BS EN 16235:2013

BSI Standards Publication

Railway application — Testing for the acceptance of running characteristics of railway vehicles — Freight wagons — Conditions for dispensation of freight wagons with defined characteristics from on-track tests according to EN 14363

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The UK committee draws users' attention to the distinction between normative and informative elements, as defined in Clause 3 of the CEN/CENELEC Internal Regulations, Part 3.

Normative: Requirements conveying criteria to be fulfilled if compliance with the document is to be claimed and from which no deviation is permitted.

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When rounded values require unit conversion for use in the UK, users are advised to use equivalent values rounded to the nearest whole number. The use of absolute values for converted units should be avoided in these cases. For the values used in this standard:

100 km/h has an equivalent value of 60 mile/h
120 km/h has an equivalent value of 75 mile/h

The UK participation in its preparation was entrusted to Technical Committee RAE/1/-/8, Railway Applications - Vehicle/Track Interaction.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Railway application - Testing for the acceptance of running characteristics of railway vehicles - Freight wagons - Conditions for dispensation of freight wagons with defined characteristics from on-track tests according to EN 14363

Applications ferroviaires - Essais en vue de l'homologation du comportement dynamique des véhicules ferroviaires - Wagons - Conditions pour la dispense des wagons avec caractéristiques définies concernant les essais en ligne selon l'EN 14363

Bahnanwendungen - Prüfung für die fahrtechnische Zulassung von Eisenbahnfahrzeugen - Güterwagen - Bedingungen für Güterwagen mit definierten Eigenschaften zur Befreiung von Streckenfahrversuchen nach EN 14363

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Foreword

This document (EN 16235:2013) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2014, and conflicting national standards shall be withdrawn at the latest by April 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

EN 14363 defines the requirements for railway vehicles with respect to running behaviour. The approval process in accordance with EN 14363, including the dispensation defined in this standard, is illustrated in normative Annex B (flow chart).

It is recognised that experience has demonstrated that running gear fitted to wagons that operate safely can also be fitted to other wagons which are within certain design limits. These other wagons will also operate safely without the need to undergo on-track testing. This experience is based on the characteristics of track design, track maintenance and vehicle maintenance in the European network since 1998. This document defines the process to determine the conditions under which such dispensation from testing can be given for a vehicle defined by the running gear and its relevant parameters together with the associated parameter limits of wagon bodies.

Vehicles for the transport of freight on the railway have historically been subject to standardisation. Very early common items like wheels, buffers, draw gear, etc. were developed as standardised components to fulfil safety requirements, for achieving ease of repair and maintenance for international traffic and low cost. Freight wagons have a wide range of applications and consequently the parameters will vary. In the UIC work for the standardisation and interchange of freight wagons certain processes for acceptance with respect to running characteristics evolved and these were formalised in UIC 432 and UIC 572 among others. The principles of this standard are similar to the intention of these two leaflets.

NOTE Vehicles accepted through the UIC process were also accepted for RIV (Regolamento Internazionale Veicoli) service, i.e. international interchange between the RIV railways. This was replaced by the General Contract of Use for Wagons (GCU) agreement on 1st July 2006. Following the Directive 2008/57/EC the Conventional Rail Technical Specification for Interoperability for Freight Wagons (CR TSI WAG) was elaborated, which contains interoperability requirements for freight wagons.

The following principles apply to the use of this standard:

1) The railway system requires comprehensive technical rules in order to ensure an acceptable interaction of vehicle and track.

2) New railway vehicles are approved (in the UIC 432 the term homologated is used) before being placed into service in accordance with numerous national and international regulations. In addition, existing approval is checked when operating conditions are extended. The approval is based on test results, calculations and/or comparisons with existing vehicles in order to achieve a safety level according to the recognised standards and regulations.

3) It is of particular importance that the existing level of safety and reliability is not compromised even when changes in design and operating practices are demanded.

This standard does not prevent the use of the principles laid down applying to other types of rolling stock.

1 Scope

This European Standard defines the process to determine the conditions under which dispensation from on-track testing according to EN 14363 can be given to freight wagons. In its application this document specifies the means by which dispensation from on-track tests is possible.

This European Standard is subordinate to EN 14363.

This European Standard is not limited to any type of freight vehicle; however certain types, which have been previously accepted under the auspices of UIC, are considered to have a continuing dispensation from on-track testing. These freight vehicles are detailed within this document.

The dispensation conditions described in this document apply to all freight vehicles used in international, multilateral or national rail freight transportation, which operate without restriction on standard gauge tracks (1 435 mm). The various rail-inclinations used in Europe (1:20, 1:40 and 1:30) are covered by the conditions for dispensation.

NOTE The test procedures described in this standard (and in EN 14363) can be applied also to applications with other track gauges e.g. 1 524 mm or 1 668 mm. The limit values could be different, as the details of such networks are not known by the authors of this standard. If established running gear are existing in such restricted networks the related ranges of running gear and vehicle parameters for dispensation from on-track tests might be specified together with the operational parameters (speed, cant deficiency, maximum axle load) based on previous tests and operating experiences. These limit values and parameters will be specified under national responsibility.

This European Standard only contains requirements for characteristics related to requirements for on-track tests specified in EN 14363.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and 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.

EN 13715, *Railway applications — Wheelsets and bogies — Wheels — Tread profile*

EN 14363, *Railway applications — Testing for the acceptance of running characteristics of railway vehicles — Testing of running behaviour and stationary tests*

EN 15313, *Railway applications — In-service wheelset operation requirements — In-service and off-vehicle wheelset maintenance*

EN 15551, *Railway applications — Railway rolling stock — Buffers*

EN 15566, *Railway applications — Railway rolling stock — Draw gear and screw coupling*

EN 15687, *Railway applications — Testing for the acceptance of running characteristics of freight vehicles with static axle loads higher than 225 kN and up to 250 kN*

3 Terms and definitions

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

NOTE Other terms and definition can be found in EN 14363 and EN 13749.

3.1
'declaration of conformity' with this standard
declaration that contains all necessary information for the description of a proven vehicle configuration

3.2
standardised running gear
running gear, bogie or single axle suspension system, which ensures compliance with the requirements related to on-track tests as specified in EN 14363 (for axle loads above 22,5 t also according to EN 15687) for a vehicle that has vehicle body parameters in a defined range

3.3
established running gear
running gear previously approved by UIC for which compliance with Clause 6 of this standard is in place of the 'declaration of conformity' with this standard

3.4
homologation file
file that contains the relevant parameters and their permitted modification range that represents the values of the standardised running gear when assessed according to the requirements of Clause 5 of this standard

3.5
bogies of Y25 family
bogies that are defined by:

- a torsional elastic frame, consisting of two side beams with or without head beam;
- spring suspension with two sets of helical suspension spring (a set may also consist of one spring) per axle box;
- a lateral and vertical dry friction damping depending on part of the vertical load supported by the axle box;
- a wheelset guiding with a maximum allowed nominal lateral displacement of ± 10 mm

and called for example Y21, Y23, Y25, Y27, Y31, Y33 or Y37

3.6
2-axle steering axle bogie family
steering axle bogie family that is defined by:

- a stiff frame, consisting of two side beams with a head beam;
- a leaf spring mounted in links guiding the axle;
- a nominal longitudinal clearance of the axle guiding of ± 6 mm;
- a nominal lateral clearance of the axle guiding of ± 23 mm;

and called for example DB 65, LHB 82, WU 83, Talbot U

3.7
3-axle steering axle bogie family
steering axle bogie family that is defined by:

- a stiff frame, consisting of two side beams with a head beam;
- a leaf spring mounted in links guiding the axle;
- a nominal longitudinal clearance of the axle guiding of ± 10 mm;
- a nominal lateral clearance of the axle guiding of ± 25 mm;

and called for example DB 711 to DB 715

3.8
mass distribution coefficient
description of the distribution of mass of the vehicle around the vertical axis given by:

$$\Phi = \frac{\sqrt{\frac{I^*_{zz}}{m^*}}}{2a^*} = \frac{i^*_{zz}}{2a^*}$$

where

I^*_{zz} is the moment of inertia of the vehicle body relative to the vertical axis through the centre of gravity of the vehicle body

i^*_{zz} is the radius of inertia of the vehicle body relative to the vertical axis through the centre of gravity of the vehicle body

m^* is the mass of the vehicle body

$2a^*$ is the distance between running gear centres

3.9
coefficient of height of centre of gravity
coefficient which is used to control maximum height of centre of gravity depending on margin of wheel force on outer rail in curves during on-track testing:

$$\chi = Q_0 \left[1 + 2{,}3\ h_{cg} \frac{I_{adm}}{(2b_A)^2} \right]$$

where

Q_0 is the static wheel load

h_{cg} is the height of the centre of gravity of the vehicle relative to the centre of the wheelset

I_{adm} is the admissible cant deficiency

$2b_A$ is the lateral distance between the contact points of the wheels (approximately 1 500 mm for standard gauge)

3.10
factor for track loading parameters
lowest ratio between limit values and estimated values for maximum and quasi-static wheel load:

$$\lambda' = \min\left(\frac{x_{lim}}{X(PA)_{max}}; \frac{y_{lim}}{Y(PA)_{max}}; \ldots \right)$$

where

x_{lim}, y_{lim} are the limit values of the assessment quantities of EN 14363 or EN 15687

$X(PA)_{max}$, $Y(PA)_{max}$ are the estimated values of assessment quantities evaluated from on-track tests performed for the assessment quantities Q_{qst} and Q_{max} for normal measuring method (only applicable for vehicles with static axle loads higher than 225 kN up to 250 kN)

4 Deviations from requirements

If deviating from some points of the requirements of this standard for a particular assessment, these deviations shall be reported and explained. Then the influence on the assessment of the vehicle in terms of the acceptance criteria shall be evaluated and recorded. The outcome of this study shall be considered as an integral part of the requirements of this standard when applied to the assessment process of the vehicle.

5 Acceptance process to achieve a standardised running gear status

5.1 General

Standardised running gear according to this standard shall be certified. For this purpose on-track tests according to EN 14363 (for axle loads above 22,5 t also according to EN 15687) shall be carried out with two different vehicles. If both vehicles pass the tests described in 5.2, the running gear shall be certified as standardised running gear in a 'declaration of conformity' with this standard that contains:

- a description of the standardised running gear; the relevant parameters and their proven range as specified in 5.3 and 5.4;
- the range of applicable parameters of the vehicle body as specified in 5.5;
- the applicable operating conditions.

Vehicles with parameters within the range defined in the 'declaration of conformity' and equipped with a standardised running gear have dispensation from on-track testing according to EN 14363 (for axle loads above 22,5 t also according to EN 15687).

The established running gear defined in Clause 6 of this standard shall be regarded as fulfilling the requirements of this chapter and the parameters specified in Clause 6 shall be regarded as equivalent to the 'declaration of conformity'.

This procedure applies only to the on-track tests as required in the relevant clauses of EN 14363 (for axle loads above 22,5 t also according to EN 15687). It does not give approval for safety against derailment on twisted track (5.1) and under longitudinal compressive forces in S-shaped curves (5.2).

5.2 Test requirements

5.2.1 Extent of tests

On-track tests shall be carried out according to the complete procedure specified in EN 14363 (for axle loads above 22,5 t also according to EN 15687).

The tests shall be performed for the same intended operating conditions (V_{adm} and I_{adm}) with two wagons with different body parameters within the ranges defined in Table 1 as follows:

- one wagon of short running gear distance; and
- one wagon of long running gear distance.

For the purposes of assessment of running behaviour in loaded condition, a typical loading condition shall be tested.

NOTE 1 It is not necessary to test the worst position of centre of gravity (as it is in most cases impossible to have a density of the load, filling the whole loading gauge, that would lead to the maximum axle load).

Table 1 — Body parameters

		2-axle wagons		Bogie wagons	
		Short test wagon	Long test wagon	Short test wagon	Long test wagon
Distance between running gear centres	$2a$* [m]	≤ 7	≥ 9	≤ 7	≥ 13
Acceptable range of torsional coefficient of vehicle body	c_t*[kNmm²/rad]	$0{,}5 \times 10^{10} \ldots 8 \times 10^{10}$	$0{,}5 \times 10^{10} \ldots 8 \times 10^{10}$	$0{,}5 \times 10^{10} \ldots 8 \times 10^{10}$	$0{,}5 \times 10^{10} \ldots 8 \times 10^{10}$

In addition, 2 axle wagons for speeds ≥ 100 km/h shall be tested in loaded condition also in sections of test zone 2 with clearances given by a gauge ≥ 1 450 mm in combination with wheelsets having distances between active faces at the minimum operation limit.

If the design parameters and the operation parameters require the application of the normal measuring method, it is nevertheless acceptable to perform such tests with one of the vehicles based on measurements of lateral acceleration. In that case, it shall be demonstrated that a relationship exists between accelerations and the sum of the guiding forces on the vehicle tested according to the normal measuring method and a related limit value shall be established.

NOTE 2 This requirement is an extension of the application of the simplified measuring method, using information gathered with vehicle tested according to the normal measuring method.

NOTE 3 This requirement is intended to be transferred to the test conditions in EN 14363.

5.2.2 Certification

The compliance of new types of bogies or running gear with the requirements of this standard shall be documented in the 'declaration of conformity' with this standard. This declaration shall include:

— an unequivocal and unique name for the running gear;

— range of parameters of the running gear (see 5.3);

— detailed technical description of the interface between vehicle body and running gear (see 5.4);

— range of parameters of car bodies to be used together with the running gear (see 5.5);

— wear limits which are essential to sustain an acceptable running behaviour (maintenance rules are outside the scope of this document).

Examples for such information can be found in Annex C to Annex L, where these are given for already accepted running gear.

5.3 Range of running gear parameters for dispensation from on-track tests

The functional details of the running gear relevant to the running behaviour during on-track tests according to EN 14363 (for axle loads above 22,5 t also according to EN 15687) shall be specified in the acceptance process. Table 2 and Table 3 give an indication of which parameter shall be available for acceptance purposes. In addition the following shall be specified:

— admissible speed V_{adm};

— admissible cant deficiency I_{adm}.

Following successful testing according to 5.2 the acceptable parameter variation range for a dispensation from on-track tests for single-axle running gear and bogies is given by the range between the nominal tested parameters of the running gear and the extended range where specified in Table 2 and Table 3 for single-axle running gear and bogies. All parameters given in these tables are nominal values. The upper limit of the acceptable range depends on the maximum tested value of the respective parameter, the lower limit on the minimum tested value.

Successful testing means that on-track tests according to EN 14363 (for axle loads above 22,5 t also according to EN 15687) showed compliance with the acceptance criteria given in these standards.

To extend the applicable parameter range of a standardised running gear, test results of a third tested vehicle outside the previously tested range shall be used.

Table 2 — Accepted parameter ranges for a single axle running gear which was tested successfully according to 5.2

Nominal parameter		**Minimum**	**Maximum**
Vertical eigenfrequency (see Annex C)	ν_z	0,9 $\nu_{z,tested}$ in load range	1,12· $\nu_{z,tested}$ in load range
Vertical damping		nominal characteristics of tested running gear	
Lateral and longitudinal suspension characteristics		nominal characteristics of tested running gear	
Distance between centres of axle bearings (suspension base)	$2b_z$	$2b_{z,\ tested}$ – 100 mm	$2b_{z,\ tested}$ + 170 mm
Nominal wheel diameter	D	D_{tested} – 90 mm	D_{tested} + 90 mm

Table 3 — Accepted parameter ranges for a bogie which was tested successfully according to 5.2

Nominal parameter		**Minimum**	**Maximum**
Bogie axle distance (between outer axles of the bogie)	$2a^{+}$	$2a^{+}_{\text{tested}}$	$2a^{+}_{\text{tested}}$ + 0,2 m
Vertical eigenfrequency (see Annex C)	ν_{z}	0,90 $\nu_{z,\text{tested}}$ in full range between tare and loaded condition	1,12· $\nu_{z,\text{tested}}$ in full range between tare and loaded condition
Vertical damping		nominal characteristics of tested running gear	
Axle guiding longitudinal		nominal characteristics of tested running gear	
Axle guiding lateral		nominal characteristics of tested running gear	
Lateral secondary suspension characteristics		nominal characteristics of tested running gear	
Distance between centres of axle bearings (suspension base)	$2b_{z}$	$2b_{z,\text{ tested}}$ – 100 mm	$2b_{z,\text{ tested}}$ + 170 mm
Yaw moment of bogie[a]	M^{*}_{z}	0,80 $M^{*}_{z,\text{tested}}$	1,20 $M^{*}_{z,\text{tested}}$
Moment of inertia of whole bogie (around z-axis)	I^{*}_{zz}	-	1,10 $I^{*}_{zz,\text{tested}}$
Nominal wheel diameter	D	D_{tested} – 90 mm	D_{tested} + 90 mm
Nominal height of centre pivot relative to centre of wheelset	h_{cp}	$h_{\text{cp,tested}}$ – 150 mm	$h_{\text{cp,tested}}$ + 50 mm

[a] For a friction based yaw resistance torque measured at two specified loads typical for tare and loaded condition. For other systems, appropriate parameters shall be used to control stability and safety against derailment in tare condition and maximum guiding force in loaded conditions.

5.4 Description of the interface between running gear and vehicle body

A description of the physical interface between running gear and vehicle body shall include:

— the yaw characteristics of the running gear;

— range of vertical characteristics of side bearers (if applicable);

— range of characteristics of secondary suspension (stiffnesses, hysteresis/damping)(if applicable);

— drawings.

5.5 Range of vehicle body parameters for dispensation from on-track tests

The functional details of the vehicle body relevant to the running behaviour during on-track tests according to EN 14363 (for axle loads above 22,5 t also according to EN 15687) shall be specified in the acceptance process. Table 4 gives an indication of which parameter shall be available for acceptance purposes.

Table 4 — Accepted parameter range for vehicles (including articulated wagons and permanently coupled units) equipped with a running gear which was tested successfully according to 5.2

		Minimum	**Maximum**
Distance between wheelsets (non bogie vehicles)	$2a^*$	Lowest value of either 6 m or $2a^*_{tested}$	Highest value of either 10 m or $2a^*_{tested}$
Distance between bogie centres (bogie vehicles)	$2a^*$	Lowest value of either 6,5 m or $2a^*_{tested}$	$2a^*_{tested}$ + 3 m
Centre of gravity height of tare wagon	$h_{cg,\ tare}$	-	1,2 $h_{cg,tare,tested,\ max}$
Centre of gravity height of loaded wagon	$h_{cg,\ loaded}$		1,2 $h_{cg,loaded,tested,\ max}$ [b]
Coefficient of height of centre of gravity – loaded vehicle [a]	χ	-	$\chi_{loaded,tested,max} \cdot (1 + 0{,}8\ (\lambda' - 1))$ with λ' – factor for track loading parameters (see 3.10)
Torsional coefficient per vehicle body	c_t^*	> 0,5 × 10^{10} kNmm²/rad	-
Mean axle load of the tare wagon (non-bogie wagon)	$P_{mean,tare}$	If $P_{mean,\ tare,\ tested} \leq$ 6,75 t: Lowest value of either 5,75 t or $P_{mean,tare,tested}$ else $0{,}85 \cdot P_{mean,tare,tested}$	-
Mean axle load of the tare wagon (bogie wagon)	$P_{mean,tare}$	If $P_{mean,\ tare,\ tested} \leq$ 4,7 t: Lowest value of either 4 t or $P_{mean,tare,tested}$ else $0{,}85 \cdot P_{mean,tare,tested}$	-
Maximum axle load	P	-	$1{,}05 \cdot P_{tested}$
Mass distribution coefficient (tare and loaded vehicle)	Φ	-	$1{,}2 \cdot \Phi_{tested}$

[a] For evaluation of χ (see Clause 3) use:
I_{adm} = 130 mm for axle loads ≤ 225 kN and
I_{adm} = 100 mm for axle loads > 225 kN and up to 250 kN.

[b] It was originally intended to replace this requirement by the requirement for χ. As this is not reasonable for high λ' values or low axle loads, it is intended to develop a less restrictive requirement for the future when more information is available.

Following successful testing according to 5.2, the acceptable parameter variation range for a dispensation from on-track tests for a vehicle body is given by the nominal tested parameters of the vehicle bodies and, where specified in Table 4, by the extended range. All parameters given in this table are nominal values. The upper limit of the acceptable range depends on the maximum tested value of the respective parameter, the lower limit on the minimum tested value.

To extend the applicable vehicle parameter range of a standardised running gear, test results of a third tested vehicle outside the previously tested range shall be used.

6 Established running gear

6.1 General

This clause specifies certain parameters of suspensions and running gear that shall be known as established running gear. The requirements for the components, operational and design requirements from the point of view of running dynamics are defined in this clause and in normative Annexes D, G, I, J and L. Several existing versions of accepted components fulfilling the normative requirements are given in informative Annexes E, F, H and K.

The details in this chapter shall replace the ‘declaration of conformity’ required in Clause 5. As a result, vehicles with parameters within the defined ranges and equipped with Established Running Gear shall have dispensation from on-track testing according to EN 14363.

NOTE Established Running Gear according to this standard was previously approved under the auspices of UIC.

