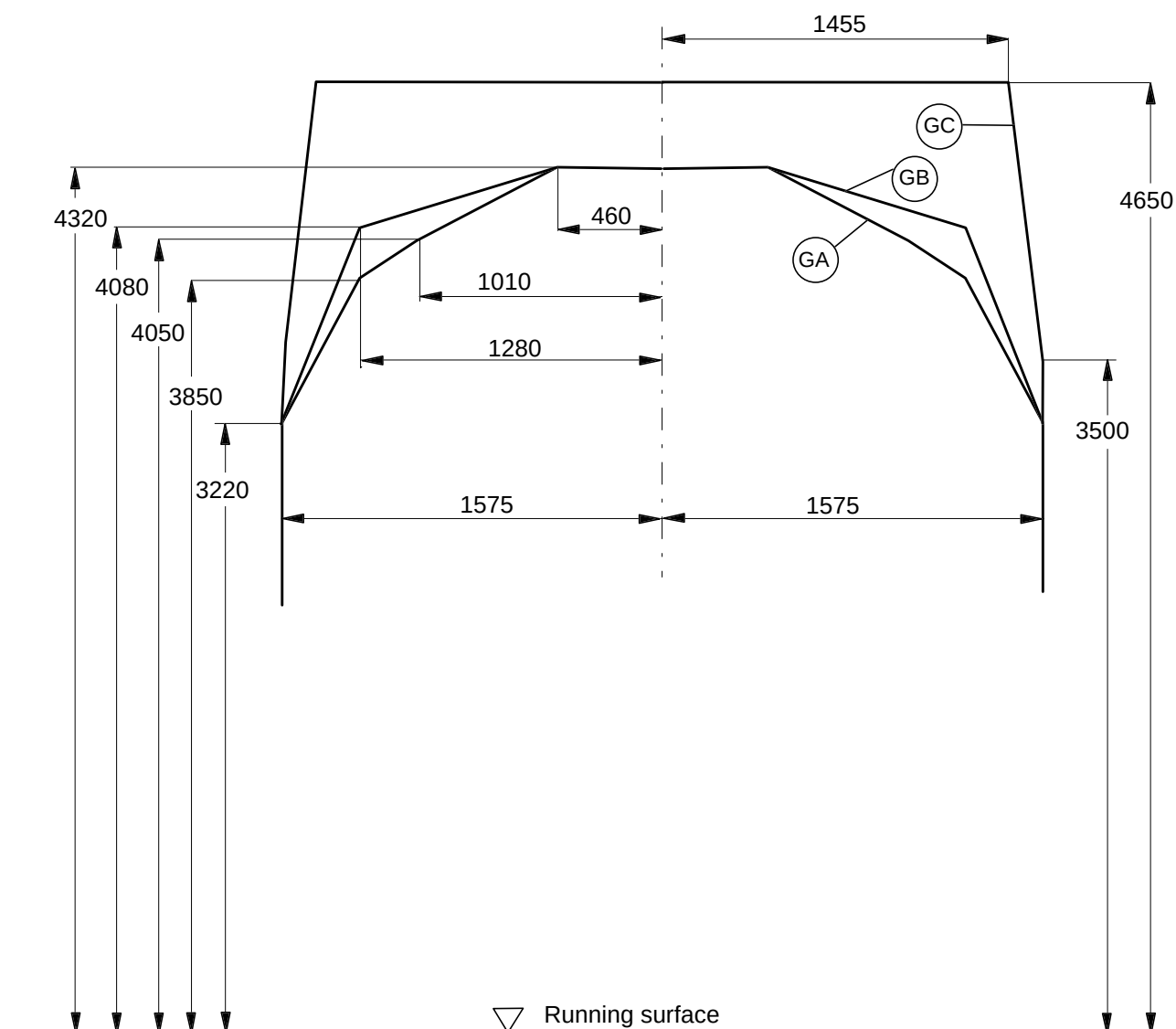


Fig. 1 - Reference profile

NB : Up to a height of 3 220 mm, the static reference profile of the GA, GB and GC gauges is identical to that of the static gauge G1 in *UIC Leaflet 505-5*.

