# Commission Regulation (EU) No 1301/2014 of 18 November 2014 on the technical specifications for interoperability relating to the ‘energy’ subsystem of the rail system in the Union (Text with EEA relevance)

# ANNEX

# Appendix D

## Specification of the pantograph gauge

### D.1 SPECIFICATION OF THE MECHANICAL KINEMATIC PANTOGRAPH GAUGE

#### D.1.1 **General**

##### D.1.1.1 *Space to be cleared for electrified lines*

In the case of lines electrified by an overhead contact line, an additional space should be cleared:
— to accommodate the OCL equipment,
— to allow the free passage of the pantograph.

This Appendix deals with the free passage of the pantograph (pantograph gauge). The electrical clearance is considered by the Infrastructure Manager.

##### D.1.1.2 *Particularities*

The pantograph gauge differs in some aspects from the obstacle gauge:
— The pantograph is (partly) live and, for this reason, an electrical clearance is to be complied with, according to the nature of the obstacle (insulated or not),
— The presence of insulating horns should be taken into account, where necessary. Therefore a double reference contour has to be defined to take account of the mechanical and electrical interference simultaneously,
— In collecting condition, the pantograph is in permanent contact with the contact wire and, for this reason, its height is variable. So is the height of the pantograph gauge.

##### D.1.1.3 *Symbols and abbreviations*

| **Symbol** | **Designation** | **Unit** |
|---|---|---|
| $b_w$ | Half-length of the pantograph bow | m |
| $b_{w,c}$ | Half-length of the pantograph bow conducting length (with insulating horns) or working length (with conducting horns) | m |
| $b'_{o,mec}$ | Width of mechanical kinematic pantograph gauge at upper verification point | m |
| $b'_{u,mec}$ | Width of mechanical kinematic pantograph gauge at lower verification point | m |
| $b'_{h,mec}$ | Width of mechanical kinematic pantograph gauge at intermediate height, h | m |
| Subscript a : refers to the outside of the curve<br>Subscript i : refers to the inside of the curve | | |

| | | |
|---|---|---|
| $d_l$ | Lateral deviation of contact wire | m |
| $D'_0$ | Reference cant taken into account by the vehicle for the pantograph gauge | m |
| $e_p$ | Pantograph sway due to the vehicle characteristics | m |
| $e_{po}$ | Pantograph sway at the upper verification point | m |
| $e_{pu}$ | Pantograph sway at the lower verification point | m |
| $f_s$ | Margin to take account of the raising of the contact wire | m |
| $f_{wa}$ | Margin to take account of the wear of the pantograph contact strip | m |
| $f_{ws}$ | Margin to take account of the bow trespassing the contact wire due to the pantograph sway | m |
| $h$ | Height in relation to the running surface | m |
| $h'_{co}$ | Reference roll centre height for the pantograph gauge | m |
| $h'$ | Reference height in the calculation of the pantograph gauge | m |
| $h'_o$ | Maximum verification height of the pantograph gauge in a collecting position | m |
| $h'_u$ | Minimum verification height of the pantograph gauge in a collecting position | m |
| $h_{eff}$ | Effective height of the raised pantograph | m |
| $h_{cc}$ | Static height of the contact wire | m |
| $I'_0$ | Reference cant deficiency taken into account by the vehicle for the pantograph gauging | m |
| Subscript a : refers to the outside of the curve<br>Subscript i : refers to the inside of the curve | | |