6.2 Wagons with single axle running gear

6.2.1 General

Three different types of single axle running gear are established:

— double link suspension;

— long link suspension "Niesky 2";

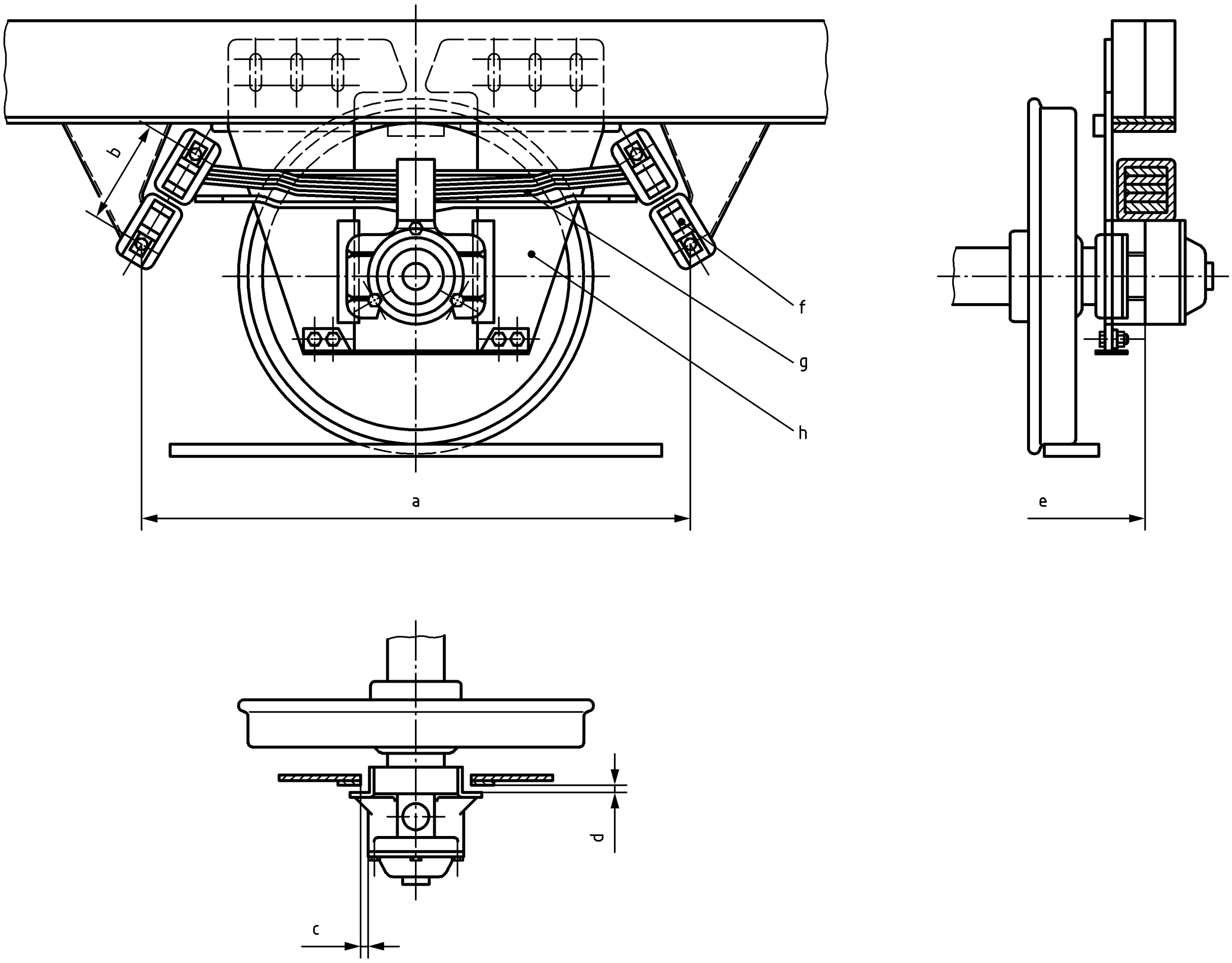
— suspension "S 2000".

Requirements for permanently coupled units consisting of 2-axle elements are given in 6.2.5.

6.2.2 Double link suspension

6.2.2.1 General

An example for a double link suspension according to this standard is shown in Figure 1 and described by characteristics relevant to running dynamics in 6.2.2.2 to 6.2.2.4 and the operational and design limitations in 6.2.2.5. The existing and accepted components are given in Annex D to Annex F.



Key

a distance between suspension brackets; the distance between suspension brackets shall be the length of the spring + 300 mm

b distance between centres of the link pins

c longitudinal clearance

d lateral clearance

e distance between centres of axle bearings (suspension base) between 1 900 mm and 2 170 mm

f double link

g leaf spring

h axle guard

Figure 1 — Double link suspension, overview

The clearance between axle box and axle guard shall be:

— laterally $\geq$ 20 mm;

— longitudinally = min ($3 \times 2a^{*}/1\,000$; 22,5 mm).

6.2.2.2 Assembly double link

The link assembly as described in Annex D is the key part of the double link suspension according to this standard.

6.2.2.3 Component spring

The springs of the established double link suspension according to this standard shall comply with a range of characteristics defined by Table 5. Annex C gives details about the definition of the describing parameters. The existing springs which fulfil these requirements are given in Annex E.

Table 5 — Range of vertical spring characteristics for double link suspension for dispensation from on-track tests according to EN 14363

Type		Trapezoidal leaf spring [b, e]	Parabolic spring [c, e]
Maximum axle load	P_{max}	20,0 t [d]	22,5 t [d]
Lower limit for vertical eigenfrequency	ν_{zl} [a]	1,5 Hz [b]	1,85 Hz [c]
Upper limit for vertical eigenfrequency	ν_{zu} [a]	4,0 Hz [b]	3,4 Hz [c]
Range of damping	Λ	12 % to 15 %	7 % to 10 % [f]
Range of diameter of spring eye	d_i	36 mm	36 mm to 41 mm

[a] Calculated with nominal stiffness according to the definition in Annex C.

[b] A maximum manufacturing tolerance of 8 % for the stiffness is required.

[c] A maximum manufacturing tolerance of 7 % for the stiffness is required.

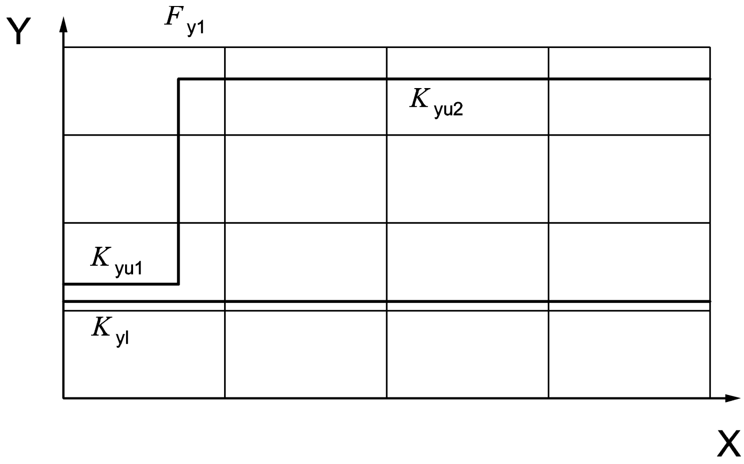
[d] The strength of the springs and the maximum vertical deflection is not in the scope of this standard.

[e] Existing springs which fulfil these requirements are given in Annex E.

[f] For operation in UK clamping is required in order to increase damping to $12\ \% < \Lambda < 17\ \%$.

6.2.2.4 Component axle guard

The axle guard of the established double link suspension according to this standard shall comply with a range of characteristics defined by Figure 2 and Table 6. Characteristics of existing solutions which fulfil these requirements are given in Annex F.



Key

X force F_y in kN

Y stiffness K_y in kN/mm

Figure 2 — Definition of values describing the range for lateral stiffness of axle guards for dispensation from on-track tests according to EN 14363

Table 6 — Range of lateral characteristic for axle guards of double link suspension for dispensation from on-track tests according to EN 14363

		Axle guard
Lower limit for nominal lateral stiffness [b]	K_{yl} [a]	1,20 kN/mm [c]
Upper limit for nominal lateral stiffness in first stage [b]	K_{yu1}	2,50 kN/mm [c]
Upper limit for nominal lateral stiffness in second stage [b]	K_{yu2} [a]	3,70 kN/mm [c]
Minimum force at break point between stages [b]	F_{y1} [a]	16,8 kN [c]

[a] Measured at a height of 70 mm above the centre line of the axle, the wagon being tare and new condition (i.e. approx. 380 mm below the bottom edge of the side beam in the case of wheel diameters between 920 mm and 1 000 mm).

[b] For an axle guard with a linear characteristic the stiffness of first and second stage is the same and the break point is not relevant.

[c] The strength of the axle guards as well as the minimum and maximum lateral deflection are not in the scope of this standard.

6.2.2.5 Operational and design limitations for double link suspension

Vehicles with bodies according to Table 7 and equipped with double link suspensions according to this standard have dispensation from on-track tests according to EN 14363 for axle loads up to 22,5 t with speeds up to 120 km/h and a cant deficiency up to 130 mm, when the spring design is appropriate (see 6.2.2.3).

For axle loads above 20 t in combination with speeds greater than 100 km/h, the minimum distance between active wheel faces according to EN 15313 is 1 418 mm.

NOTE This restriction is related to high lateral forces, which occurred during test runs with a maximum lateral clearance between wheelset and rails greater than 37 mm. Therefore, according to UIC 700:2004, 3.2.2, also the track gauge is restricted to 1 455 mm on D-lines according to EN 15528.

The wheel profile to be used is EN 13715 – S1002.

Table 7 — Parameters of vehicle body which may be equipped with a double link suspension according to this standard

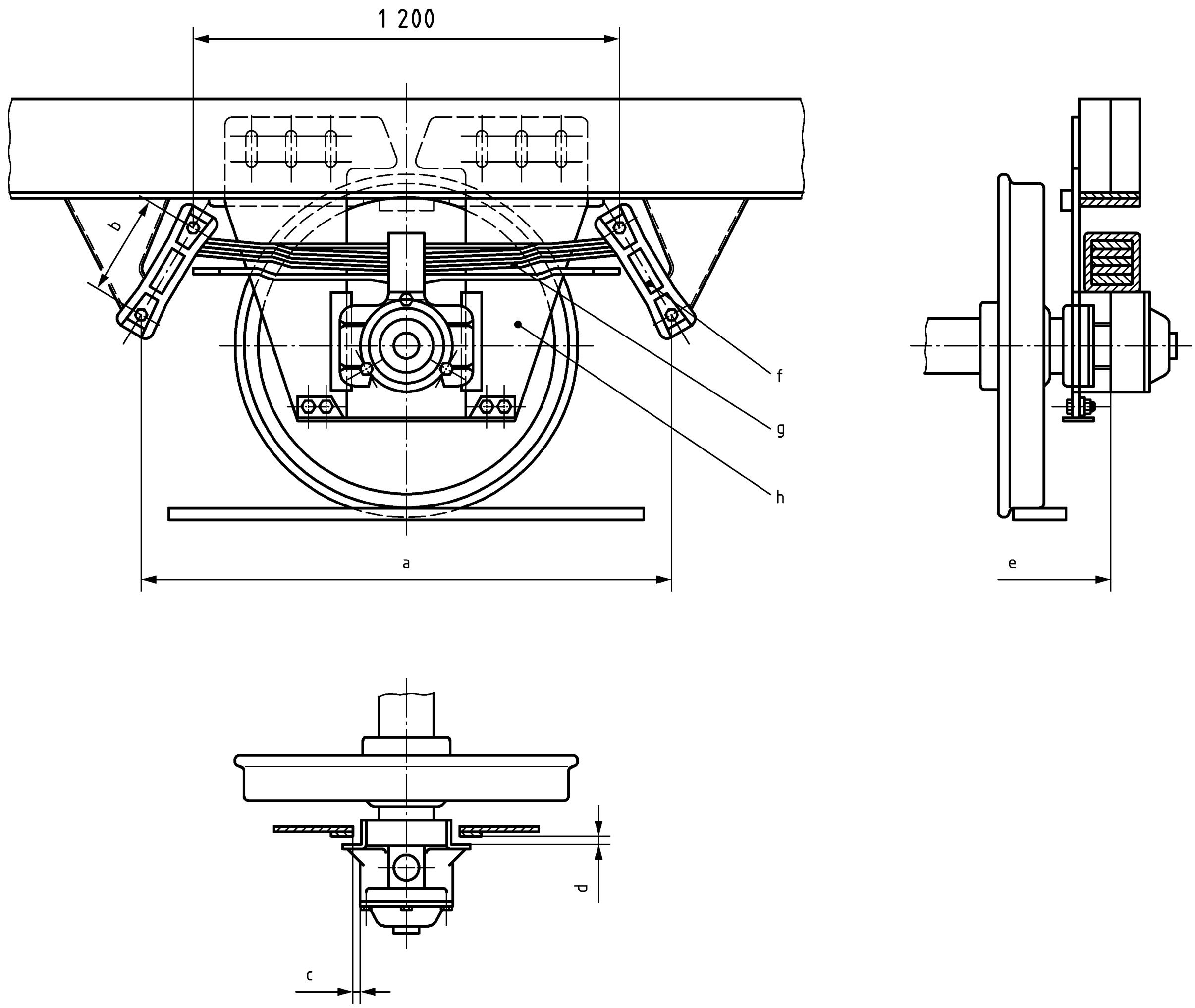
Max. axle load	**Wheelbase ($2a^*$)**		**Mass distribution coefficient Φ for tare wagons**	**Nominal wheel diameter**	**Height of centre of gravity of laden wagon**	**Torsional coefficient of wagon body (c_t^*)**	**Mass of wagon in tare condition**
	min.	max.			max.	min.	min.
t	m	m	-	mm	mm	10^{10} kNmm^2/rad	t
20	8,0	10,0	0,55	920 or 840	2 500	0,5	11,5
22,5	8,0	10,0	0,55	920	2 380	0,5	11,5

6.2.3 Long link suspension "Niesky 2"

6.2.3.1 General

An example for a long link suspension "Niesky 2" according to this standard is shown in Figure 3 and described by characteristics relevant to running dynamics in 6.2.3.2 and 6.2.3.3 and the operational and design limitations in 6.2.3.4. The existing versions of accepted components are given in Annex G.

Dimensions in millimetres



Key

a distance between suspension brackets: the distance between suspension brackets shall be the length of the spring + 300 mm
b distance between centres of the link pins
c longitudinal clearance
d lateral clearance
e distance between centres of axle bearings (suspension base) = between 1 900 mm and 2 170 mm
f long link
g leaf spring
h axle guard

Figure 3 — Long link suspension "Niesky 2", overview

The clearance between axle box and axle guard shall be:

— laterally ≥ 20 mm;

— longitudinally = min ($3 \times 2a^{*}/1\,000$; 22,5 mm).

6.2.3.2 Assembly long link

The link assembly as described in normative Annex G is the key part of the long link suspension "Niesky 2" according to this standard.

6.2.3.3 Components spring and axle guard

The characteristics of the components spring and axle guard for the "Niesky 2" suspension are the same as for the double link suspension (see 6.2.2.3 and 6.2.2.4).

6.2.3.4 Operational and design limitations for "Niesky 2" suspension

Vehicles with bodies according to Table 8 and equipped with long link suspensions "Niesky 2" according to this standard have dispensation from on-track tests according to EN 14363 for axle loads up to 22,5 t with speeds up to 120 km/h and a cant deficiency up to 130 mm, when the spring design is appropriate (see 6.2.2.3).

NOTE On lines classified as “D” according to EN 15528 the track gauge is restricted to 1 455 mm according to UIC 700:2004, 3.2.2.

The wheel profile to be used is EN 13715 – S1002.

Table 8 — Parameters of vehicle body which may be equipped with a long link suspension "Niesky 2" according to this standard

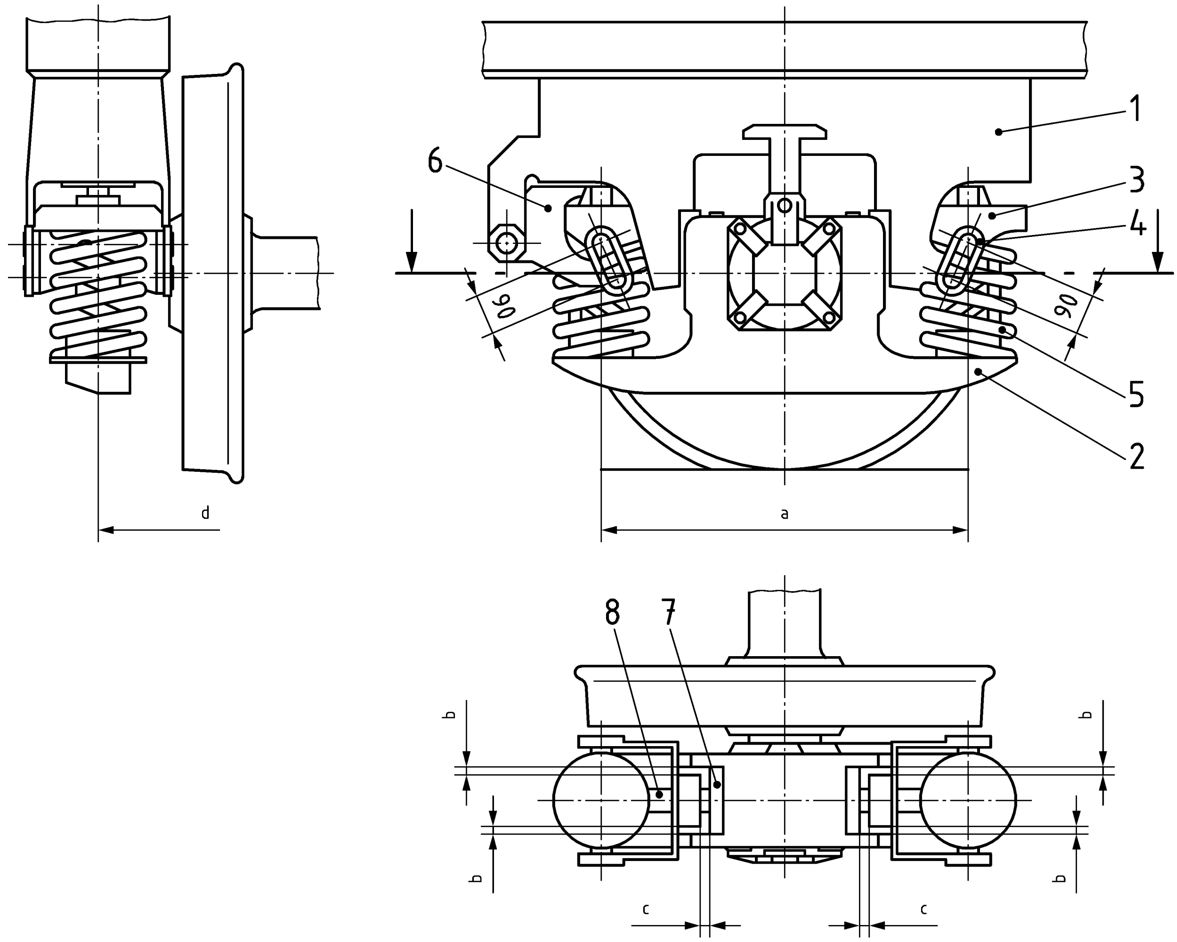
Max. axle load	**Wheelbase ($2a^*$)**		**Mass distribution coefficient Φ for tare wagons**	**Nominal wheel diameter**	**Height of centre of gravity of laden wagon**	**Torsional coefficient of wagon body (c_t^*)**	**Mass of wagon in tare condition**
	min.	max.			max.	min.	min.
t	m	m	-	mm	mm	10^{10} kNmm^2/rad	t
20	8,0	10,0	0,55	920 or 840	2 500	0,5	11,5
20	6,0	8,0	0,55	920 or 840	2 500	4,0	11,5
22,5	8,0	10,0	0,55	920	2 380	0,5	11,5
22,5	6,0	8,0	0,55	920	2 380	4,0	11,5

6.2.4 Suspension "S 2000"

6.2.4.1 General

An example of a "S 2000" suspension according to this standard is shown in Figure 4 and described by characteristics relevant to running dynamics in 6.2.4.2 and the operational and design limitations in 6.2.4.3.

Dimensions in millimetres



Key

1 bracket
2 axle box
3 spring cap
4 damping link (dry friction)
5 coil spring
6 articulation stirrup
7 axle damper friction pad
8 axle damper plunger
a distance between suspension brackets = 810 mm
b lateral clearance
c longitudinal clearance
d distance between centres of axle bearings (suspension base) = between 1 900 mm and 2 170 mm

Figure 4 — Suspension "S 2000", overview

The clearance between axle box and bracket shall be:

— laterally ≥ 20 mm;

— longitudinally = min (3 × $2a^*$/1 000; 22,5 mm).