3.2 - Rules for static reference profiles

These rules are applicable solely for calculating maximum load profile. They shall be valid only in cases where the coefficient of flexibility of the wagon + load combination is not greater than that of the standard loads shown in point B.1 - page 39.

The rules for the kinematic calculations, arising from point 4.2.4 - page 17 may be applied to clearly-defined loads.

The term "clearly-defined loads" in this context shall be understood to mean transferrable unit loads with known geometric parameters, for example containers and swap bodies loaded on carrier wagons fitted with load positioning and securing devices, and semi-trailers with deflated air suspension or mechanical suspension (with a known roll flexibility coefficient¹) conveyed on recess wagons.

Under these conditions, the wagon + load combination can be treated as a normal single wagon.

To allow for tolerances on centring, the half-widths should be at most equal to those of the reference profiles shown in Fig. 1 - page 4 reduced by the following values of E_i and E_a .

3.2.1 - GA and GB static gauges

- **Height $h \leq 3,22$ m.** The formulae applicable are those relating to the static gauge (see UIC Leaflet 505-5, Appendix H).
- **Height $h > 3,22$ m.** The formulae applicable are as set out below²:

1. *For the sections between bogie pivots or between end-axles of vehicles not mounted on bogies*

- Where:

$$\left(an - n^2 + \frac{p^2}{4} \right) \leq 7,5 + 32,5k \quad \Delta_i = 7,5 + 32,5k$$

- Where:

$$\left(an - n^2 + \frac{p^2}{4} \right) > 7,5 + 32,5k \quad \Delta_i = an - n^2 + \frac{p^2}{4}$$

$$E_i = \left[\frac{\Delta_i}{500} + \frac{1,465 - d}{2} + q + w + [x_i]_{>0} - 0,075 - 0,065k \right]_{>0} \quad (601)$$

with:
$$x_i = \frac{1}{750} \left(an - n^2 + \frac{p^2}{4} - 100 \right) ;$$

k (see Table 1 - page 6)

1. These provisions do not affect characteristics of wagons of UIC Leaflet 596-6.
2. With the exception of k, the symbols used are those already applied in UIC Leaflet 505-1.

2. For sections beyond bogie pivots or end-axes of vehicles not mounted on bogies

- Where:

$$\left(an + n^2 - \frac{p^2}{4} \right) \leq 7,5 + 32,5k, \quad \Delta_a = 7,5 + 32,5k$$

- Where:

$$\left(an + n^2 - \frac{p^2}{4} \right) > 7,5 + 32,5k, \quad \Delta_a = an + n^2 - \frac{p^2}{4}$$

$$E_a = \left[\frac{\Delta_a}{500} + \left(\frac{1,465 - d}{2} + q + w \right) \frac{2n + a}{a} + [x_a]_{>0} - 0,075 - 0,065k \right]_{>0} \quad (602)$$

with:

$$x_a = \frac{1}{750} \left(an + n^2 - \frac{p^2}{4} - 100 \right) ;$$

k (see Table 1)

Table 1 :

GA gauge	GB gauge
Where $3,22 < h < 3,85$ m, $k = \frac{h - 3,22}{0,63}$	Where $3,22 < h < 4,08$ m, $k = \frac{h - 3,22}{0,86}$
Where $h \geq 3,85$ m, $k = 1$	Where $h \geq 4,08$ m, $k = 1$

NB : Explanations justifying the reduction formulae and k are given in Appendix B - page 39.

3.2.2 - GC static gauge

The reduction formulae applicable are those valid for the *UIC Leaflet 505-5* static gauge.