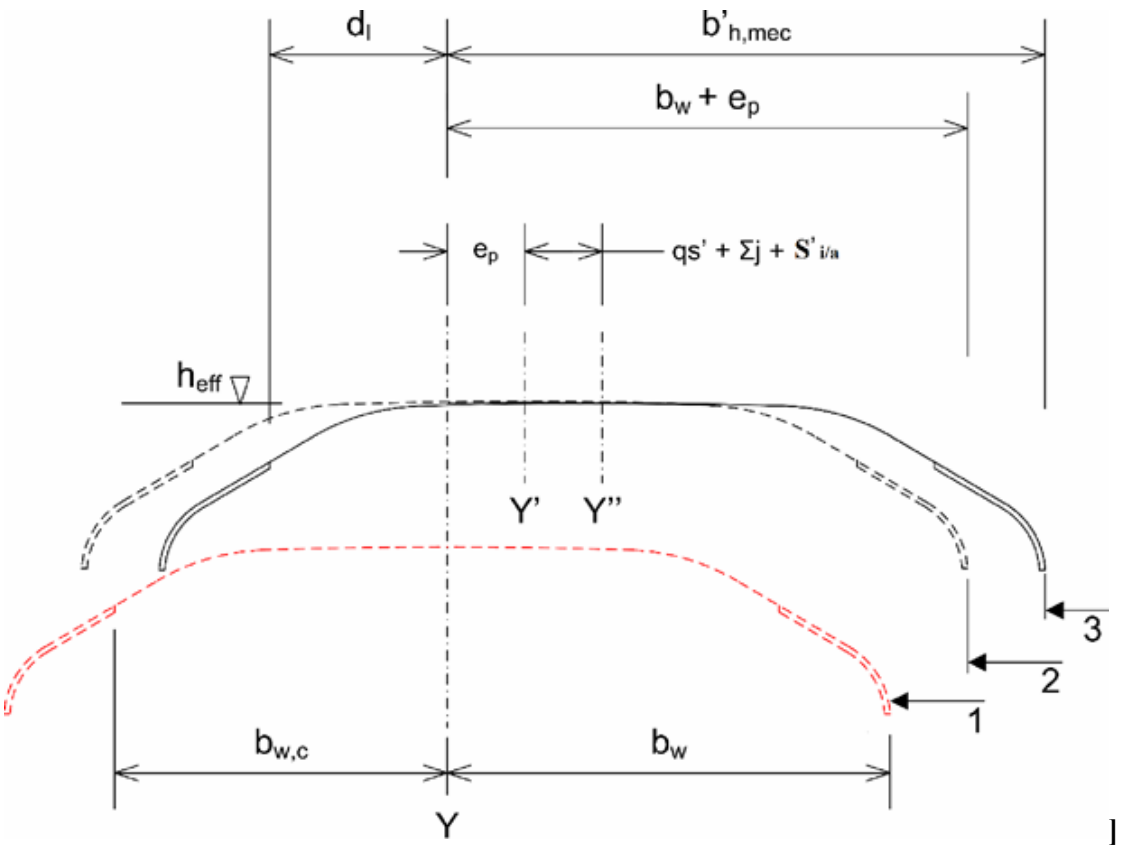
| | | |
|---|---|---|
| $L$ | Distance between rail centres of a track | m |
| $l$ | Track gauge, distance between the rail running edges | m |
| $q$ | Transverse play between axle and bogie frame or, for vehicles not fitted with bogies, between axle and vehicle body | m |
| $qs'$ | Quasi-static movement | m |
| $R$ | Horizontal curve radius | m |
| $s'_o$ | Flexibility coefficient taken into account by agreement between the vehicle and the infrastructure for the pantograph gauging | |
| $S'_{i/a}$ | Allowed additional overthrow on the inside/ outside of the curve for pantographs | m |
| w | Transverse play between bogie and body | m |
| [X1$\Sigma_j$ | Sum of the (horizontal) safety margins covering some random phenomena (j = 1, 2 or 3) for the pantograph gauge | m] |
| Subscript a : refers to the outside of the curve<br>Subscript i : refers to the inside of the curve | | |

**Editorial Information**

**X1** Substituted by Corrigendum to Commission Regulation (EU) No 1301/2014 of 18 November 2014 on the technical specifications for interoperability relating to the 'energy' subsystem of the rail system in the Union (Official Journal of the European Union L 356 of 12 December 2014).

D.1.1.4 *Basic principles*

[F1*Figure* **Pantograph mechanical gauges**
*D.1*




*Caption:*

| | | |
|---|---|---|
| Y | : | Centre line of the track |
| Y′ | : | Centre line of the pantograph — for deriving the free passage reference profile |
| Y″ | : | Centre line of the pantograph — for deriving the mechanical kinematic pantograph gauge |
| 1 | : | Pantograph profile |
| 2 | : | Free passage reference profile |
| 3 | : | Mechanical kinematic gauge |

**Textual Amendments**

**F1** Substituted by Commission Implementing Regulation (EU) 2018/868 of 13 June 2018 amending Regulation (EU) No 1301/2014 and Regulation (EU) No 1302/2014 as regards provisions on energy measuring system and data collecting system (Text with EEA relevance).

The pantograph gauge is only met if the mechanical and electrical gauges are complied with simultaneously:

— The free passage reference profile includes the pantograph collector head length and the pantograph sway $e_p$, which applies up to the reference cant or cant deficiency,

— Live and insulated obstacles shall remain outside the mechanical gauge,

— Non insulated obstacles (earthed or at a potential different from the OCL) shall remain outside the mechanical and electrical gauges.

### D.1.2 **Specification of the mechanical kinematic pantograph gauge**

D.1.2.1 *Specification of the width of the mechanical gauge*

D.1.2.1.1 *Scope*

The width of the pantograph gauge is mainly specified by the length and displacements of the pantograph under consideration. Beyond specific phenomena, phenomena similar to those of the obstacle gauge are found in the transverse displacements.