6.2.4.2 Component spring and double Lenoir damping system

The Lenoir damping system provides a load dependent friction damping between axle box and bracket in vertical and lateral direction: Both springs of the suspension are guided by a spring cap on their upper end which has a longitudinal freedom relative to the bogie frame. The frame is partly supported by this spring cap via an inclined link. This link generates – depending on its inclination – a horizontal force which presses the spring cap towards the bogie frame. This longitudinal force is transmitted to the bogie frame via a plunger and produces vertical and lateral friction damping in the friction surfaces.

The friction depends on the load on the first stage of the suspension, the inclination of the link and the friction coefficient of the friction surfaces.

Furthermore the characteristic of the longitudinal axle guiding is strongly influenced by the Lenoir damper system.

The surfaces of the friction liner shall be smooth and unlubricated and made of manganese steel.

The nominal slope of the rings of the Lenoir damper shall be 20° and the nominal distance between centres of the pivots of ring shall be 90 mm.

The springs of the established suspension S 2000 according to this standard shall comply with a range of characteristics defined by Table 9. Annex C gives details about the definition of the describing parameters. The existing spring which fulfils these requirements is given in the Note.

Table 9 — Range of vertical spring characteristics for double link suspension for dispensation from on-track tests according to EN 14363

		Helical suspension spring
Maximum axle load	P_{max}	up to 25,0 t [c]
Lower limit for vertical eigenfrequency	ν_{zl} [a]	1,9 Hz [b]
Upper limit for vertical eigenfrequency	ν_{zu} [a]	3,4 Hz [b]
Range of damping	Λ	double Lenoir damper as described in 6.2.4.2

[a] Calculated with nominal stiffnesses according to definition in Annex C.

[b] A manufacturing tolerance ≤ ± 5 % for the stiffness is required.

[c] The strength of the springs and the maximum vertical deflection are not in the scope of this standard.

NOTE The only standardised solution for the "S 2000" suspension has the following vertical characteristic per axle box:

- Stiffness, 1. stage c_{z1} = 0,613 kN/mm;
- Stiffness, 2. stage c_{z2} = 1,817 kN/mm;
- Transition force F_1 = 40,5 kN.

6.2.4.3 Operational and design limitations for "S 2000" suspension

Vehicles with bodies according to Table 10 and equipped with "S 2000" suspensions according to this standard have dispensation from on-track tests according to EN 14363 for axle loads up to 22,5 t with speeds up to 120 km/h and a cant deficiency up to 130 mm, when the spring design is appropriate (see 6.2.4.2).

NOTE On lines classified as “D” according to EN 15528 the track gauge is restricted to 1 455 mm according to UIC 700:2004, 3.2.2.

The wheel profile to be used is EN 13715 – S1002.

Table 10 — Parameters of vehicle body which may be equipped with a "S 2000" suspension according to this standard

Max. axle load	Wheelbase ($2a^*$)		Mass distribution coefficient Φ for tare wagons	Nominal wheel diameter	Height of centre of gravity of laden wagon	Torsional coefficient of wagon body (c_t^*)	Mass of wagon in tare condition
	min.	max.			max.	min.	min.
t	m	m	-	mm	mm	10^{10} kNmm^2/rad	t
20	8,0	10,0	0,55	920 or 840	2 500	0,5	11,5
20	6,0	8,0	0,55	920 or 840	2 500	4,0	11,5
22,5	8,0	10,0	0,55	920	2 380	0,5	11,5
22,5	6,0	8,0	0,55	920	2 380	4,0	11,5

6.2.5 Permanently coupled units consisting of 2-axle elements

Permanently coupled units consisting of 2-axle elements equipped with one of the single axle running gear described in 6.2.2, 6.2.3 or 6.2.4 have dispensation from on-track tests according to EN 14363 for the operational conditions described in 6.2.2.5, 6.2.3.4 or 6.2.4.3, if each element fulfils the requirements for the vehicle body given in the related Tables 7, Table 8 or Table 10. These units shall be equipped with coupling between the elements either consisting of:

— standard side buffers and screw couplers described in EN 15551 and EN 15566;

— diagonal buffers and screw couplers as described in J.1; or

— coupler bar described in J.2.

6.3 Wagons equipped with 2-axle bogies

6.3.1 General

Two different families of 2-axle bogies are established:

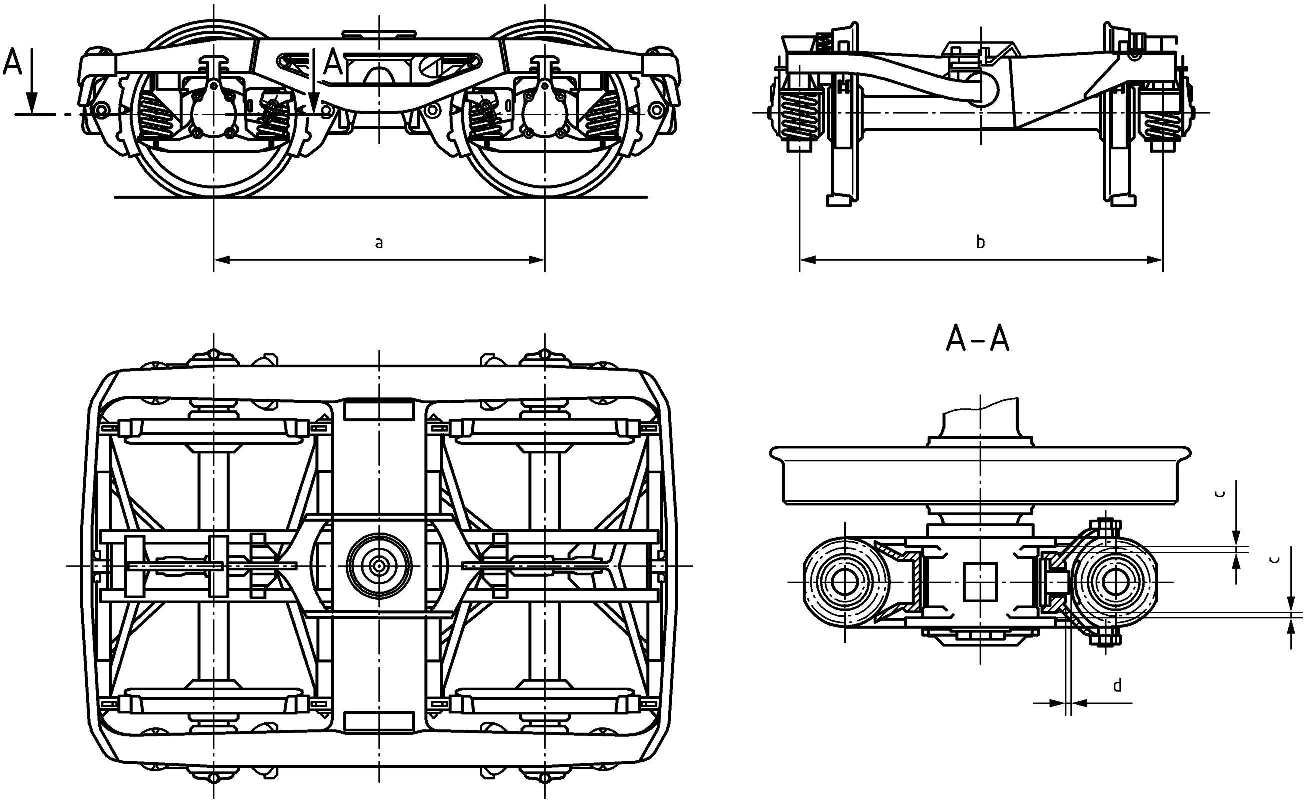
— Y25 family;

— 2-axle steering axle bogie.

6.3.2 Running gear of the family Y25

6.3.2.1 General

An example for a bogie of the Y25 family according to this standard is shown in Figure 5 and described by characteristics relevant to running dynamics in Table 11 and 6.3.2.2 to 6.3.2.4 and the operational and design limitations in 6.3.2.5.



Key

a axle distance see Table 11

b distance between centres of axle bearings (suspension base), between 1 900 mm and 2 170 mm

c lateral clearance see Table 11

d longitudinal clearance see Table 11

Figure 5 — General overview of a Y25-bogie (example) together with axle guiding

Table 11 — Parameters of Y25 bogie family

Parameter	**Nominal value**		**Nominal value**	
Max. speed	100 km/h		120 km/h	
Nominal wheel diameter	760 mm to 920 mm		760 mm to 920 mm	
Side bearers	unsprung with vertical clearance or sprung as specified in 6.3.2.4		sprung as specified in 6.3.2.4	
Axle distance	1,8 m	2,0 m	1,8 m	2,0 m
Maximum moment of inertia around vertical axis	5 750 kgm²	6 250 kgm²	5 750 kgm²	6 250 kgm²
Lateral clearance of axle:	± 10 mm			
Longitudinal clearance per axle box	4 mm only in one direction			
Yaw hysteresis magnitude M_R of bogie, as specified in EN 14363 evaluated with a tare wagon of 20 t tare mass	(10 ± 4) kNm			
Yaw hysteresis magnitude M_R of bogie as specified in EN 14363, evaluated with a loaded wagon of 20 t axle load	≤ 40 kNm			
Yaw hysteresis magnitude M_R of bogie as specified in EN 14363, evaluated with a loaded wagon of 22,5 t axle load	≤ 45 kNm			
Other requirements	given in 6.3.2.2 to 6.3.2.5			

6.3.2.2 Component spring

The springs of the established Y25 bogie family according to this standard shall comply with a range of characteristics defined by Table 12. Existing springs which fulfil these requirements are given in H.1.

Table 12 — Range of vertical spring characteristics Y25 suspension for dispensation from on-track tests according to EN 14363

Type		**Helical suspension spring** [b, d]
Maximum axle load	P_{max}	up to 25,0 t [c]
Lower limit for vertical eigenfrequency	ν_{zl} [a]	2,3 Hz [b]
Upper limit for vertical eigenfrequency	ν_{zu} [a]	5,1 Hz [b]
Range of damping	Λ	Lenoir damper as described in 6.3.2.3[e]

[a] Calculated with nominal stiffnesses according to the definition in Annex C.

[b] Manufacturing tolerance of stiffness < ± 5 %.

[c] The strength of the springs and the maximum vertical deflection are not in the scope of this standard.

[d] Existing springs which fulfil these requirements are given in H.1.

[e] Other designs providing equivalent friction behaviour are possible.

6.3.2.3 Component Lenoir damping system

Dimensions in millimetres

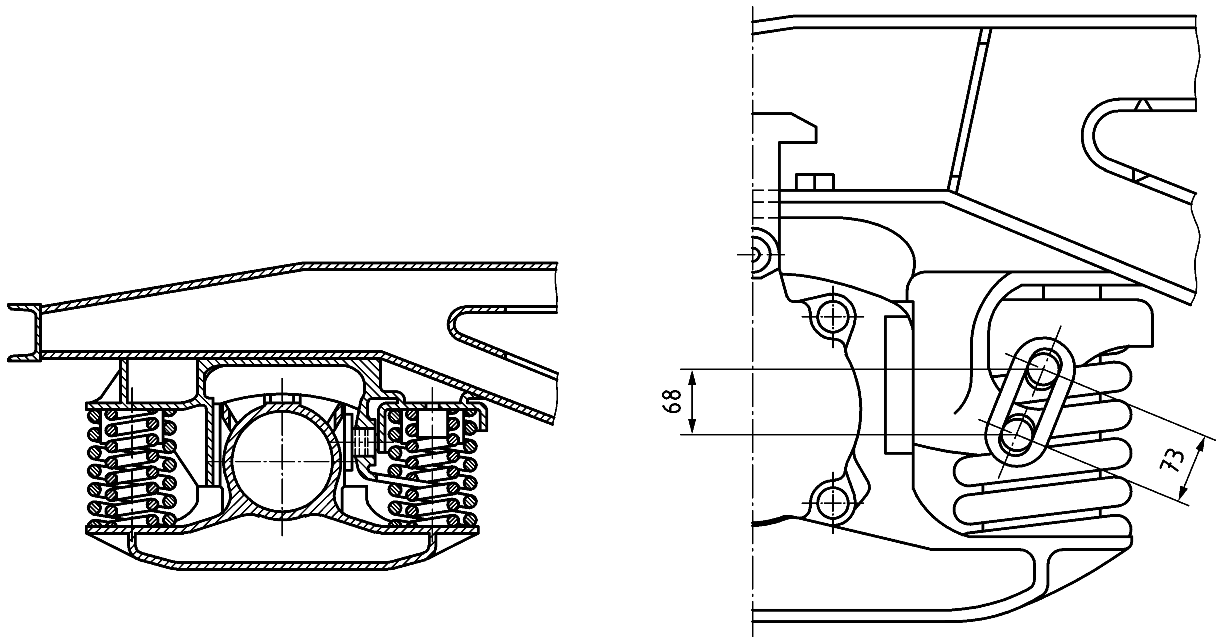


Figure 6 — Lenoir damping system for Y25-bogie family

The Lenoir damping system as shown in Figure 6 provides a load dependent friction damping between axle box and bogie frame in vertical and lateral direction: The outer spring of the suspension is guided by a spring cap on its upper end which has a longitudinal freedom relative to the bogie frame. The bogie frame is partly supported by this spring cap via an inclined link. This link generates – depending on its inclination – a horizontal force which presses the spring cap towards the bogie frame. This longitudinal force is transmitted to the bogie frame via a plunger and produces vertical and lateral friction damping in the friction surfaces.

The friction depends on the load on the first stage of the suspension, the inclination of the link and the friction coefficient of the friction surfaces.

Furthermore the characteristic of the longitudinal axle guiding is strongly influenced by the Lenoir damper system.

The friction surfaces are smooth manganese steel liners, used without lubrication.

6.3.2.4 Component side bearer

The side bearers as specified in Figure 7 provide together with the bogie centre casting a sufficient rotational torque as specified in Table 11. The side bearer housing 1 shall incorporate a liner 2 of composite material.

Each sliding element shall be pre-loaded with a nominal force (F1+F2) of 16 kN with the bogie mounted to the wagon.

The vertical clearance J_2 is proven related to dynamic behaviour in the range between 6 mm and 14 mm.

NOTE 1 Clearance J_2 below the normal value of 12 mm might be necessary for gauging purposes. In the shown design they might be obtained by insertion of shims below the side bearer stops 3. In any case, the nominal mean spring height of both springs is 91 mm and the clearance Z is greater than the clearance J_2. This does not influence the running dynamic behaviour of the wagon. The behaviour in the transition curve is handled by the assessment of safety against derailment in twisted track according to EN 14363.

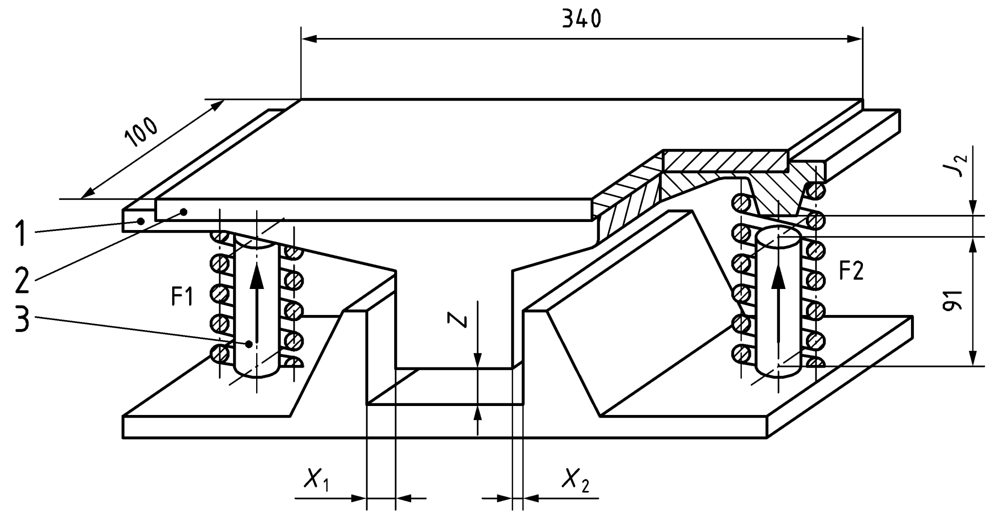
For the spring only one proven solution exists. The nominal stiffness for the whole side bearer is 570 N/mm. This existing spring is given in H.2.

The longitudinal clearance $X_1 + X_2$ has an influence on running stability. The nominal value shall be 2 mm.

Similar designs leading to the same rotational torque but without longitudinal clearance are permitted.

NOTE 2 Longitudinal clearance $X_1 + X_2$ (due to in-service tolerances) above 6 mm might lead to unacceptable running behaviour.

Dimensions in millimetres



Key

1 side bearer housing
2 side bearer liner of composite material
3 vertical side bearer stop
F1 nominal force as pre-load
F2 nominal force as pre-load
J_2 vertical clearance
X_1 longitudinal clearance
X_2 longitudinal clearance
Z vertical clearance > J_2

Figure 7 — Sprung side bearer for Y25 bogie family

6.3.2.5 Operational and design limitations for bogies of Y25 family

Vehicles with bodies according to Table 13 and equipped with bogies of the Y25 family according to this standard have dispensation from on-track tests according to EN 14363 for axle loads up to 22,5 t when the bogie is designed for this axle load and with speeds up to 120 km/h and a cant deficiency up to 130 mm, when the spring design is appropriate (see 6.3.2.2).

The wheel profile to be used is EN 13715 – S1002.

Table 13 — Parameters of vehicle body which may be equipped with a bogie of Y25 family

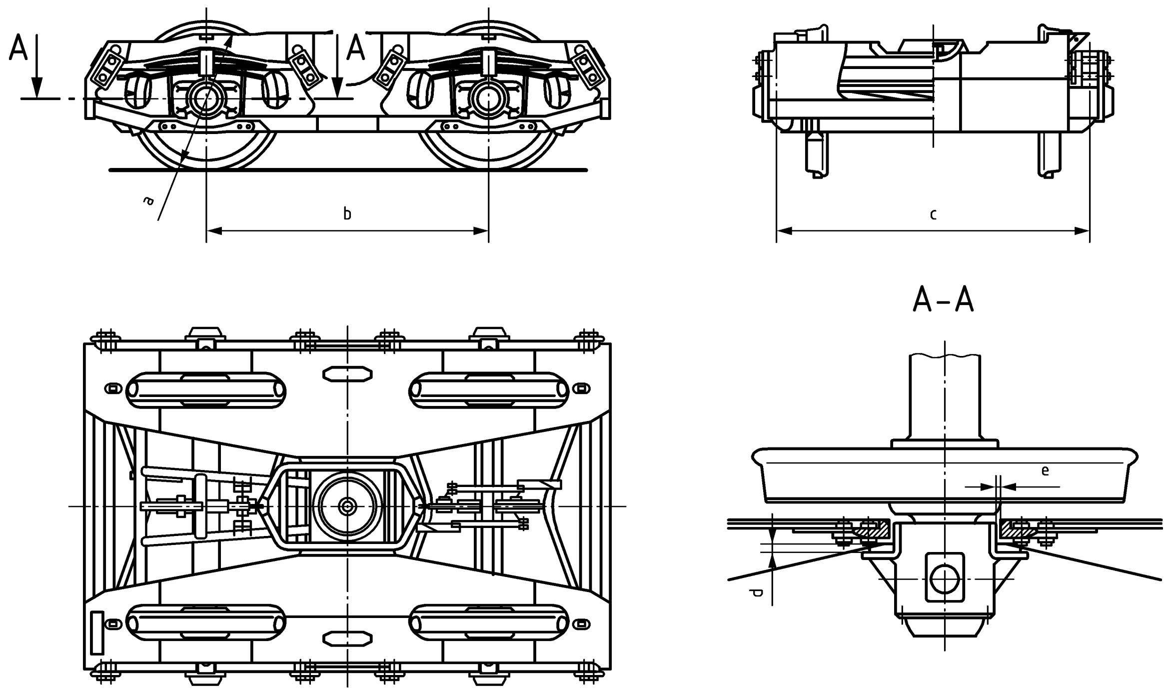
Max. axle load	**Distance between bogie centres ($2a^*$)**		**Mass distribution coefficient Φ for tare wagons**	**Height of centre of gravity of laden wagon**	**Torsional coefficient of wagon body (c_t^*)**	**Mass of wagon in tare condition**
t	m	m	-	mm	10^{10} kNmm^2/rad	t
	min.	max.	max.	max.	min.	min.
20	6,5	20,0	0,55	2 500	0,5	16
22,5	6,5	20,0	0,55	2 380	0,5	16

6.3.3 2-axle steering axle bogie family

6.3.3.1 General

An example for a steering axle bogie with leaf springs according to this standard is shown in Figure 8 and described by characteristics relevant to running dynamics in Table 14 and 6.3.3.2 to 6.3.3.4 and the operational and design limitations in 6.3.3.5.