4 - GA, GB and GC kinematic gauges

4.1 - Reference profiles

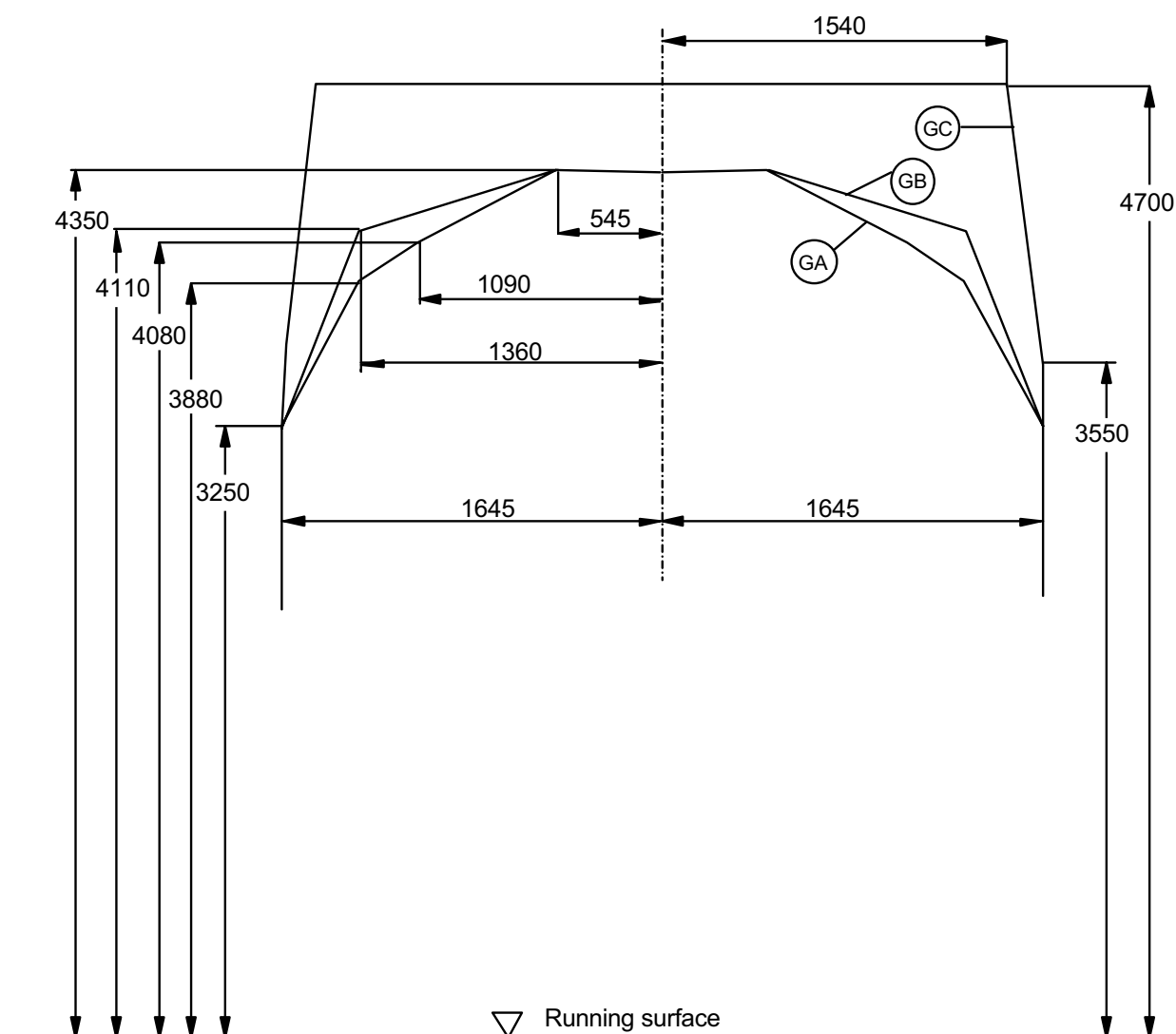


Fig. 2 - Reference profile

NB : For heights between 400 and 3 250 mm, the reference profile of GA, GB and GC gauges is identical to that given in *UIC Leaflet 505-1 and 505-4*.
For heights $\leq 0,4$ m, the reference profile is that associated with the gauge applicable to lower parts.