The pantograph gauge shall be considered at the following heights:

— The upper verification height $h'_o$

— The lower verification height $h'_u$

Between those two heights, it can be considered that gauge width varies in a linear way.

The various parameters are shown in figure D.2.

D.1.2.1.2 *Calculation methodology*

The pantograph gauge width shall be specified by the sum of the parameters defined below. In the case of a line run by various pantographs, the maximum width should be considered.

For the lower verification point with h = $h'_u$:

$$bt_{u(i/a),mec} = \left(b_w + e_{pu} + St_{i/a} + qst_{i/a} + \sum_j\right)_{\max}$$

For the upper verification point with h = $h'_o$:

$$bt_{o(i/a),mec} = \left(b_w + e_{po} + St_{i/a} + qst_{i/a} + \sum_j\right)_{\max}$$

Note i/a = inside/outside curve.

For any intermediate height h, width is specified by means of an interpolation:

$$bt_{h,mec} = bt_{u,mec} + \frac{h-h_u}{h_o-h_u} \times (bt_{o,mec} - bt_{u,mec})$$

D.1.2.1.3 *Half-length bw of the pantograph bow*

The half-length $b_w$ of the pantograph bow depends on the type of pantograph used. The pantograph profile(s) to be considered are defined in LOC&PAS TSI, point 4.2.8.2.9.2.

D.1.2.1.4 *Pantograph sway ep*

The sway mainly depends on the following phenomena:

— Play $q + w$ in the axle boxes and between bogie and body.

— The amount of body inclination taken into account by the vehicle (depending on the specific flexibility $s_0'$, the reference cant $D'_0$ and the reference cant deficiency $I'_0$).

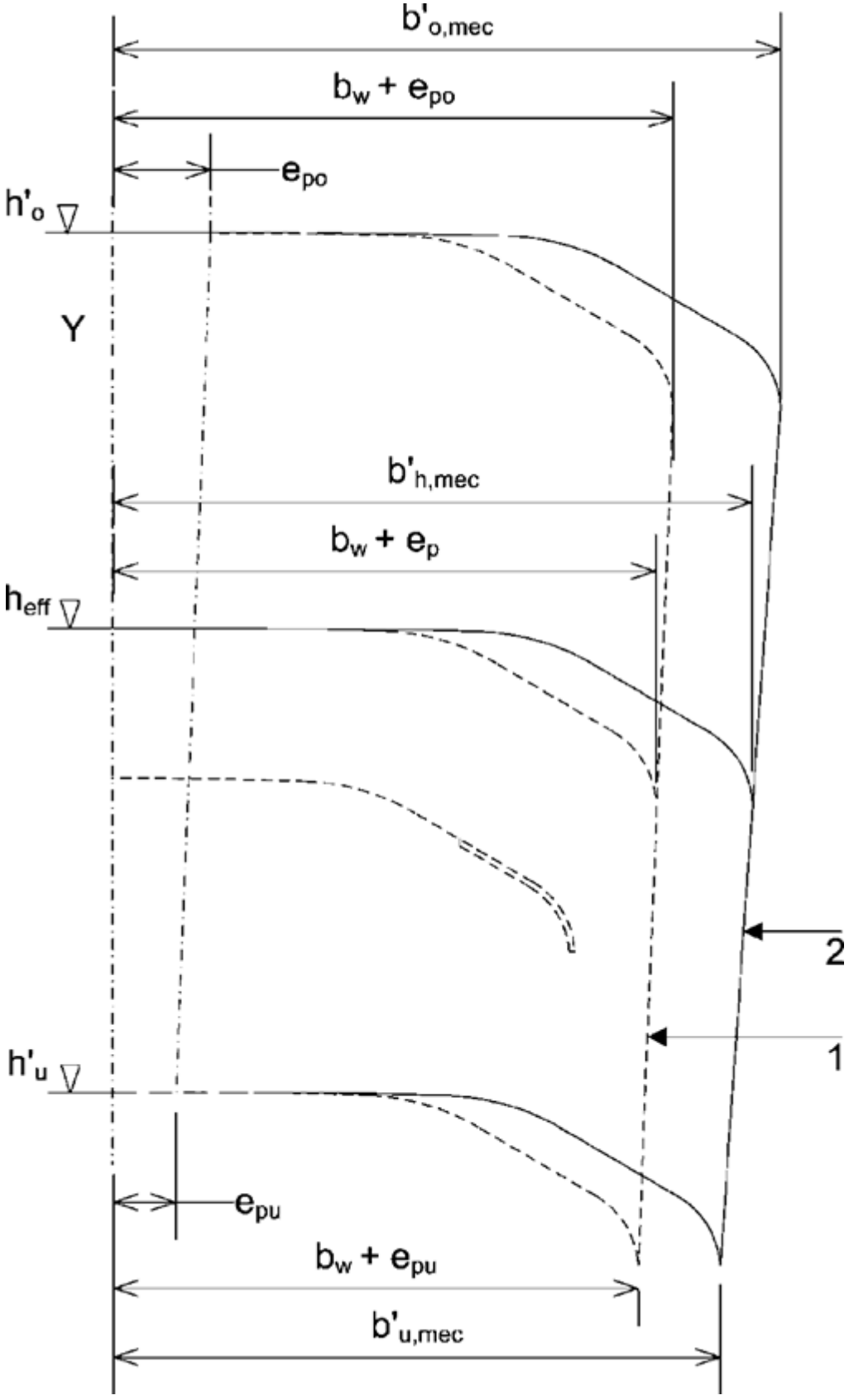
— The mounting tolerance of the pantograph on the roof.