Dimensions in millimetres



Key

a nominal wheel diameter
b axle distance see Table 14
c distance between axle bearings (suspension base) = between 1 900 mm and 2 170 mm
d lateral clearance of axle
e longitudinal clearance per axle box

Figure 8 — General overview of a 2-axle steering axle bogie (example) with axle guiding

Table 14 — Parameters of 2-axle steering axle bogies

Parameter	Nominal value	Nominal value
Max. speed	100 km/h	120 km/h
Max. axle load	20 t	22,5 t
Type of spring	linear trapezoidal	progressive, parabolic
Nominal wheel diameter	920 mm	920 mm
Side bearers	unsprung with vertical clearance 5 ± 1 mm	unsprung with vertical clearance 5 ± 1 mm
Axle distance	1,8 m	1,8 m
Maximum moment of inertia around vertical axis	7 000 kgm^2	7 000 kgm^2
Lateral clearance of axle:	± 23 mm	± 23 mm
Longitudinal clearance per axle box	± 6 mm	± 6 mm
Axle guiding principle	self steering (see 6.3.3.3)	self steering (see 6.3.3.3)
Yaw hysteresis magnitude M_R according to EN 14363	no limit values specified according to [8]	no limit values specified according to [8]
Other requirements		given in 6.3.2.2 to 6.3.2.5

6.3.3.2 Component spring

The springs of the standardised steering axle bogie according to this standard shall comply with a range of characteristics defined by Table 15. Existing springs which fulfil these requirements are given in Annex K.

Table 15 — Range of vertical spring characteristics for 2-axle steering axle bogies for dispensation from on-track tests according to EN 14363

Type		Trapezoidal springs [b, e]	Parabolic springs [c, e]
Maximum axle load	P_{max}	20 t [d]	up to 23,5 t [d]
Lower limit for vertical eigenfrequency	ν_{zl} [a]	2,0 Hz [b]	2,1 Hz [c]
Upper limit for vertical eigenfrequency	ν_{zu} [a]	5,5 Hz [b]	4,4 Hz [c]
Range of damping	Λ	12 % to 15 %	7 % to 10 % [f]
Range of diameter of spring eye	d_i	36 mm	36 mm to 41 mm

[a] Calculated with nominal stiffnesses according to the definition in Annex C.

[b] A maximum manufacturing tolerance of 8 % for the stiffness is required.

[c] A maximum manufacturing tolerance of 7 % for the stiffness is required.

[d] The strength of the springs and the maximum vertical deflection are not in the scope of this standard.

[e] Existing springs which fulfil these requirements are given in Annex K.

[f] For operation in UK clamping is required in order to increase damping: 12 % < Λ < 17 %.

6.3.3.3 Assembly link

The link assembly as described in Annex I is the key component of the steering axle bogie family according to this standard.

There are three types of links described in Annex I:

- rectangle link assembly in I.2;
- trapezoidal link assembly in I.3;
- long link assembly in I.4.

6.3.3.4 Component bogie centre pivot

The bogie centre pivot provides together with the side bearers a sufficient rotational torque. An example for the design of the centre pivot on the bogie is given in Figure 9.

Dimensions in millimetres

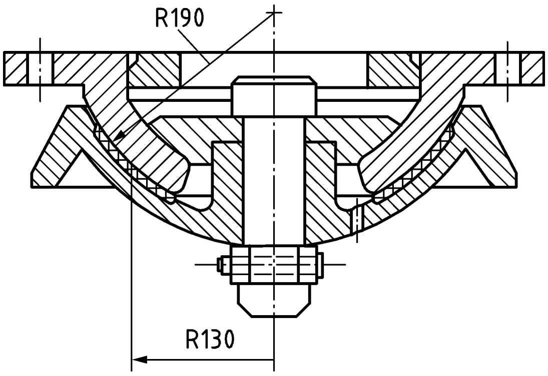


Figure 9 — Bogie centre pivot

6.3.3.5 Component side bearer

The side bearers provide together with the bogie centre pivot a sufficient rotational torque. An example for the support of the wagon body on the bogie is given in Figure 10.

Dimensions in millimetres

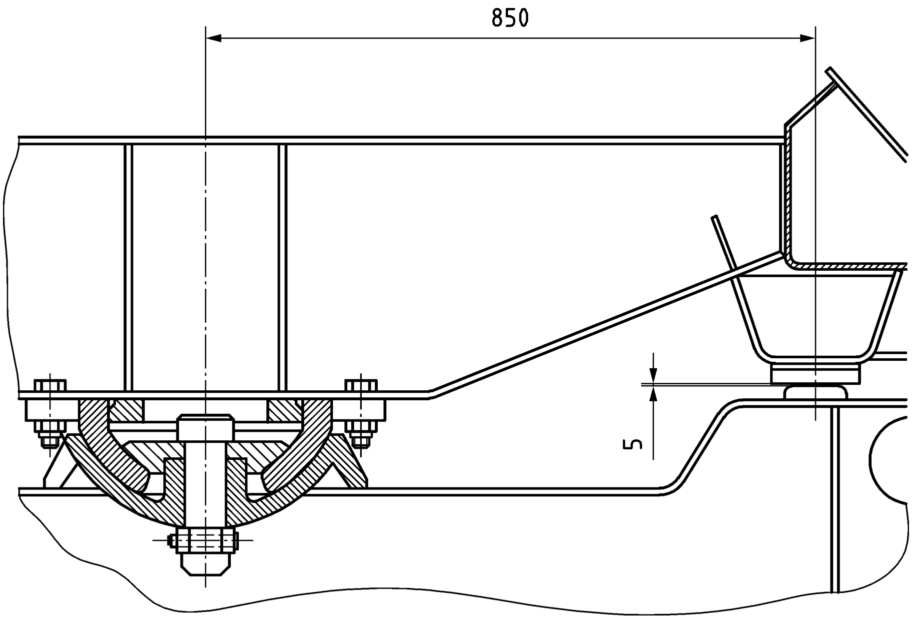


Figure 10 — Unsprung side bearer for 2-axle steering axle bogie

6.3.3.6 Operational and design limitations for steering axle bogies

Vehicles with bodies according to Table 16 and equipped with bogies of the two steering axle bogie family according to this standard have dispensation from on-track tests according to EN 14363 for axle loads up to 22,5 t when the bogie is designed for this axle load and with speeds up to 120 km/h or 100 km/h with a cant deficiency up to 130 mm, when the spring design is appropriate (see 6.3.3.2).

The wheel profile to be used is EN 13715 – S1002.

Table 16 — Parameters of vehicle body which may be equipped with a 2-axle steering axle bogie

Max. axle load	Distance between bogie centres ($2a^*$)		Mass distribution coefficient Φ for tare wagons	Height of centre of gravity of laden wagon	Torsional coefficient of wagon body (c_t^*)	Mass of wagon in tare condition
t	m	m	-	mm	10^{10} kNmm^2/rad	t
	min.	max.	max.	max.	min.	min.
20	6,5	20,0	0,55	2 500	0,5	16
22,5	6,5	20,0	0,55	2 380	0,5	16

6.3.4 Permanently coupled unit consisting of 2-axle bogie wagons

Permanently coupled units consisting of elements equipped with one of the bogie types described in 6.3.2, and 6.3.3 have dispensation from on-track tests according to EN 14363 for the operational conditions described in 6.3.2.5 or 6.3.3.5 if each element fulfils the requirements for the vehicle body given in the related Table 13 or Table 16. These units shall be equipped with coupling between the elements either consisting of:

— standard side buffers and screw couplers described in EN 15551 and EN 15566; or

— coupler bar described in J.2.

6.3.5 Articulated wagons equipped with three 2-axle bogies Y25

Articulated wagons equipped with bogies of Y25 family and articulations as described in Annex L have also dispensation from on-track tests according to EN 14363.

The articulated wagon shall meet the requirements of Table 13 for each wagon body except the mass of the wagon in tare condition. The wagon shall have a minimum axle load of 4 t.

The articulation shall be one of those described in L.1 and L.2 or L.3 and L.4.

6.4 Wagons equipped with 3-axle bogies

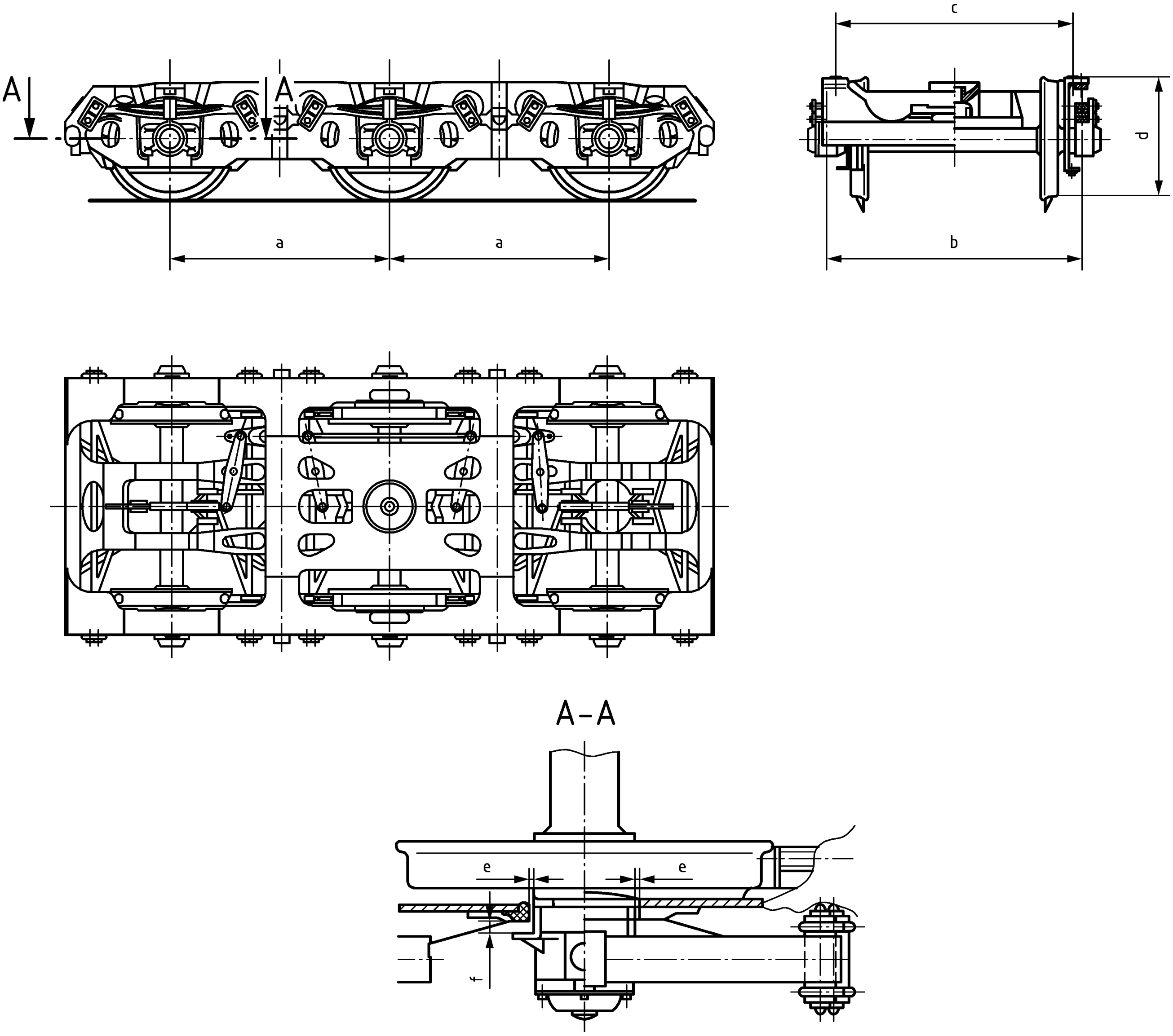
6.4.1 General

Only one family of 3-axle bogies is established: the 3-axle bogie family with link suspension.

6.4.2 3-axle bogie with link suspension

6.4.2.1 General

An example for a bogie of the 3-axle bogie with link suspension according to this standard is shown in Figure 11 and described by characteristics relevant to running dynamics in Table 17 and 6.4.2.2 to 6.4.2.4 and the operational and design limitations in 6.4.2.5.



Key

a axle distance = 1 700 mm

b distance between centres of axle bearings (suspension base) = 2 000 mm

c distance between side bearers = 1 820 mm

d height of side bearers above top of rail

e longitudinal clearance

f lateral clearance

Figure 11 — General overview of a 3-axle steering axle bogie (example) with axle guiding

Table 17 — Parameters of 3 axle steering axle bogies

Parameter	Nominal value
Max. speed	120 km/h
Nominal wheel diameter	920 mm
Side bearers	unsprung with vertical clearance (5 ± 1) mm
Axle distance	1,7 m
Maximum moment of inertia around vertical axis	14 000 kgm^2
Lateral clearance of axle:	± 25 mm
Longitudinal clearance per axle box	± 10 mm
Axle guiding principle	self steering (see 6.4.2.3)
Yaw hysteresis magnitude M_R according to EN 14363	no limit values specified according to [8]
Other requirements	given in 6.3.2.2 to 6.3.2.5

6.4.2.2 Component spring

The springs of the standardised steering axle bogie according to this standard shall comply with a range of characteristics defined by Table 18. Existing springs which fulfil these requirements are given in Annex K.

Table 18 — Range of vertical spring characteristics for double link suspension for dispensation from on-track tests according to EN 14363

Type		**Trapezoidal springs** [b, e]	**Parabolic springs** [c, e]
Maximum axle load	P_{max}	up to 22 t [d]	up to 25 t [c, d]
Lower limit for vertical eigenfrequency	ν_{zl} [a]	2,1 Hz [b]	1,9 Hz [c]
Upper limit for vertical eigenfrequency	ν_{zu} [a]	5,1 Hz [b]	5,6 Hz [c]
Range of damping	Λ	12 % to 15 %	7 % to 10 % [f]
Range of diameter of spring eye	d_i	36 mm	36 mm to 41 mm

[a] Calculated with nominal stiffnesses according to the definition in Annex C.

[b] A maximum manufacturing tolerance of 8 % for the stiffness is required.

[c] A maximum manufacturing tolerance of 7 % for the stiffness is required.

[d] The strength of the springs and the maximum vertical deflection are not in the scope of this standard.

[e] Existing springs which fulfil these requirements are given in Annex K.

[f] For operation in UK clamping is required in order to increase damping: $12\ \% < \Lambda < 17\ \%$.

6.4.2.3 Component link

The link assembly as described in Annex I is the key component of the steering axle bogie family according to this standard.

There are three types of link assemblies described in Annex I:

— rectangle link assembly in I.2;

— trapezoidal link assembly in I.3;

— long link assembly in I.4.

6.4.2.4 Component side bearer

The side bearers provide together with the bogie centre a sufficient rotational torque. An example for the support of the wagon body on the bogie is given in Figure 12.

Dimensions in millimetres

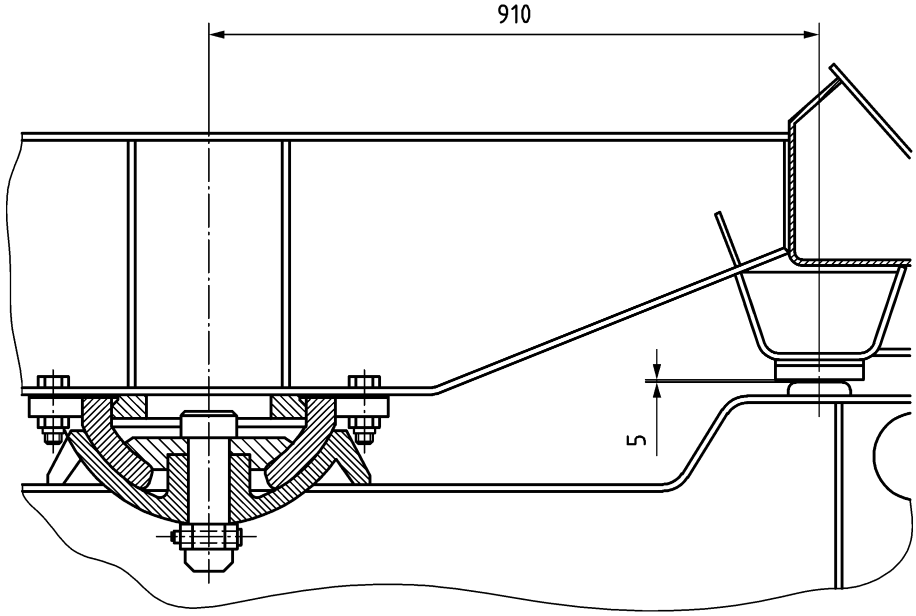


Figure 12 — Unsprung side bearer for 3-axle steering axle bogie

6.4.2.5 Operational and design limitations for 3-axle steering axle bogies

Vehicles with bodies according to Table 19 and equipped with bogies of the three steering axle bogie family according to this standard have dispensation from on-track tests according to EN 14363 for axle loads up to 22,5 t when the bogie is designed for this axle load and with speeds up to 120 km/h and a cant deficiency up to 130 mm, when the spring design is appropriate (see 6.4.2.2).

The wheel profile to be used is EN 13715 – S1002.

Table 19 — Parameters of vehicle body which may be equipped with a 3-axle steering axle bogie

Max. axle load	**Distance between bogie centres ($2a^*$)**		**Mass distribution coefficient Φ for tare wagons**	**Height of centre of gravity of laden wagon**	**Torsional coefficient of wagon body (c_t^*)**	**Mass of wagon in tare condition**
t	m	m	-	mm	10^{10} kNmm^2/rad	t
	min.	max.	max.	max.	min.	min.
22,5	6,2	9,5	0,55	2 380	0,5	28

Annex A
(informative)

Symbols

Table A.1 contains a summary of the symbols of the quantities and characteristic figures for freight wagons with standardised characteristics related to their dispensation from on-track tests according to EN 14363 as well as supplementary information and terms.

Table A.1 — Symbols *(1 of 2)*

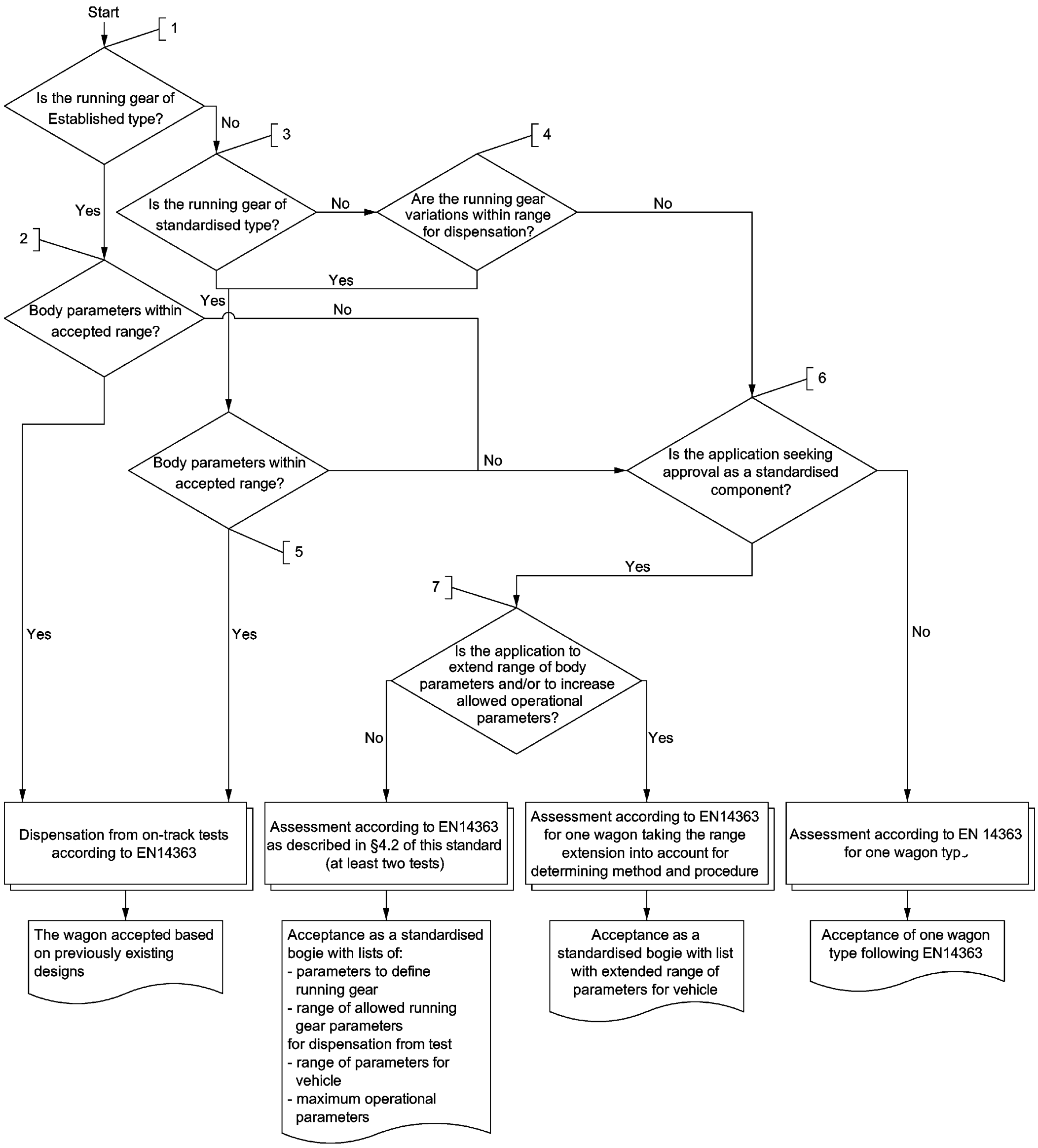
Symbol	**Significance**	**Symbol**	**Significance**
Reference system on vehicle			
x, y, z	Direction of co-ordinates		
i	Wheelset index	j	Wheel index (vehicle side, 1: right, 2: left)
Symbols associated with quantities (in this example the quantity is a)			
a^*	Partial system, vehicle body / secondary suspension	a_{lim}	Limit value
a_{adm}	Admissible value	a_{mean}	Mean value
a_l	Lower value	a_u	Upper value
a_{tare}	Value of tare wagon	a_{loaded}	Value of the loaded wagon
a_{tested}	Value of the tested quantity (wagon, component)	a_p	Value related to transition point
Symbol	**Significance**	**Symbol**	**Significance**
$2a^*$	Distance between running gear centres	M_R	Yaw hysteresis magnitude of bogie, as specified in EN 14363
$2a^+$	Bogie axle distance (between outer axles of the bogie)	M^*_z	Yaw moment of bogie as specified in EN 14363, see Table 3, footnote [a]
$2b_A$	Lateral distance between wheel rail contact points	m^*	Mass of the vehicle body
$2b_z$	Distance between centres of axle bearings (suspension base)	n	Number of leaves
c^*_t	Torsional coefficient of vehicle body	P_{max}	Maximum axle load
c_z	Vertical stiffness of spring	$P_{mean,tare}$	Mean axle load of the tare wagon
D	Nominal wheel diameter	Q_0	Static wheel load
d_i	Diameter of spring eye	Q_{max}	Maximum wheel force

Table A.1 *(2 of 2)*

Symbol	Significance	Symbol	Significance
F	Force	Q_{qst}	Quasi-static wheel force
g	Acceleration of gravity	s	Deflection
H_1	Spring height under a load of 20 kN under a trolley mounting	V_{adm}	Admissible speed
h_{cg}	Height of centre of gravity of vehicle relative to centre of wheelset	χ	Coefficient of height of centre of gravity see 3.9
I_{adm}	Admissible cant deficiency	Φ	Mass distribution coefficient, see 3.8
I^*_{zz}	Moment of inertia, see 3.8	Λ	Damping
i^*_{zz}	Radius of inertia, see 3.8	λ'	Factor for track loading parameters, see 3.10
K_y	Stiffness of axle guard, see 6.2.2.4	ν_z	Vertical eigenfrequency
L_0	Length of a leaf spring		

Annex B
(normative)

Approval process for freight wagons related to running behaviour



Key

1 Does the matter concern approval of a vehicle with established running gear? See Clause 6.

2 Are the body parameters within the range as specified in Table 1?

3 Does the matter concern approval of a vehicle with Standardised running gear? The running gear was then previously tested using the methodology of this EN.