4.2 - Rules associated with the kinematic reference profiles for calculating the maximum vehicle profile

4.2.1 - Tractive units (except railcars)

4.2.1.1 - GA and GB kinematic gauges

- **Height $h \leq 0,4$ m.** The rules applicable are those associated with the gauge for lower parts.
- **Height $0,4 < h \leq 3,25$ m.** The rules applicable are those given in *UIC Leaflet 505-1*.
- **Height $h > 3,25$ m.** The rules applicable are those given in *UIC Leaflet 505-1*, with the exception of the following formulae¹:

4.2.1.1.1 - Vehicles for which play w is independent of the curve radius or varies in linear fashion by reference to the curvature

1. For sections between bogie pivots or between end-axles of vehicles not mounted on bogies

- Where:
$$an - n^2 + \frac{p^2}{4} - 500(w_{\infty} - w_{i(250)}) \leq 7,5 + 32,5k$$

$$E_i = \frac{1,465 - d}{2} + q + w_{\infty} + z - 0,015 \quad (603)$$

- Where:
$$an - n^2 + \frac{p^2}{4} - 500(w_{\infty} - w_{i(250)}) > 7,5 + 32,5k$$

$$E_i = \frac{an - n^2 + \frac{p^2}{4}}{500} + \frac{1,465 - d}{2} + q + w_{i(250)} + z + [x_i]_{>0} - 0,030 - 0,065k \quad (604)$$

with:
$$x_i = \frac{1}{750} \left(an - n^2 + \frac{p^2}{4} - 100 \right) + w_{i(150)} - w_{i(250)}$$

k and z (see Table 2 - page 11)

1. With the exception of k, the symbols used are those applied in *UIC Leaflet 505-1*.

2. For sections beyond bogie pivots or end-axes of vehicles not mounted on bogies

- Where:

$$an + n^2 - \frac{p^2}{4} - 500 \left[(w_{\infty} - w_{i(250)}) \frac{n}{a} + (w_{\infty} - w_{i(250)}) \frac{n+a}{a} \right] \leq 7,5 + 32,5k$$

$$E_a = \left(\frac{1,465 - d}{2} + q + w_{\infty} \right) \frac{2n+a}{a} + z - 0,015 \quad (605)$$

- Where:

$$an + n^2 - \frac{p^2}{4} - 500 \left[(w_{\infty} - w_{i(250)}) \frac{n}{a} + (w_{\infty} - w_{i(250)}) \frac{n+a}{a} \right] > 7,5 + 32,5k$$

$$E_a = \frac{an + n^2 - \frac{p^2}{4}}{500} + \left(\frac{1,465 - d}{2} + q \right) \frac{2n+a}{a} + w_{i(250)} \frac{n}{a} + w_{a(250)} \frac{n+a}{a} + z + [x_a]_{>0} - 0,030 - 0,065k \quad (606)$$

with:
$$x_a = \frac{1}{750} \left(an + n^2 - \frac{p^2}{4} - (120 - 20k) \right) + (w_{i(150)} - w_{i(250)}) \frac{n}{a} + (w_{a(150)} - w_{a(250)}) \frac{n+a}{a}$$

k and z (see Table 2 - page 11)

4.2.1.1.2 - Vehicles for which w varies in non-linear fashion by reference to the curvature

1. For sections between bogie pivots or end-axles of vehicles not mounted on bogies

For each point on the vehicle, the value of E_i to be taken is the highest obtained from application of:

- formula (603) above,
- formulae (607) and (608) below in which the value of R to be taken maximises the portion between coupling hooks.