— The transverse flexibility of the mounting device on the roof.

— The height under consideration $h'$.

*Figure D.2*

**Specification of the width of the mechanical kinematic gauge of the pantograph at different heights**



D.1.2.1.5 *Additional overthrows*

The pantograph gauge has a specific additional overthrows. In case of standard track gauge the following formula applies:

$$S'_{i/a} = \frac{2,5}{R} + \frac{\ell - 1,435}{2}$$

For other track gauges the national rules apply.

D.1.2.1.6 *Quasi-static effect*

Since the pantograph is installed on the roof, the quasi-static effect plays an important role in the calculation of the pantograph gauge. That effect is calculated from the specific flexibility $s_0'$, reference cant $D'_0$ and reference cant deficiency $I'_0$:

$$qst_i = \frac{S_0}{L}[D - D_0]_{>0}(h - h_{c0})$$

$$qst_a = \frac{S_0}{L}[I - I_0]_{>0}(h - h_{c0})$$

*Note*: Pantographs are normally mounted on the roof of a power unit, whose reference flexibility $s_0'$ is generally smaller than that of the obstacle gauge $s_0$.

D.1.2.1.7 *Allowances*

According to gauge definition, the following phenomena should be considered:

— Loading dissymmetry;

— The transverse displacement of the track between two successive maintenance actions;

— The cant variation occurring between two successive maintenance actions;

— Oscillations generated by track unevenness.

**[**[X1]The sum of the abovementioned allowances is covered by Σj.**]**

D.1.2.2 *Specification of the height of the mechanical gauge*

Gauge height shall be specified on the basis of the static height $h_{cc}$, of the contact wire at the local point under consideration. The following parameters should be considered:

— The raising $f_s$ of the contact wire generated by the pantograph contact force. The value of $f_s$ depends on the OCL type and so shall be specified by the Infrastructure Manager in accordance with point 4.2.12.

— The raising of the pantograph head due to the pantograph head skew generated by the staggered contact point and the wear of the collector strip $f_{ws} + f_{wa}$. The permissible value of $f_{ws}$ is shown in LOC & PAS TSI and $f_{wa}$ depends on maintenance requirements.

The height of the mechanical gauge is given by the following formula:

$$h_{eff} = h_{cc} + f_s + f_{ws} + f_{wa}$$

D.1.3 **Reference parameters**

Parameters for the kinematic mechanical pantograph gauge and for Specification of the maximum lateral deviation of the contact wire shall be as follows:

— l — according to track gauge

— $s'_o = 0,225$

— $h'_{co} = 0,5$ m

— $I'_0 = 0,066$ m and $D'_0 = 0,066$ m

— $h'_o$ = 6,500 m and $h'_u$ = 5,000 m

### D.1.4 **Calculation of maximum lateral deviation of contact wire**

The maximum lateral deviation of the contact wire shall be calculated by taking into consideration the total movement of the pantograph with respect to the nominal track position and the conducting range (or working length, for pantographs without horns made from a conducting material) as follows:

[X1

$$d_l = b_{w,c} + b_w - bl_{h,mec}$$

]

$b_{w,c}$ — defined in points 4.2.8.2.9.1 and 4.2.8.2.9.2 of LOC&PAS TSI

**Changes to legislation:**
There are outstanding changes not yet made to Commission Regulation (EU) No 1301/2014. Any changes that have already been made to the legislation appear in the content and are referenced with annotations.
View outstanding changes

**Changes and effects yet to be applied to :**

- Regulation revoked by S.I. 2020/318 Sch. 2
- Recital 6 Text repeal by EUR 2018/868 Regulation