4 Are the running gear parameters within allowed range for dispensation from on-track tests? See 5.3.

5 Are – for the running gear in question – the vehicle parameters within allowed range for dispensation from on-track tests? See 5.5.

6 Does the applicant seek application for one wagon type (answer is No) or to have a running gear standardised (answer is Yes)?

7 If one test was already executed previously one additional test with another body will extend the range of body parameters. If one test was already executed previously one additional test with increased operational parameters (permitted speed, cant deficiency or axle load) will increase the range of allowed operational parameters.

Figure B.1 — Approval process for freight wagons related to running behaviour

Annex C
(normative)

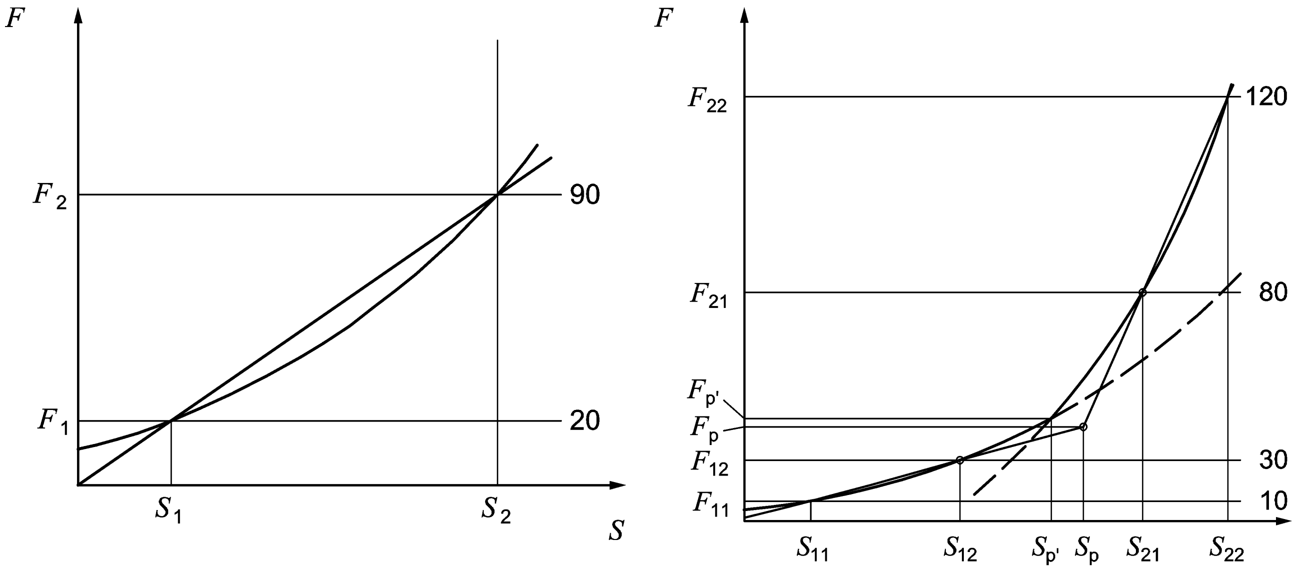
Definition of frequency range for suspensions — Definition of spring characteristic

The specification of the vertical spring characteristics of the suspension is fundamental to the ride characteristics. It is possible to specify the spring characteristics in a number of ways, to avoid uncertainty. The following is the definition of the characteristics used in this standard.

Suspensions can be distinguished by the number of spring stages. In most applications suspensions with one or two stages are used. For practical purposes they are linearised.

The stiffness of a one stage leaf spring suspension is determined when the spring is assembled together with the links from the deflection s at loads of F_1 = 20 kN and F_2 = 90 kN.

The stiffnesses of a two stage leaf spring suspension are determined when the spring is assembled together with the links from the deflection s at loads of F_{11} = 10 kN and F_{12} = 30 kN for the first stage and at loads of F_{21} = 80 kN and F_{22} = 120 kN for the second stage. The theoretical point where the stiffness changes from the first stiffness to the second stiffness is called the **transition point** s_p, the associated load is called the **transition load** F_p. The transition point is defined as the intersection of the two linearised stiffnesses when plotted on a load deflection graph.



a) b)

Key

F force in kN

S deflection in mm

Figure C.1 — Examples for linearisation of leaf spring characteristics

For suspensions with more than two stages, the reference loads for linearisation in each stage shall be declared.

Continuously progressive springs are not linearised.

In this standard the suspension characteristic is determined by the theoretically calculated eigenfrequency range of the undamped vertical rigid bounce mode for the full load range:

$$\nu = \frac{1}{2\pi}\sqrt{\frac{c_z}{F_z / g}}$$

where

c_z is the vertical stiffness of the suspension;

F_z is the vertical load of the suspension;

g is the acceleration of gravity.

The assessment of compliance of a suspension with the specification for a running gear type is made by comparison of these eigenfrequencies in the whole load range of the vehicle with the specified frequency range for the running gear.

NOTE 1 This definition can only be used for dispensation from on-track tests, the proof of safety against derailment in twisted track according to EN 14363 is outside the scope of this standard.

NOTE 2 For two stage suspensions the eigenfrequencies are determined at three loads, the minimum load, the transition load and the maximum load. Since there are two stiffnesses defined for the spring, both stiffnesses apply to the transition load calculation of the eigenfrequencies. This will result in four values of eigenfrequencies.

For the purpose of this standard the friction damping Λ is defined by the half hysteresis width relative to the deflection at a load of 30 kN (see also EN 14200). It is measured after approximately 10 000 load cycles in a roller carriage.

NOTE 3 When mounted in the links and during operation of a vehicle this value increases. For the purposes of dispensation from testing these higher values are not taken into account.

$$\Lambda = (s_{12u} - s_{12l}) / (s_{12u} + s_{12l})$$

NOTE 4 To identify the established spring, the spring height H_1 measured at a load of 20 kN in a test rig using a trolley arrangement is given in Annex E and Annex K.

Annex D
(normative)

Established component double link assembly for 2-axle wagons

The following gives details of the established link components for the double link assembly. Only details that are significant to the satisfactory dynamic performance are included.

Table D.1 to Table D.5 and Figure D.2 to Figure D.8 give the relevant manufacturing dimensions in mm, other dimensions are required to produce the items but these are not critical to the dynamic performance.

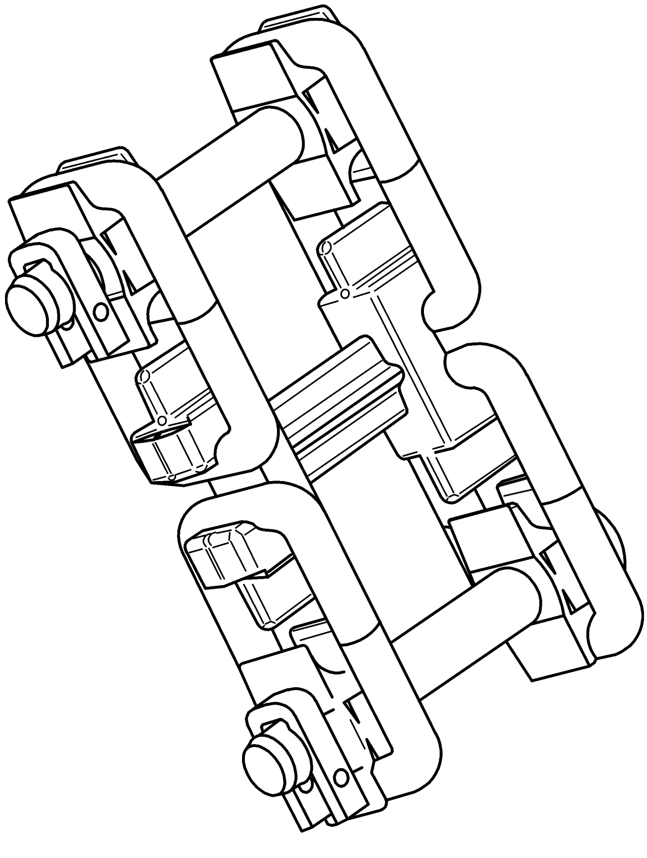


Figure D.1 — Example of double link assembly

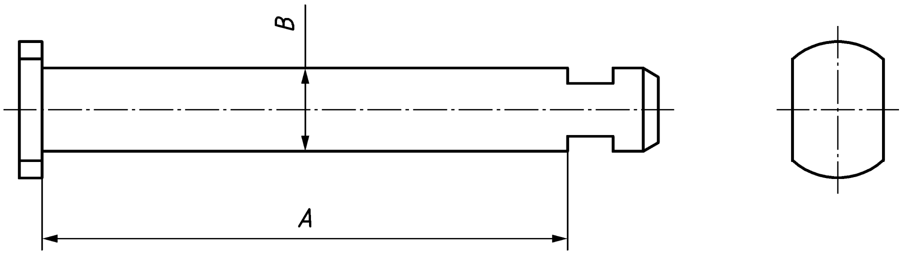


Figure D.2 — Link pin

Table D.1 — Significant link pin dimensions

Dimension (mm)	**Tolerance** (mm)
A = 221	+ 1 0
B = ∅ 35 *B* = ∅ 40	0 - 0,5

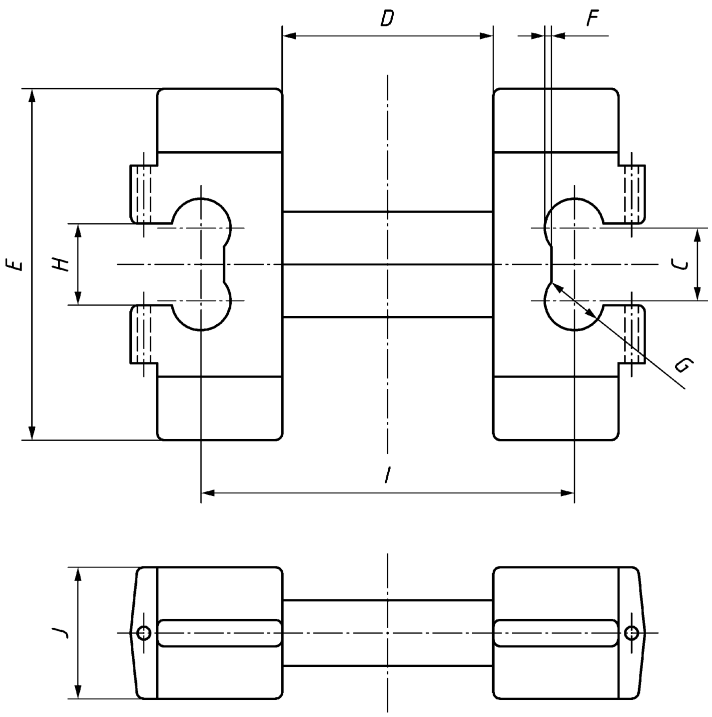


Figure D.3 — Intermediate bearing

Table D.2 — Significant intermediate bearing dimensions

Dimension (mm)	**Tolerance** (mm)
C = 33	0 - 1
D = 96	+ 1 0
E = 160	+ 2 0
F = 3	
G = ∅ *27*	+ 0,5 0
H = 37	+ 2 0
I = 170	+ 2 -1
J = 60	0 -1

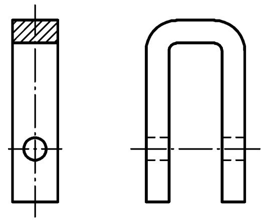


Figure D.4 — Clip

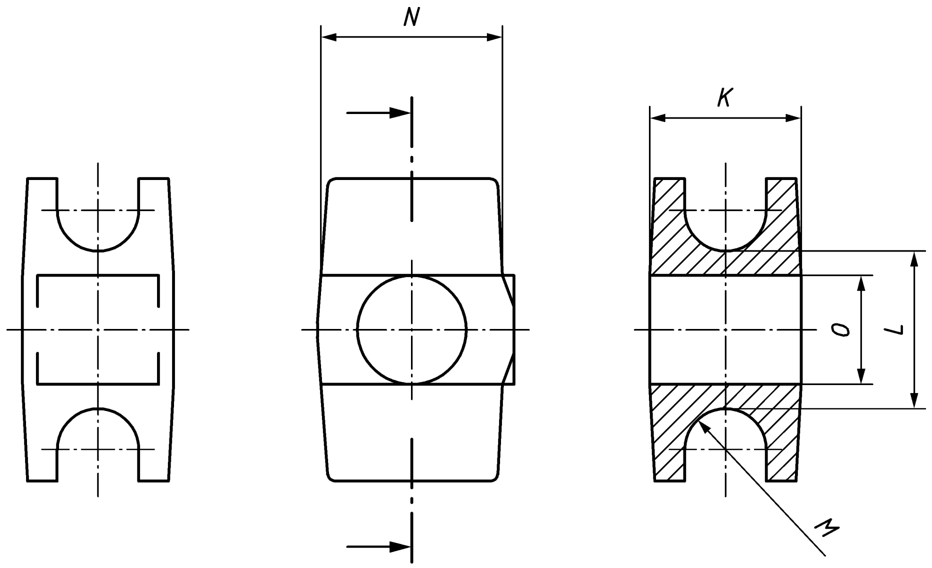


Figure D.5 — End bearing

Table D.3 — Significant end bearing dimensions

Dimension (mm)	**Tolerance** (mm)
K = 50	0 - 0,5
L = 52	+ 2 0
M = R13,5	+ 0,5 0
N = 60	+ 0 -1
O = ∅ 36 *O* = ∅ 41	+ 0,5 0

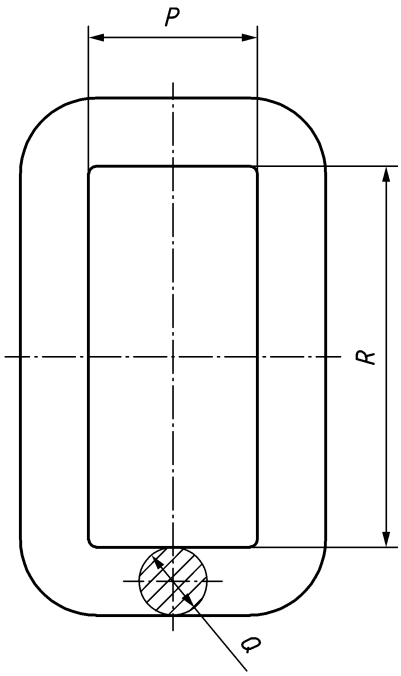


Figure D.6 — Link

Table D.4 — Significant link dimensions

Dimension (mm)	**Tolerance** (mm)
P = 62	+1 0
Q = ∅ 25	+ 0,5 - 0,5
R = 140	0 - 2

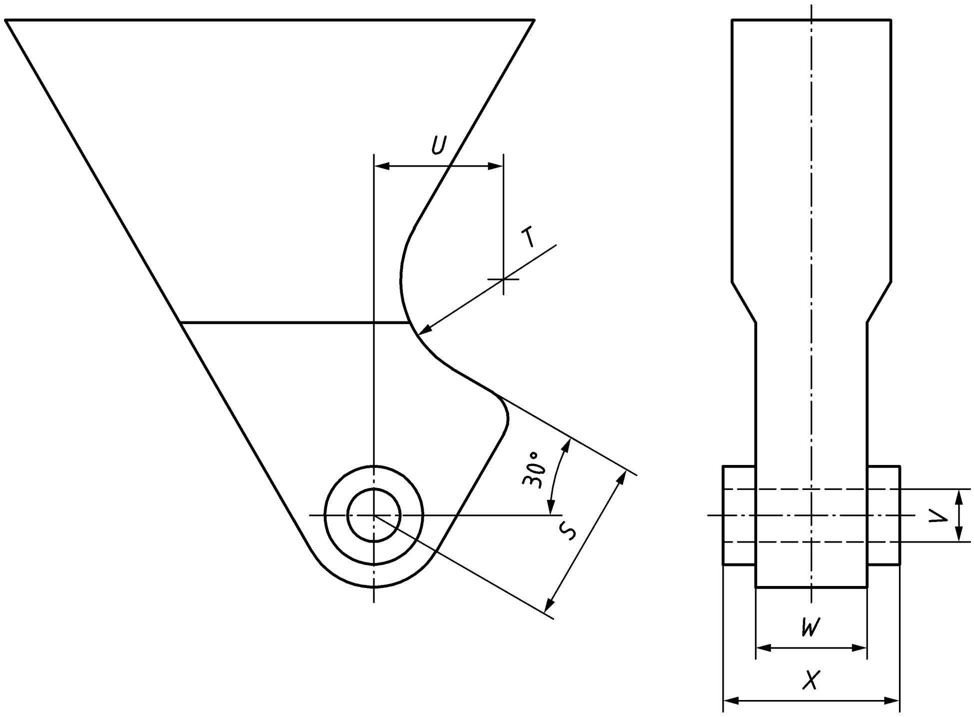
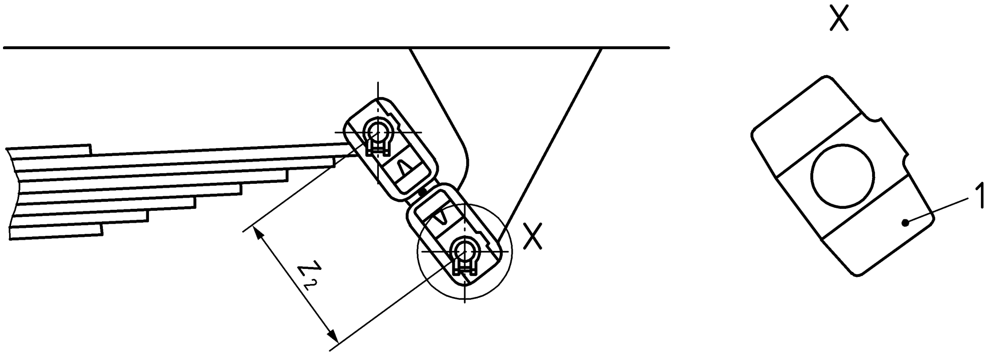


Figure D.7 — Suspension bracket

Table D.5 — Significant suspension bracket dimensions

Dimension (mm)	**Tolerance** (mm)
S = 113	0 - 2
T = R70 / R80	
U = 88 / 80	
V = ∅ 36 *V* = ∅ 41	+ 0,5 0
W = 76	0 - 1
X = 120	0 - 0,5



Key

X fitted position of end bearing

Z_2 distance between link pins = 289 mm

Figure D.8 — Assembly instruction

Annex E
(informative)

Standardised leaf springs for double link suspension and "Niesky 2" suspension

The following gives details of established springs for the double link suspension and "Niesky 2" suspension.