$$E_i = \left[\frac{an - n^2 + \frac{p^2}{4} - (7,5 + 32,5k)}{2R} + w_{i(R)} \right] + \frac{1,465 - d}{2} + q + z - 0,015 \quad (607)$$

with: $\infty > R \geq 250$ m

$$E_i = \left[\frac{an - n^2 + \frac{p^2}{4} - 100}{2R} + w_{i(R)} \right] + \frac{1,465 - d}{2} + q + z - 0,170 - 0,065k \quad (608)$$

with: $250 > R \geq 150$ m

k and z (see Table 2 - page 11)

2. For sections beyond bogie pivots or end-axles of vehicles not mounted on bogies

For each point on the vehicle, the value of E_a to be taken is the highest obtained from application of:

- formula (605) above,
- formulae (609) and (610) below in which the value of R to be taken maximises the portion between coupling hooks.

for: $\infty > R \geq 250$ m

$$E_a = \left[\frac{an + n^2 - \frac{p^2}{4} - (7,5 + 32,5k)}{2R} + w_{i(R)} \frac{n}{a} + w_{a(R)} \frac{n+a}{a} \right] + \left(\frac{1,465 - d}{2} + q \right) \frac{2n+a}{a} + z - 0,015 \quad (609)$$

for: $250 > R \geq 150$ m

$$E_a = \left[\frac{an + n^2 - \frac{p^2}{4} - (120 - 20k)}{2R} + w_{i(R)} \frac{n}{a} + w_{a(R)} \frac{n+a}{a} \right] + \left(\frac{1,465-d}{2} + q \right) \frac{2n+a}{a} + z + 0,210 - 0,105k \quad (610)$$

k and z (see Table 2)

Table 2 :

GA gauge	GB gauge
Where $3,25 < h < 3,88$ m, $k = \frac{h-3,25}{0,63}$	Where $3,25 < h < 4,11$ m, $k = \frac{h-3,25}{0,86}$
Where $h \geq 3,88$ m, $k = 1$	Where $h \geq 4,11$ m, $k = 1$
$z = \left[\frac{s}{30} + \tan(\eta_0 - 1^\circ) \right]_{>0} (h - h_c) + \left[\frac{s}{10} (h - h_c) - (0,04 - 0,01k)(h - 0,5) \right]_{>0}$	

NB : Explanations justifying reduction formulae and k are given in Appendix B - page 39.

4.2.1.2 - GC kinematic gauge

- **Height $h \leq 0,4$ m.** The rules applicable are those associated with the gauge for lower parts.
- **Height $> 0,4$ m.** The rules applicable are those given in *UIC Leaflet 505-1*, irrespective of the value of height h.

4.2.2 - Railcars

NB : The gauge characteristics of railcars, whose bogies can be considered to be motor or carrying bogies, are described in *UIC Leaflet 505-1*.

4.2.2.1 - GA and GB kinematic gauges

- **Height $h \leq 0,4$ m.** The rules applicable are those associated with the gauge for lower parts.
- **Height $0,4 < h \leq 3,25$ m.** The rules applicable are those given in *UIC Leaflet 505-1*.
- **Height $h > 3,25$ m.** The rules applicable are those given in *UIC Leaflet 505-1* with the exception of the following formulae¹:
 - railcars all with motor bogies: the formulae are those given in point 4.2.1.1 - page 8 (Power cars);
 - railcars all with carrying bogies: the formulae are those given in point 4.2.3.1 - page 13 (Coaches and vans);
 - railcars with motor bogie and carrying bogie: the reduction formulae given in point 4.2.1.1 - page 8 may either be applied as they stand, or replaced with the following formulae which offer manufacturers a slight advantage in the centre-part and at the ends of the vehicle body.