Table E.1 — Standardised trapezoidal springs for 2-axle freight wagons

Type		**Linear trapezoidal leaf spring Type A**	**Linear trapezoidal leaf spring Type B**	**Linear trapezoidal leaf spring for existing vehicles**	**Progressive trapezoidal leaf spring**
Note		UIC 517:2007, Annex A	UIC 517:2007, Annex A	UIC 517:2007, Annex B Not used for new vehicles	UIC 517:2007, I.1, I.3, I.4, K.1, K.2
Maximum axle load for 100 km/h	$P_{max,100}$	20 t	20 t	20 t	20 t
Maximum axle load for 120 km/h	$P_{max,120}$	20 t	20 t	18 t	20 t
Length	L_0	1 400 mm	1 200 mm	1 400 mm	1 200 mm
Number of leaves	n	9	8	8	5 + 4
Stiffness in first stage	$c_{z,1}$	0,970 kN/mm $^{\pm 8\%}$	1,370 kN/mm $^{\pm 8\%}$	0,860 kN/mm $^{\pm 8\%}$	1,140 kN/mm $^{\pm 8\%}$
Stiffness in second stage	$c_{z,2}$				2,080 kN/mm $^{\pm 8\%}$
Transition load	F_1				40,5 kN
Nominal diameter of the rolled eye	d_i	36 mm 41 mm	36 mm 41 mm	36 mm 41 mm	36 mm 41 mm
Spring height under a load of 20 kN under a trolley mounting	H_1	224 mm $^{+3}_{-2}$	199 mm $^{+3}_{-2}$	203 mm $^{+5}_{0}$	198 mm $^{+5}_{0}$

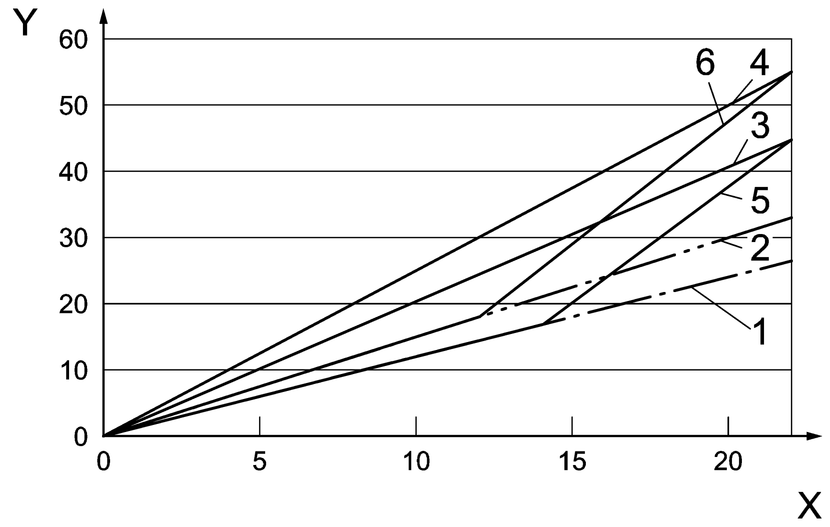
Table E.2 — Standardised parabolic springs for 2-axle freight wagons

Type		Progressive parabolic spring for existing vehicles	Progressive parabolic spring
Note		UIC 517:2007, I.1, I.3, I.4, J.1, J.2 Not used for new vehicles	UIC 517:2007, I.1, I.3, I.4, J.1, J.3
Maximum axle load for 100 km/h	$P_{max,100}$	20 t	22,5 t
Maximum axle load for 120 km/h	$P_{max,120}$	20 t	22,5 t
Length	L_0	1 200 mm	1 200 mm
Number of leaves	n	4 + 1	4+1
Stiffness in first stage	$c_{z,1}$	0,550 kN/mm $^{\pm 7\%}$	0,650 kN/mm $^{\pm 7\%}$
Stiffness in second stage	$c_{z,2}$	1,690 kN/mm $^{\pm 7\%}$	1,820 kN/mm $^{\pm 7\%}$
Transition load	F_1	37,9 kN	41,1 kN
Nominal diameter of the rolled eye	d_i	36 mm 41 mm	36 mm 41 mm
Spring height under a load of 20 kN under a trolley mounting	H_1	202 mm $^{+5}_{0}$	202 mm $^{+5}_{0}$

Annex F
(informative)

Standardised axle guards for double link suspension

Figure F.1 shows characteristics of standardised axle guards for which UIC 517 contains also design parameters.



Key

X lateral deflection in mm
Y lateral force in kN
1 UIC 517:2007, L.1, lower limit
2 UIC 517:2007, L.1, upper limit
3 UIC 517:2007, L.2, lower limit
4 UIC 517:2007, L.2, upper limit
5 UIC 517:2007, L.3, lower limit
6 UIC 517:2007, L.3, upper limit

Figure F.1 — Standardised axle guards as described in UIC 517

Annex G
(normative)

Established components long link assembly "Niesky 2"

The following gives details of the established link components for the long link assembly "Niesky 2". Only details that are significant to the satisfactory dynamic performance are included.

Table G.1 to Table G.4 and Figure G.2 to Figure G.7 give the relevant manufacturing dimensions in mm, other dimensions are required to produce the items but these are not critical to the dynamic performance.

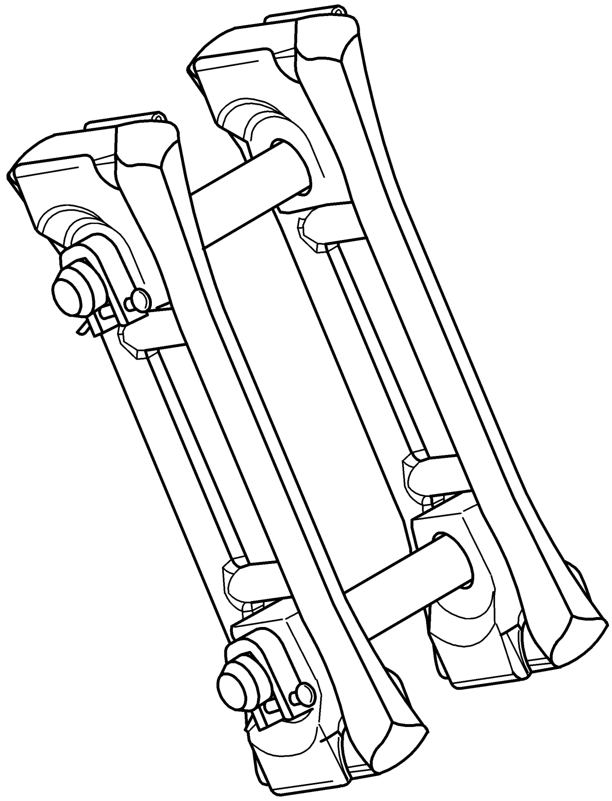


Figure G.1 — Example for long link assembly "Niesky 2"

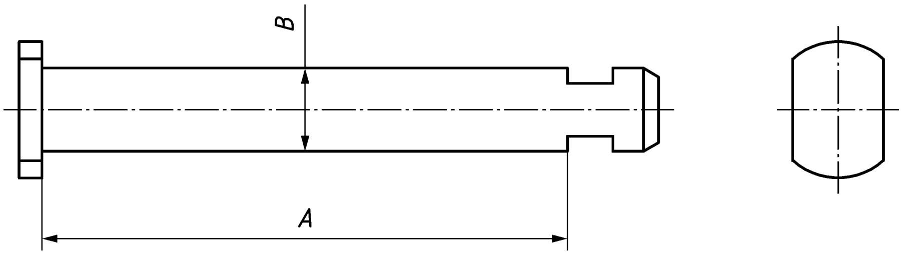


Figure G.2 — Link pin

Table G.1 — Significant link pin dimensions

Dimension (mm)	**Tolerance** (mm)
A = 221	+ 1 0
B = ∅ 35 *B* = ∅ 40	0 - 0,5

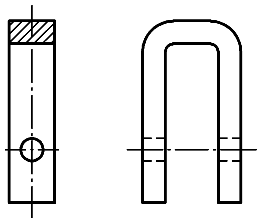


Figure G.3 — Clip

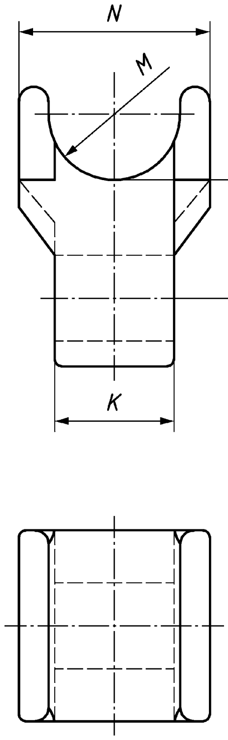


Figure G.4 — End bearing

Table G.2 — Significant end bearing dimensions

Dimension (mm)	**Tolerance** (mm)
K = 50	0 - 0,5
L = 49,5	+ 1 0
M = R 27,5	+ 0,25 0
N = 80	
O = 36 *O* = 41	+ 0,5 0
P = 80	0 - 1
Q = R8	

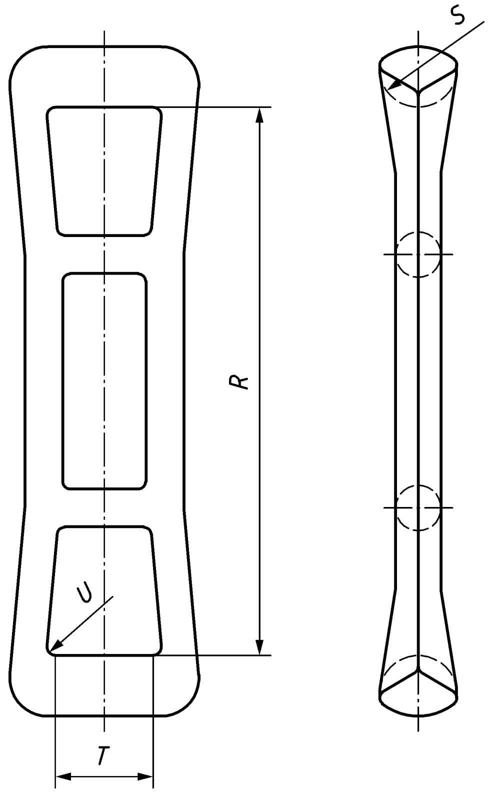


Figure G.5 — Link

Table G.3 — Significant link dimensions

Dimension (mm)	**Tolerance** (mm)
R = 388	0 - 2
S = 27,5	0 - 0,5
T = 69	+ 1 0
U = R 6	

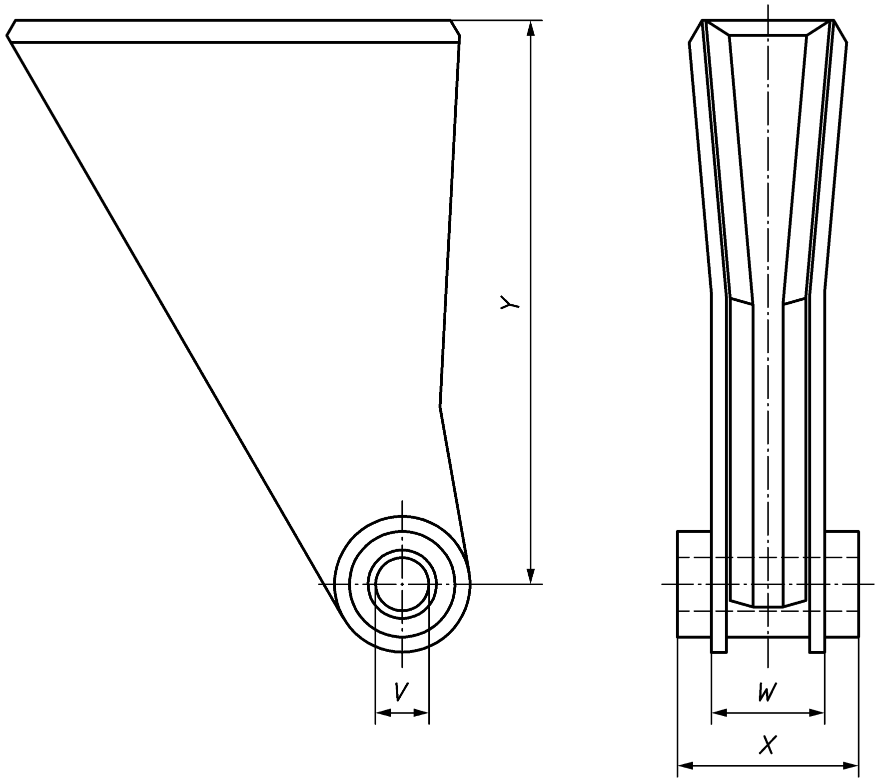


Figure G.6 — Suspension bracket

Table G.4 — Significant suspension bracket dimensions

Dimension (mm)	**Tolerance** (mm)
V = ∅ 36 *V* = ∅ 41	+ 0,5 0
W = 76	0 - 1
X = 120	0 - 0,5
Y = 378	0 + 2

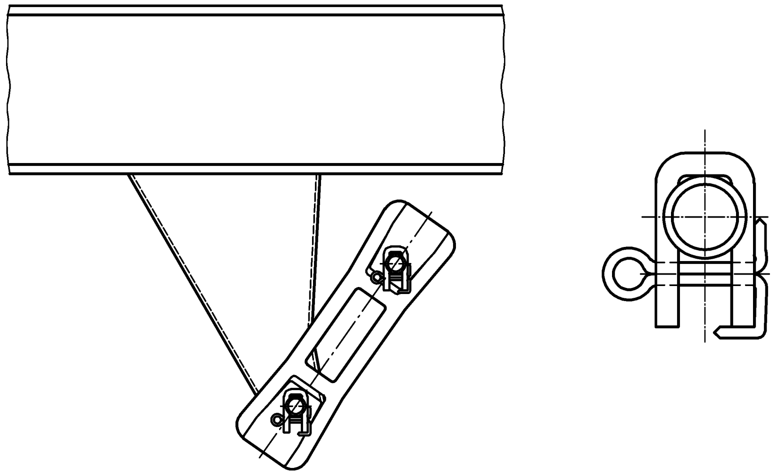


Figure G.7 — Assembly instruction of split pins and clip

Annex H
(informative)

Standardised components for Y25 family of bogies

H.1 Springs

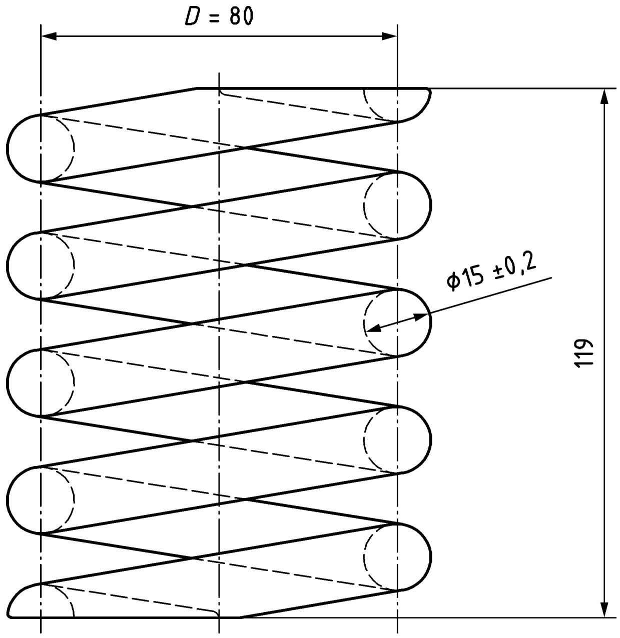
Table H.1 gives details of established springs for the Y25 family of bogies.

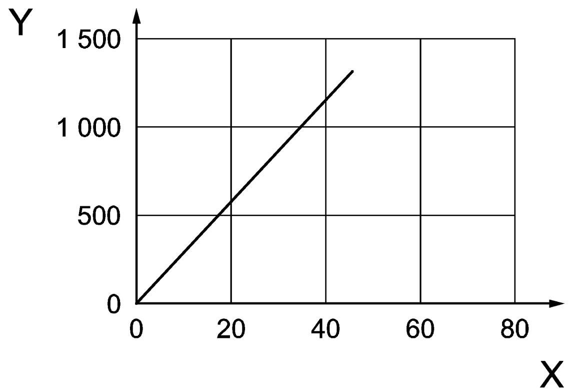
Table H.1 — Standardised helical springs for primary suspension of Y25 family bogies

Maximum axle load	P_{max}	16 t	17 t	20 t	20 t	22,5 t	22,5 t
Stiffness per axle box in first stage	$c_{z,1}$	0,625 kN/mm ±5%	0,833 kN/mm ±5%	0,833 kN/mm ±5%	1,000 kN/mm ±5%	1,000 kN/mm ±5%	1,190 kN/mm ±5%
Stiffness per axle box in second stage	$c_{z,2}$	1,316 kN/mm ±5%	2,272 kN/mm ±5%	2,500 kN/mm ±5%	2,777 kN/mm ±5%	2,500 kN/mm ±5%	3,125 kN/mm ±5%

H.2 Side bearer spring for bogies Y21, Y25 and Y33

Dimensions in millimetres





Key
X deflection in mm
Y force in daN

Figure H.1 — Standardised side bearer spring for Y25 family bogies

Table H.2 — Standardised side bearer spring for Y25 family bogies

Wire diameter	(15 ± 0,2) mm
Loaded length under 8 kN	(91 ± 2) mm
Number of active windings	3,5
Stiffness	0,285 kN/mm $^{\pm 5\%}$

Annex I
(normative)

Assembly links for steering axle bogies

I.1 General

The following gives details of the established link components for the link assembly for steering axle bogies. Only details that are significant to the satisfactory dynamic performance are included.

Table I.1 to Table I.9 and Figure I.1 to Figure I.13 give the relevant manufacturing dimensions in mm, other dimensions are required to produce the items but these are not critical to the dynamic performance.