1. With the exception of k, the symbols used are those applied in *UIC Leaflet 505-1*.

1. *Between pivots*¹ :

$$E_i = \frac{1,465-d}{2} + q + w_{\infty} \frac{a-n_{\mu}}{a} + w'_{\infty} \frac{n_{\mu}}{a} + z - 0,015 \quad (603a)$$

$$E_i = \frac{an_{\mu} - n_{\mu}^2 + \frac{p^2}{4} \frac{a-n_{\mu}}{a} + \frac{p'^2}{4} \frac{n_{\mu}}{a}}{500} + \frac{1,465-d}{2} \cdot \frac{a-n_{\mu}}{a} + q + w_{i(250)} \frac{a-n_{\mu}}{a} + w'_{i(250)} \frac{n_{\mu}}{a} + z + [x_i]_{>0} - 0,015 - 0,015 \frac{a-n_{\mu}}{a} - 0,065k \quad (604a)$$

with: $x_i = \frac{1}{750} \left(an_{\mu} - n_{\mu}^2 + \frac{p^2}{4} \cdot \frac{a-n_{\mu}}{a} + \frac{p'^2}{4} \cdot \frac{n_{\mu}}{a} - 100 \right) + (w_{i(150)} - w_{i(250)}) \frac{a-n_{\mu}}{a} + (w'_{i(250)} - w'_{i(150)}) \frac{n_{\mu}}{a}$

k and z (see Table 2 - page 11)

2. *Beyond pivots on motor-bogie side*²

$$E_a = \left(\frac{1,465-d}{2} + q + w_{\infty} \right) \frac{2n+a}{a} + z - 0,015 \quad (605b)$$

$$E_a = \frac{an + n^2 - \frac{p^2}{4} \cdot \frac{n+a}{a} + \frac{p'^2}{4} \cdot \frac{n}{a}}{500} + \frac{1,465-d}{2} \cdot \frac{n+a}{a} + q \cdot \frac{2n+a}{a} + w'_{i(250)} \frac{n}{a} + w_{a(250)} \frac{n+a}{a} + z + [x_a]_{>0} - 0,030 - 0,065k \quad (606b)$$

with: $x_a = \frac{1}{750} \left(an + n^2 - \frac{p^2}{4} \frac{n+a}{a} + \frac{p'^2}{4} \frac{n}{a} - (120-20k) \right) + (w'_{i(150)} - w'_{i(250)}) \frac{n}{a} + (w_{a(150)} - w_{a(250)}) \frac{n+a}{a}$

k and z (see Table 2 - page 11)

1. The reduction applicable for the same value of n is the highest obtained with formulae (603a) and (604a).
2. The reduction applicable for the same value of n is the highest obtained with formulae (605b) and (606b).

3. Beyond pivots on carrying-bogie side¹

$$E_a = \left(\frac{1,465-d}{2} + q \right) \frac{2n+a}{a} + w_{\infty} \frac{n}{a} + w'_{\infty} \frac{n+a}{a} + z - 0,015 \quad (605c)$$

$$E_a = \frac{an + n^2 + \frac{p^2}{4} \cdot \frac{n}{a} - \frac{p'^2}{4} \cdot \frac{n+a}{a}}{500} + \left(\frac{1,465-d}{2} + q \right) \cdot \frac{2n+a}{a} + w_{i(250)} \frac{n}{a} + w'_{a(250)} \frac{n+a}{a} + z + [x_a]_{>0} - 0,030 - 0,065k \quad (606c)$$

with:
$$x_a = \frac{1}{750} \left(an + n^2 + \frac{p^2}{4} \frac{n}{a} - \frac{p'^2}{4} \frac{n+a}{a} - (120-20k) \right) + (w_{i150} - w_{i(250)}) \frac{n}{a} + (w'_{a(150)} - w'_{a(250)}) \frac{n+a}{a}$$

k and z (see Table 2 - page 11)

4.2.2.2 - GC kinematic gauge

- **Height $h \leq 0,4$ m.** The rules applicable are those associated with the gauge for lower parts.
- **Height $> 0,4$ m.** The rules applicable are those given in *UIC Leaflet 505-1*, irrespective of the value of height h.