I.2 Assembly rectangle link

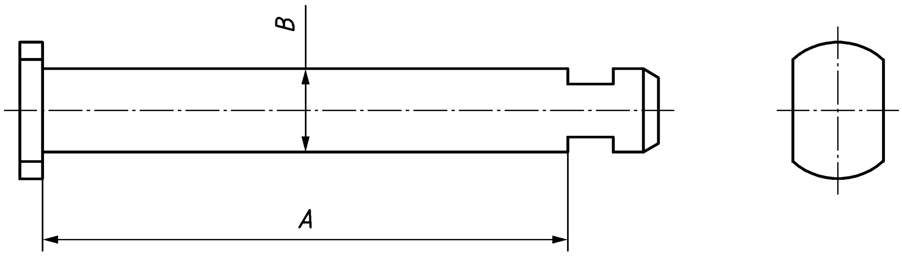


Figure I.1 — Link pin

Table I.1 — Significant link pin dimensions

Dimension (mm)	Tolerance (mm)
A = 221	+ 1 0
B = ∅ 35 *B* = ∅ 40	0 - 0,5

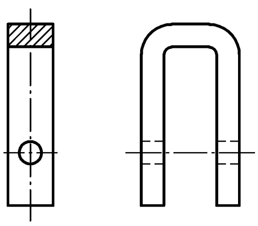


Figure I.2 — Clip

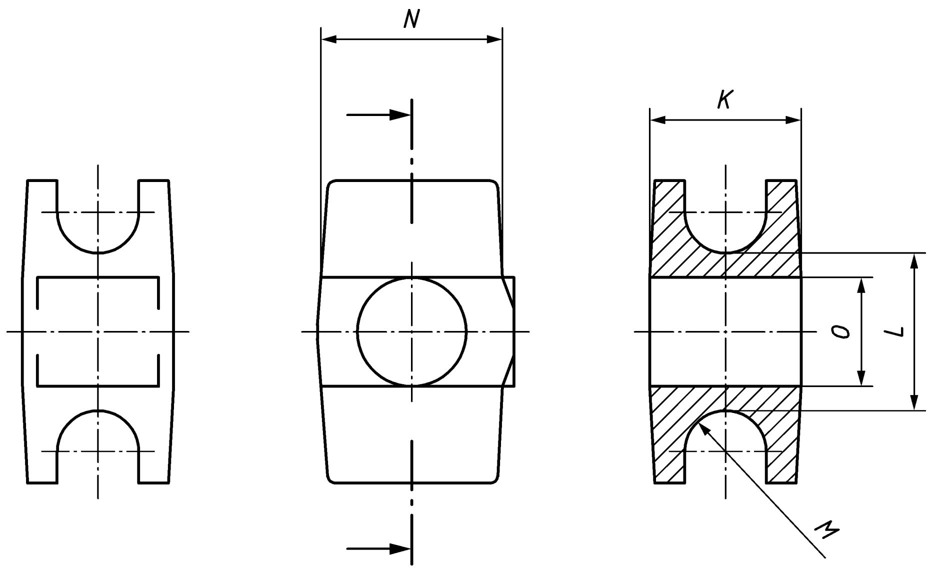


Figure I.3 — End bearing

Table I.2 — Significant end bearing dimensions

Dimension (mm)	**Tolerance** (mm)
K = 50	0 - 0,5
L = 52	+ 2 0
M = R13,5	+ 0,5 0
N = 60	+ 0 -1
O = ∅ 36 *O* = ∅ 41	+ 0,7 - 0,3

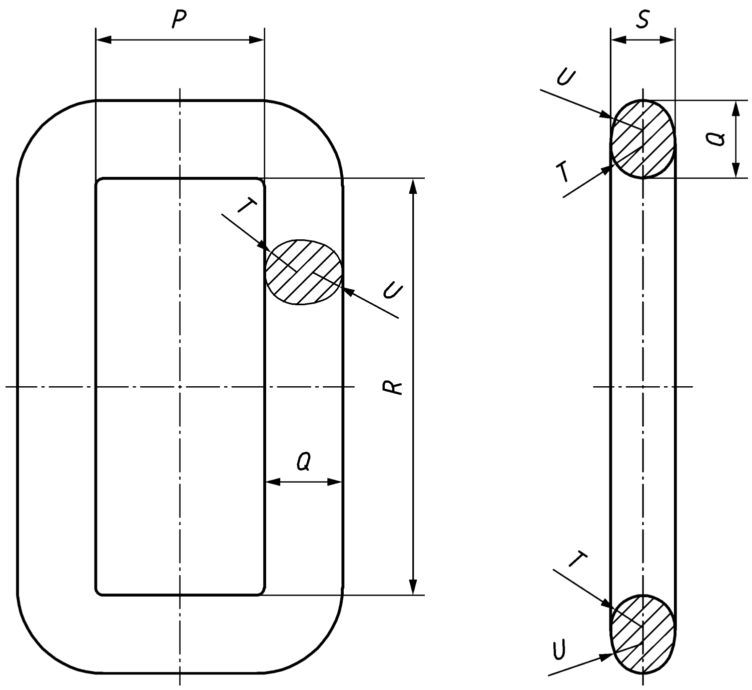


Figure I.4 — Link

Table I.3 — Significant link dimensions

Dimension (mm)	**Tolerance** (mm)
P = 62	+1 0
Q = 32	+2 -0
R = 171	0 -2
S = 26,5	+1 -1
T = 13,25	0 -0,5
U = 12,25	0 -0,5

I.3 Assembly trapezoidal link

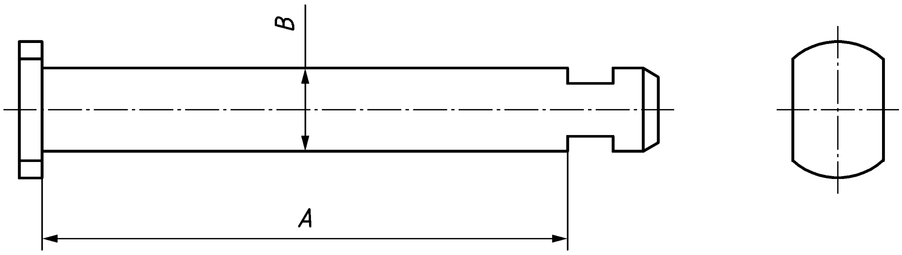


Figure I.5 —Link pin

Table I.4 — Significant link pin dimensions

Dimension (mm)	**Tolerance** (mm)
A = 221	+1 0
B = ∅ 35 *B* = ∅ 40	0 -0,5

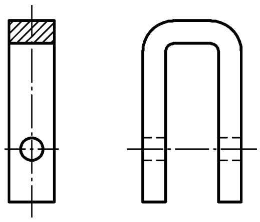


Figure I.6 — Clip

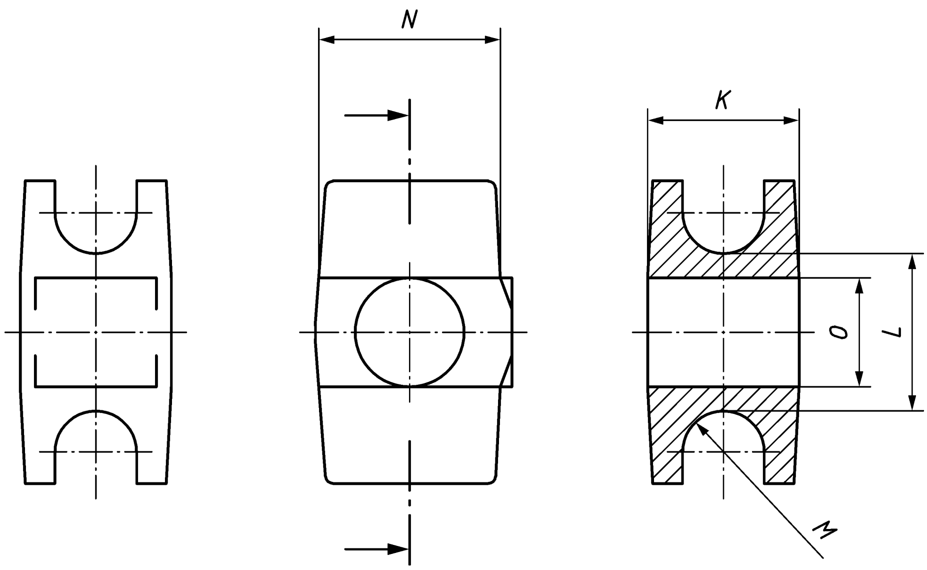


Figure I.7 — End bearing

Table I.5 — Significant end bearing dimensions

Dimension (mm)	**Tolerance** (mm)
K = 50	0 - 0,5
L = 52	+ 2 0
M = R13,5	+ 0,5 0
N = 60	+ 0 - 1
O = 36 *O* = 41	+ 0,7 - 0,3

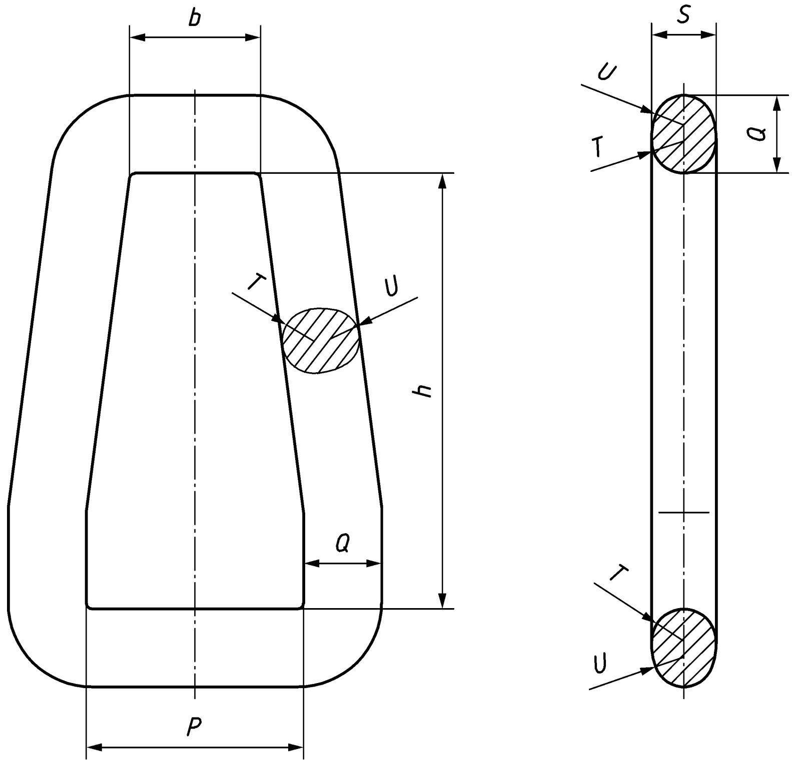
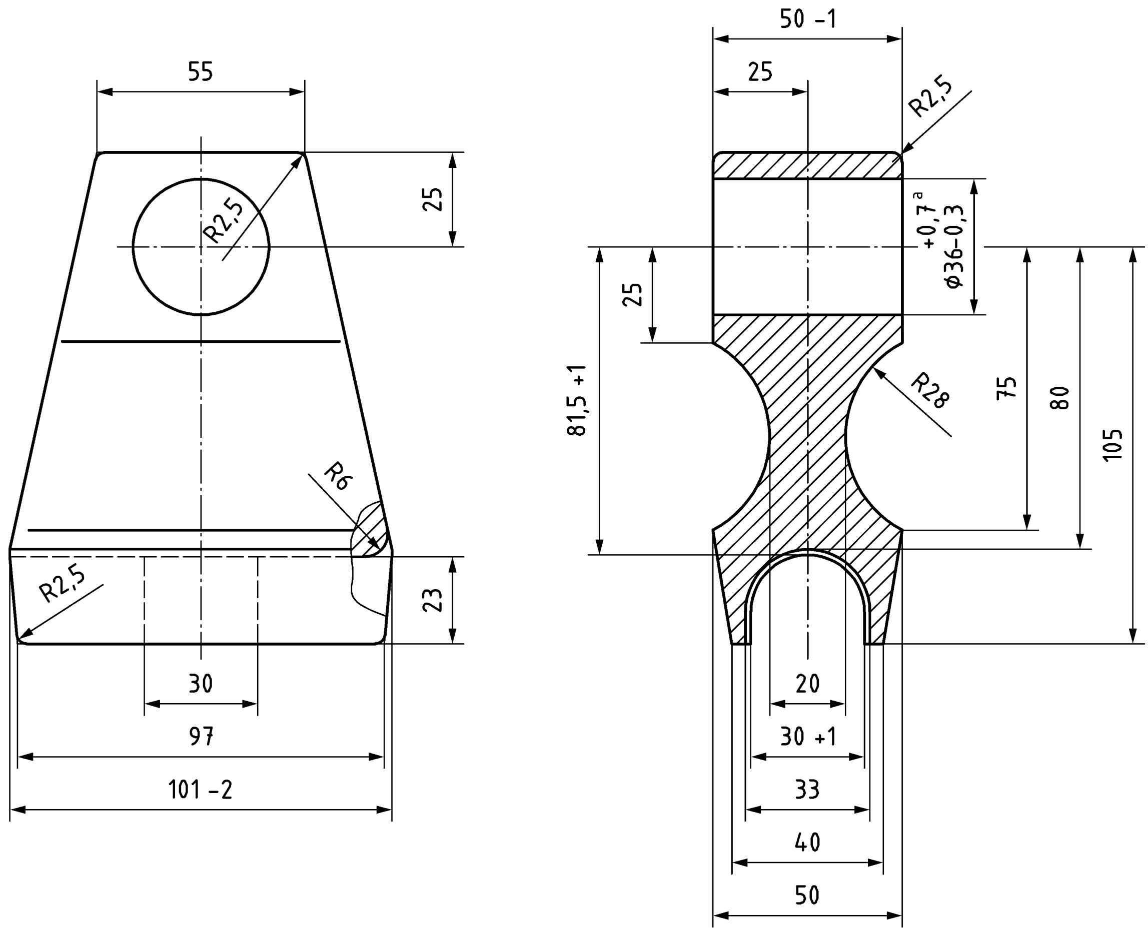


Figure I.8 — Link

Table I.6 — Significant link dimensions

Dimension (mm)	**Tolerance** (mm)
b = 61	+ 1 - 0
h = 205	+ 0 - 2
P = 102	+ 1,5 - 0
Q = 32	+ 1 - 0
S = 26,5	+ 0 - 1
T = 13,25	+ 0 - 0,5
U = 12,25	+ 0 - 0,5

Dimensions in millimetres



Key
a = 36 or 41

Figure I.9 — End bearing

I.4 Assembly long link

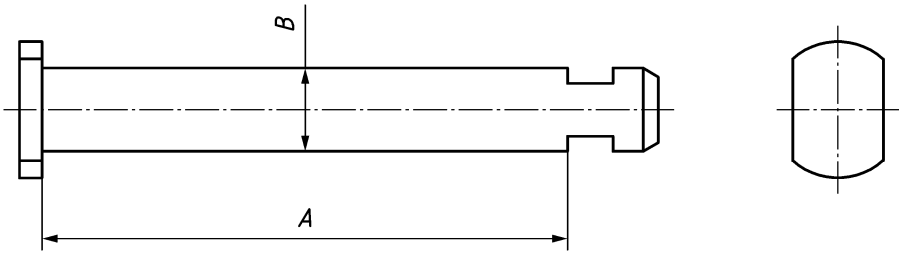


Figure I.10 — Link pin

Table I.7 — Significant link pin dimensions

Dimension (mm)	**Tolerance** (mm)
A = 221	+ 1 0
B = ∅ 35 *B* = ∅ 40	0 - 0,5

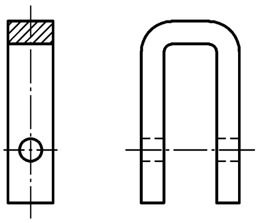


Figure I.11 — Clip

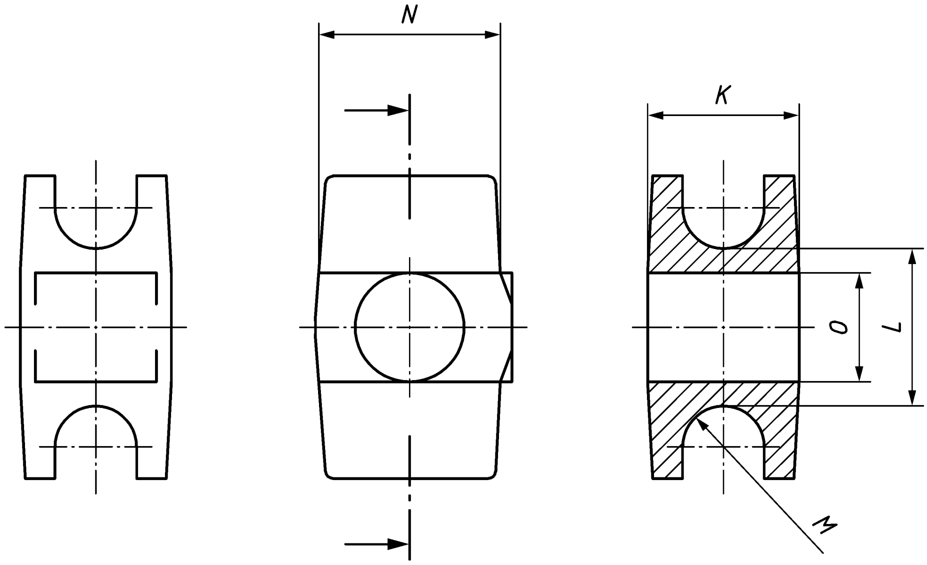


Figure I.12 — End bearing

Table I.8 — Significant end bearing dimensions

Dimension (mm)	**Tolerance** (mm)
K = 50	0 - 1
L = 52	+ 2 0
M = R13,5	+ 0,5 0
N = 60	+ 0 -2
O = ∅ 36 *O* = ∅ 41	+ 0,7 - 0,3

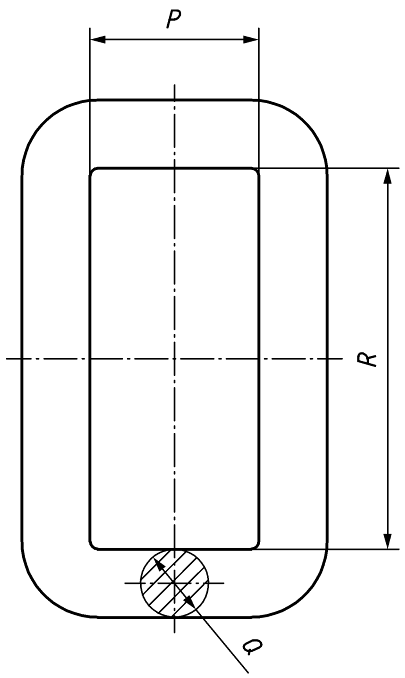


Figure I.13 — Link

Table I.9 — Significant link dimensions

Dimension (mm)	**Tolerance** (mm)
P = 62	+ 1 0
Q = ∅ 26	± 0,5
R = 325	0 - 2

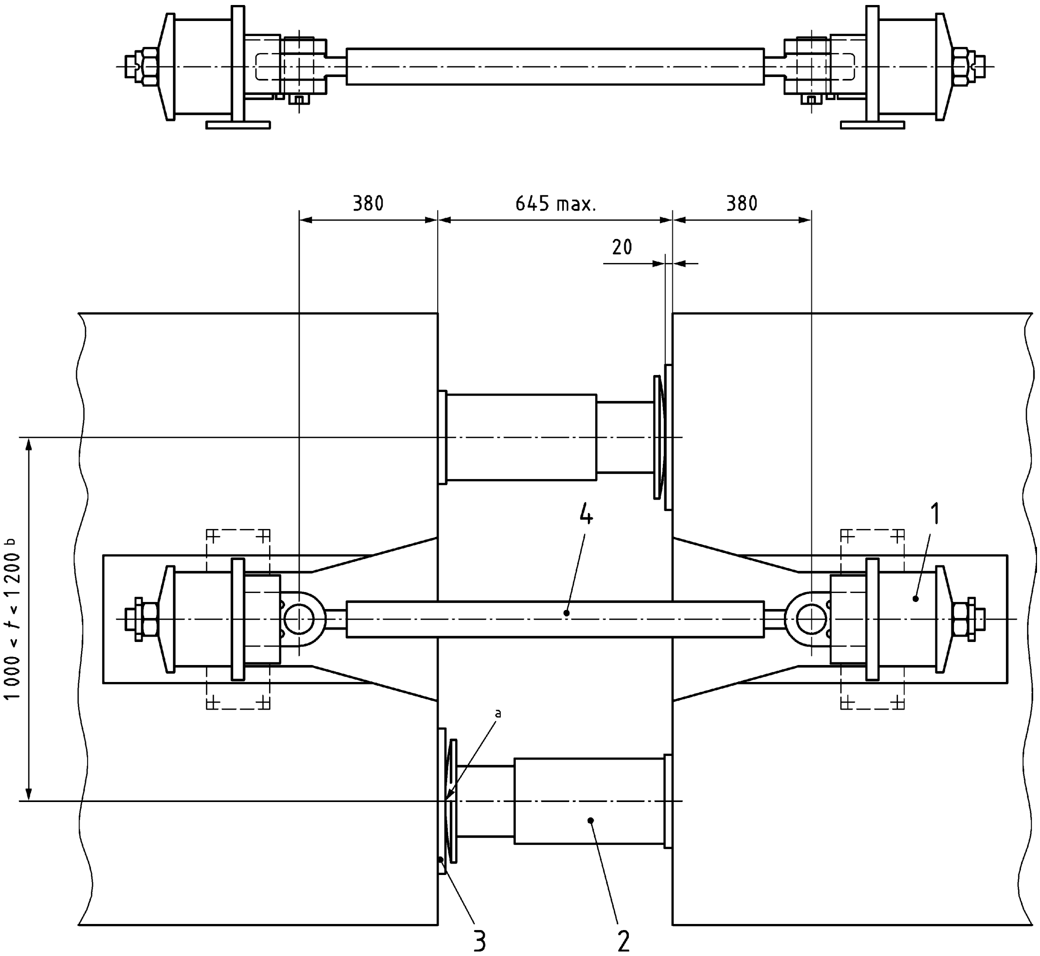
Annex J
(normative)

Inner couplings of a permanent coupled unit

J.1 Inner coupling close coupling

Permanently-Coupled wagons – Close-Coupling (Complete unit)

Dimensions in millimetres



Key

1 draw gear assembly complying with EN 15566
2 105 mm stroke buffer in accordance with EN 15551
3 wearing plate
4 general coupling
a spherical radius ≈ 750 mm
b when using buffers without buffer heads this dimension may be reduced to 900 mm

Figure J.1 — Inner coupling close coupling

J.2 Inner coupling bar

Concerning running behaviour a coupling bar shall fulfil the following requirements.

In a 250 m curve without traction and breaking forces, the torque around the vertical axis between the elements of the unit shall be less or equal to the torque around the vertical axis generated by two coupled wagons with standard ends of side buffers and draw gear according to EN 15551 and EN 15566.

Annex K
(informative)

Standardised leaf springs for 2 axle and 3-axle steering axle bogies

The following tables give details of established springs for the 2 axle and 3 axle steering axle bogies.

Table K.1 — Standardised trapezoidal springs for 2-axle steering axle bogies

Type		**Linear trapezoidal leaf spring**	
Maximum axle load for 100 km/h	$P_{max,100}$	20 t	20 t
Length	L_0	1 200 mm	1 200 mm
Number of leaves	n	8	8
Stiffness	$c_{z,}$	1,515 kN/mm $^{\pm 8\%}$	1,515 kN/mm $^{\pm 8\%}$
Nominal diameter of the rolled eye	d_i	36 mm	36 mm
Spring height under a load of 20 kN under a trolley mounting	H_1	197 mm $^{+3}_{-2}$	152 mm $^{+3}_{-2}$

Table K.2 —Standardised trapezoidal springs for 3-axle steering axle bogies

Type		**Linear trapezoidal leaf spring**		
Maximum axle load for 100 km/h	$P_{max,100}$	20 t	20 t	20/22 t
Length	L_0	1 200 mm	1 200 mm	1 200 mm
Number of leaves	n	8	8	9
Stiffness	c_z	1,515 kN/mm $^{\pm 8\%}$	1,515 kN/mm $^{\pm 8\%}$	1,666 kN/mm $^{\pm 8\%}$
Nominal diameter of the rolled eye	d_i	36 mm	36 mm	36 mm
Spring height under a load of 20 kN under a trolley mounting	H_1	197 mm $^{+3}_{-2}$	152 mm $^{+3}_{-2}$	152 mm $^{+3}_{-2}$

Table K.3 — Standardised parabolic springs for 2-axle steering axle bogies

Type		**Parabolic spring**			
Note		UIC 517:2007, I.2, I.3, I.4, J.5			
Maximum axle load for 120 km/h	$P_{max,120}$	22,5 t	22,5 t	22,5 t	23,5 t
Length	L_0	1 200 mm	1 200 mm	1 200 mm	1 200 mm
Numbers of leaves	n	4 + 1	4 + 1	4 + 1	4 + 1
Stiffness in first stage	$c_{z,1}$	0,886 kN/mm $^{\pm 7\%}$	0,917 kN/mm $^{\pm 7\%}$	0,935 kN/mm $^{\pm 7\%}$	0,935 kN/mm $^{\pm 7\%}$
Stiffness in second stage	$c_{z,2}$	1,859 kN/mm $^{\pm 7\%}$	2,174 kN/mm $^{\pm 7\%}$	2,500 kN/mm $^{\pm 7\%}$	2,632 kN/mm $^{\pm 7\%}$
Transition load	F_1	40 kN	43 kN	45 kN	46,5 kN
Nominal diameter of the rolled eye	d_i	36 mm or 41 mm	36 mm or 41 mm	36 mm or 41 mm	41 mm
Spring height under a load of 20 kN under a trolley mounting	H_1	92 mm $^{+3}_{-2}$	92 mm $^{+3}_{-2}$	92 mm $^{+3}_{-2}$	92 mm $^{+3}_{-2}$

Table K.4 — Standardised parabolic springs for 3-axle steering axle bogies

Type		**Parabolic spring**	
Note			
Maximum axle load for 120 km/h	$P_{max,120}$	22,5 t	25 t
Length	L_0	1 200 mm	1 200 mm
Number of leaves	n	4	4
Stiffness	c_z	1,613 kN/mm $^{\pm 7\%}$	2,703 kN/mm $^{\pm 8\%}$
Nominal diameter of the rolled eye	d_i	36 mm	41 mm
Spring height under a load of 20 kN under a trolley mounting	H_1	155 mm $^{+3}_{-2}$	154 mm $^{+3}_{-2}$

Annex L
(normative)

Articulation for articulated wagons equipped with bogies of Y25 family

The following figures give details of established articulations for articulated wagons:

L.1 Articulation type Talbot:

Dimensions in millimetres

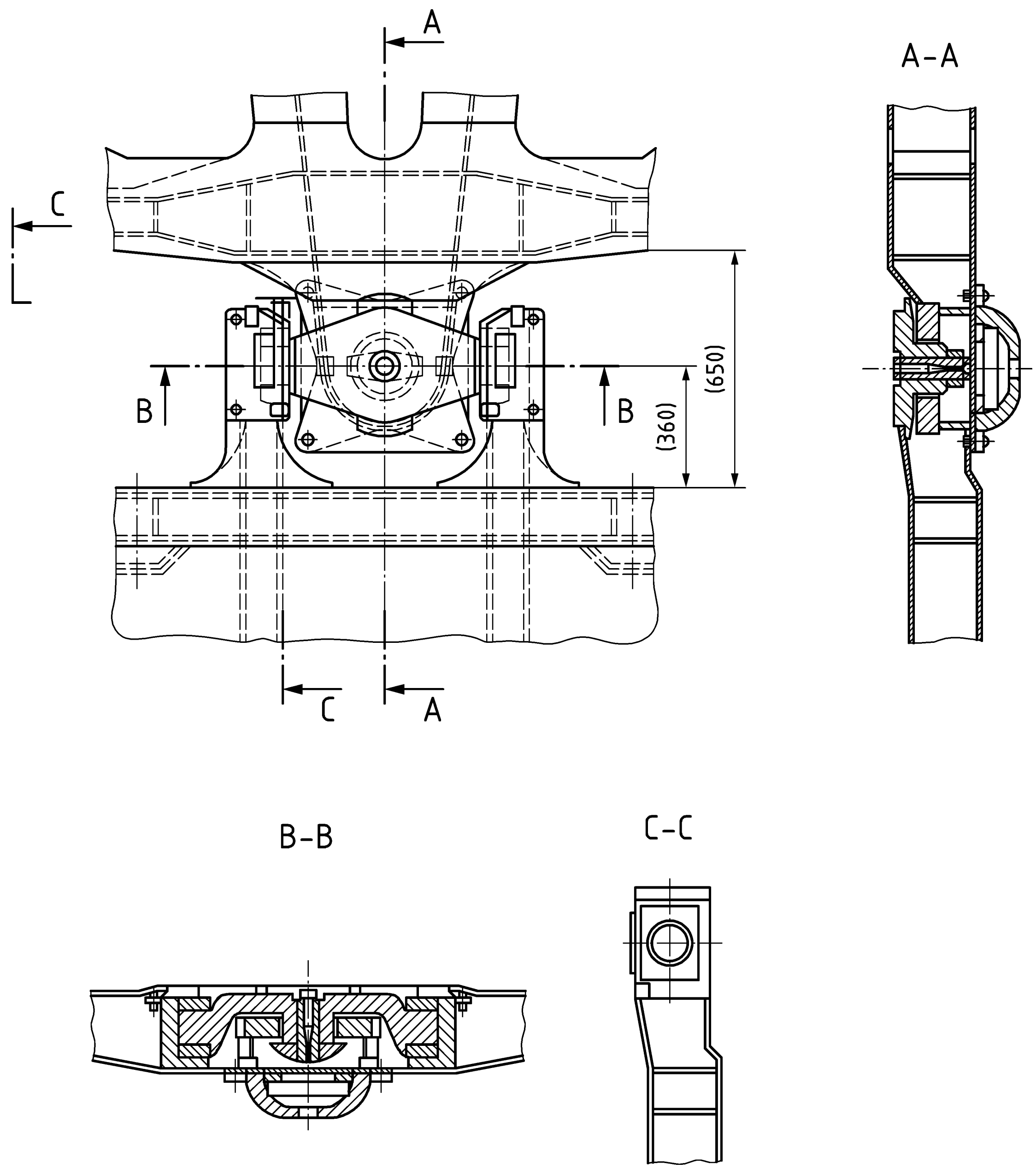
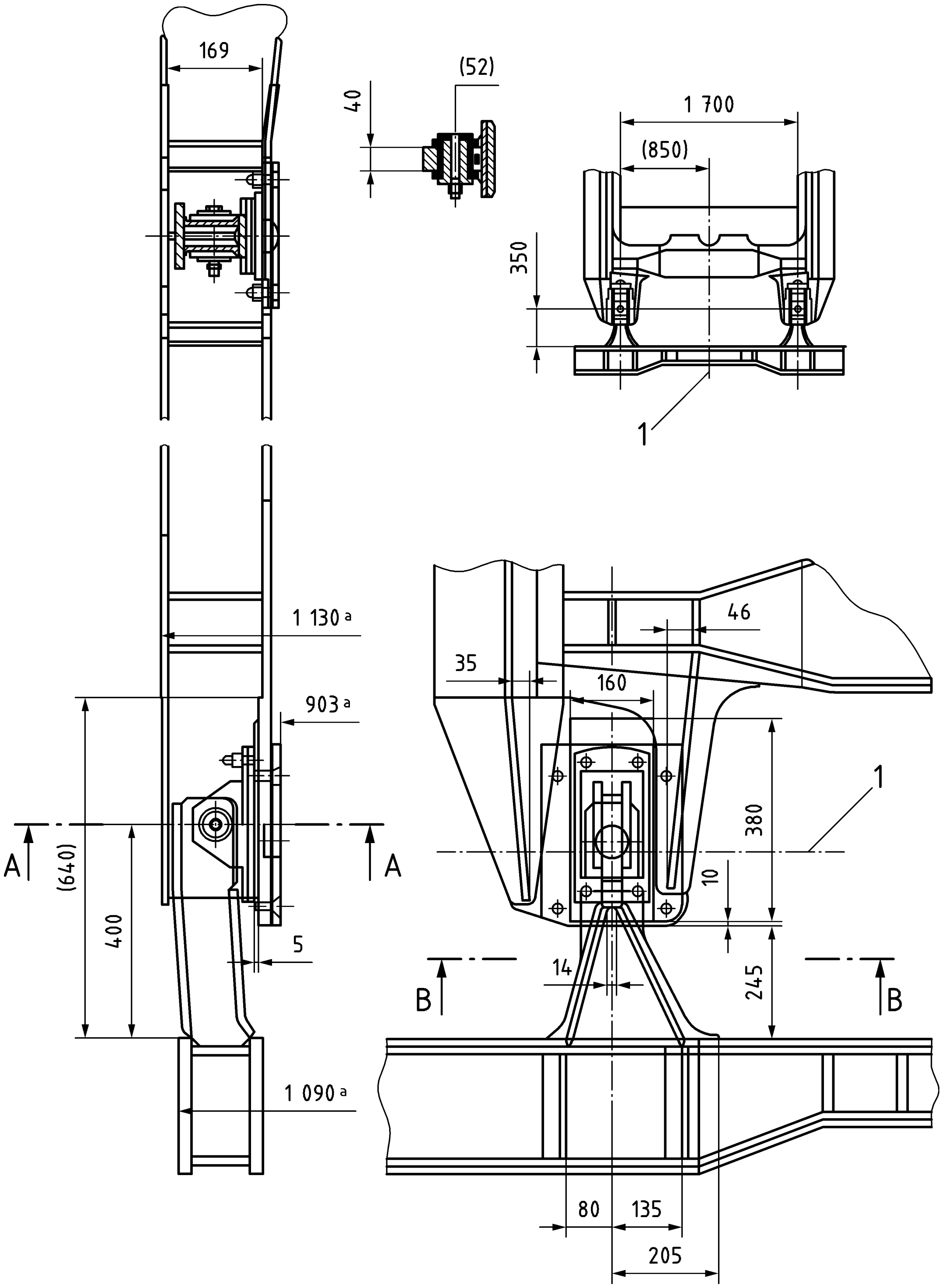


Figure L.1 — Articulation type Talbot

L.2 Articulation type Talbot, lateral support wagon body:

Dimensions in millimetres



Key

1 centre of the wagon

a distances from running surface

Figure L.2 — Articulation type Talbot, lateral support wagon body

L.3 Articulation type UIC:

Dimensions in millimetres

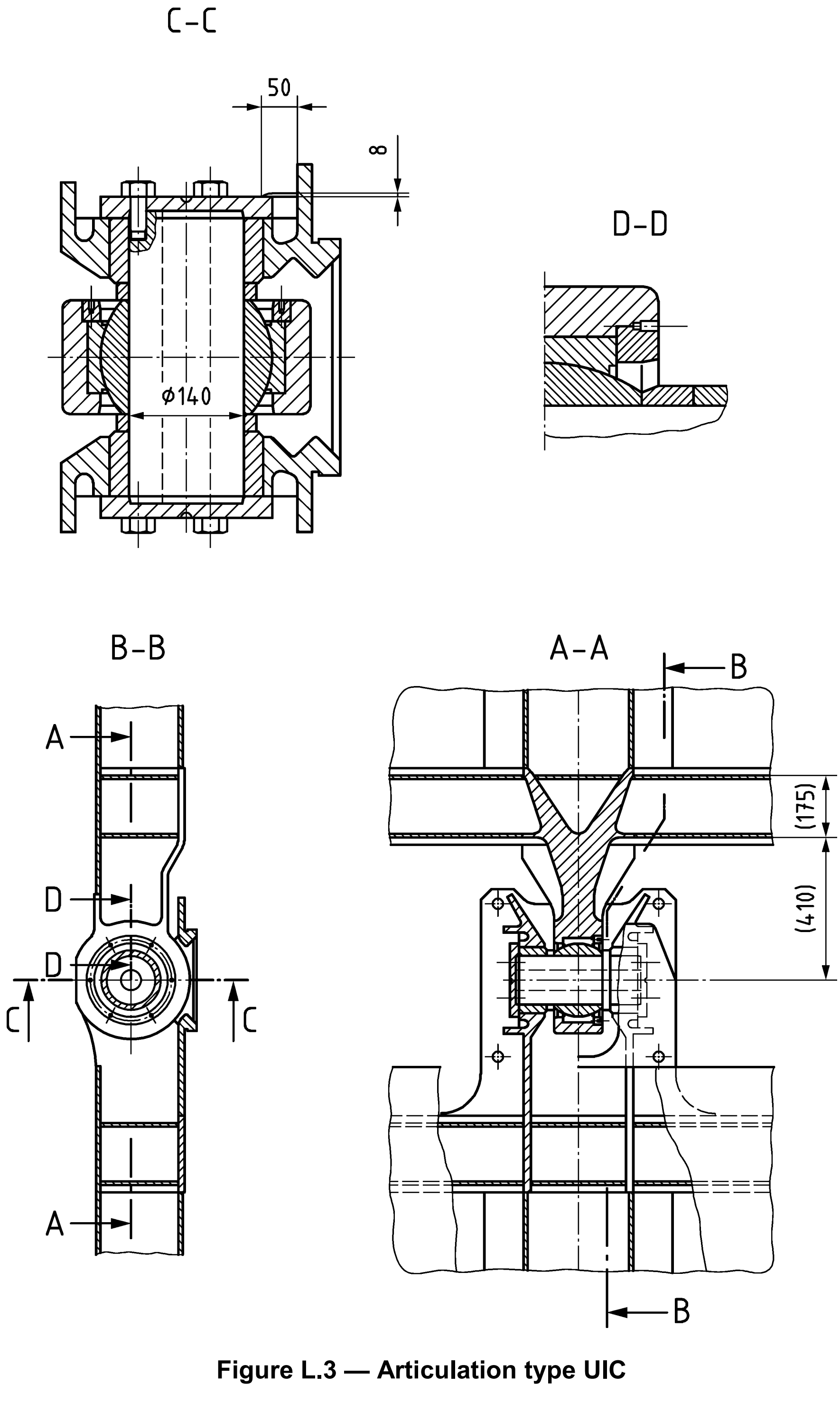
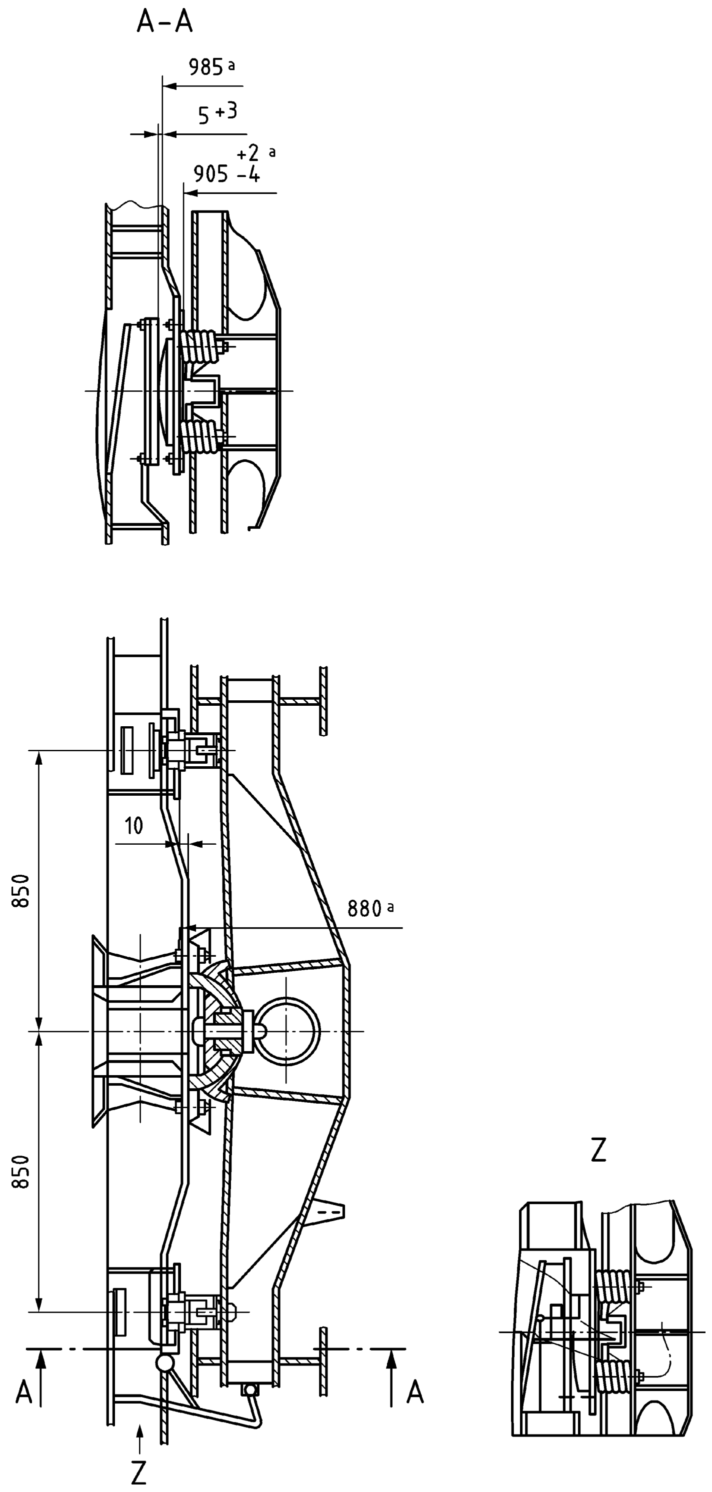


Figure L.3 — Articulation type UIC

L.4 Articulation type UIC, lateral support wagon body:

Dimensions in millimetres



Key

a distances from running surface

Figure L.4 — Articulation type UIC, lateral support wagon body

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC

This European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 2008/57/EC[1)].

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Tables ZA.1 and ZA.2 for CR Freight Wagons confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

1) This Directive 2008/57/EC adopted on 17th June 2008 is a recast of the previous Directives 96/48/EC ‘Interoperability of the trans-European high-speed rail system’ and 2001/16/EC ‘Interoperability of the trans-European conventional rail system’ and revisions thereof by 2004/50/EC ‘Corrigendum to Directive 2004/50/EC of the European Parliament and of the Council of 29 April 2004 amending Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system and Directive 2001/16/EC of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system’.

Table ZA.1 — Correspondence between this European Standard, the CR TSI RST Freight Wagon dated July 2006, published in the OJEU on 8 December 2006 and its intermediate revision published in the OJEU on 14 February 2009 and Directive 2008/57/EC

Clause/ subclauses of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
The whole standard is applicable	4.Characterisation of the subsystem 4.2. Functional and technical specifications of the subsystem, 4.2.3.2 Vehicle track interaction and gauging, Static axle load and linear load 4.2.3.4 Vehicle track interaction and gauging, Vehicle dynamic behaviour 5 Interoperability constituents 5.4 Constituents performances and specifications 5.4.2.1 Vehicle track interaction, Bogie and running gear 6. Assessment of conformity and/or suitability for use of the constituents and verification of the subsystem 6.2 Subsystem conventional rail rolling stock freight wagons 6.2.1 Assessment procedures 6.2.3 Specifications for assessment of the subsystem §6.2.3.2.1.3 Vehicle track interaction and gauging, Vehicle dynamic behaviour, Exemptions from dynamic behaviour test for wagons to be built or converted to run up to 100 km/h or 120 km/h Annex Y Constituents Bogies and running gear	Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.2 1.4 Environmental protection Clause 1.4.5 1.5 Technical compatibility §1 2 Requirements specific to each subsystem 2.4 Rolling stock 2.4.3 Technical compatibility §3	

Table ZA.2 — Correspondence between this European Standard, the Draft Commission Regulation concerning the technical specification for interoperability relating to the 'rolling stock – freight wagons' subsystem of the rail system in the European Union and repealing Commission Decision 2006/861/EC, approved by the RISC on 06.06.2012 and Directive 2008/57/EC

Clause/ subclauses of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
The whole standard is applicable	4.Characterisation of the subsystem 4.2. Functional and technical specifications of the subsystem, 4.2.3.5.2 Running dynamic behaviour 5 Interoperability constituents 5.3 Interoperability constituent specifications 5.3.1 Running gear 6. Conformity assessment and EC verification 6.1 Interoperability constituent 6.1.2 Conformity Assessment procedures §6.1.2.1 Running gear Annex B Specific procedures for running dynamics §2 Qualification of running gear	Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.2 1.4 Environmental protection Clause 1.4.5 1.5 Technical compatibility §1 2 Requirements specific to each subsystem 2.4 Rolling stock 2.4.3 Technical compatibility §3	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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