4.2.3 - Coaches and vans

4.2.3.1 - GA and GB kinematic gauges

- **Height $h \leq 0,4$ m.** The rules applicable are those associated with the gauge for lower parts.
- **Height $0,4 < h \leq 3,25$ m.** The rules applicable are those given in *UIC Leaflet 505-1*.
- **Height $h > 3,25$ m.** The rules applicable are those given in *UIC Leaflet 505-1* with the exception of the following formulae²:

1. The reduction applicable for the same value of n is the highest obtained with formulae (605c) and (606c).
2. With the exception of k, the symbols used are those applied in *UIC Leaflet 505-1*.

4.2.3.1.1 - Vehicles for which w is independent of the curve radius or varies in linear fashion in relation to curvature

1. For sections between bogie pivots

- Where:

$$an - n^2 + \frac{p^2}{4} - 500(w_{\infty} - w_{i(250)}) \leq 250(1,465 - d) + 32,5k$$

$$E_i = \frac{1,465 - d}{2} + q + w + z - 0,015 \quad (611)$$

- Where:

$$an - n^2 + \frac{p^2}{4} - 500(w_{\infty} - w_{i(250)}) > 250(1,465 - d) + 32,5k$$

$$E_i = \frac{an - n^2 + \frac{p^2}{4}}{500} + q + w_{i(250)} + z + [x_i]_{>0} - 0,015 - 0,065k \quad (612)$$

with: $x_i = \frac{1}{750} \left(an - n^2 + \frac{p^2}{4} - 100 \right) + w_{i(150)} - w_{i(250)}$

k and z (see Table 3 - page 16)

2. For sections beyond bogie pivots

- Where:

$$an + n^2 - \frac{p^2}{4} - 500 \left[(w_{\infty} - w_{i(250)}) \frac{n}{a} + (w_{\infty} - w_{i(250)}) \frac{n+a}{a} \right] \leq 250(1,465 - d) \frac{n}{a} + (7,5 + 32,5k)$$

$$E_a = \left(\frac{1,465 - d}{2} + q + w \right) \frac{2n+a}{a} + z - 0,015 \quad (613)$$

- Where:

$$an + n^2 - \frac{p^2}{4} - 500 \left[(w_{\infty} - w_{i(250)}) \frac{n}{a} + (w_{\infty} - w_{a(250)}) \frac{n+a}{a} \right] > 250(1,465 - d) \frac{n}{a} + (7,5 + 32,5k)$$

$$E_a = \frac{an + n^2 - \frac{p^2}{4}}{500} + \frac{1,465 - d}{2} \cdot \frac{n+a}{a} + q \cdot \frac{2n+a}{a} + w_{i(250)} \frac{n}{a} + w_{a(250)} \frac{n+a}{a} + z + [x_a]_{>0} - 0,030 - 0,065k \quad (614)$$

with:
$$x_a = \frac{1}{750} \left(an + n^2 - \frac{p^2}{4} - (120 - 20k) \right) + (w_{i(150)} - w_{i(250)}) \frac{n}{a} + (w_{a(150)} - w_{a(250)}) \frac{n+a}{a}$$

k and z (see Table 3 - page 16)

4.2.3.1.2 - Vehicles for which play w varies in non-linear fashion in relation to curvature

1. For sections between bogie pivots

For each point on the vehicle, the value of E_i to be taken is the highest obtained from application of:

- formula (611) above,
- formulae (615) and (616) below in which the value of R to be taken maximises the portion between coupling hooks.

for: $\infty > R \geq 250$ m

$$E_i = \left[\frac{an - n^2 + \frac{p^2}{4} - (7,5 + 32,5k)}{2R} + w_{i(R)} \right] + q + z \quad (615)$$

for: $250 > R \geq 150$ m

$$E_i = \left[\frac{an - n^2 + \frac{p^2}{4} - 100}{2R} + w_{i(R)} \right] + q + z + 0,185 - 0,065k \quad (616)$$

k and z = (see Table 3 - page 16)