UIC CODE 515-1

2nd edition, March 2003

Translation

OR

Passenger rolling stock - Trailer bogies - Running gear - General provisions applicable to the components of trailers bogies

Matériel pour le transport de voyageurs - Bogies porteurs - Organes de roulement - Dispositions générales applicables aux organes constitutifs des bogies porteurs
Reisezugwagen - Laufdrehgestelle - Laufwerke - Allgemeine Bestimmungen für die Baugruppen von Laufdrehgestellen

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

Leaflet to be classified in Volume :

V - Rolling Stock

Application :

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

This leaflet applies to standard gauge lines

Record of updates

1st edition, January 1994	First issue
2nd edition, March 2003	Retyped in FrameMaker
	Addition to point 2.1.

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

Contents

Summary

This leaflet sets out the conditions to be met by the components of trailer bogies for passenger rolling stock, in addition to the conditions specified in *UIC Leaflet 515-3 to 515-5*.

With a view to standardisation, this leaflet also presents technical solutions which have been tried and tested in service on bogies operating under the normal conditions of the principal UIC railways. This standardisation is highly desirable for economic reasons but should not inhibit innovation or progress.

1 - Conditions relating to wheelsets

O 1.1 - General provisions

The masses of the wheelsets and the components connecting them to the bogie frame shall be as low as possible.

1.2 - Wheelsets

O **1.2.1 -** The electrical resistance of the wheelset - measured between the treads of the two wheels - shall have a value which meets the requirements set out in *UIC Leaflet 813 and 512*.

R **1.2.2 -** To enable wheelsets to be lifted by certain installations used for maintenance, it is recommended that the design of the wheelset, in particular the spaces between brake discs, comply with the specifications shown in Appendix A - page 13.

1.3 - Wheels

O **1.3.1 -** The wheel diameter when new shall be within the range 800 mm - 1 000 mm. The recommended values are 890 and 920 mm.

O **1.3.2 -** The wheels shall be of the monobloc type (solid wheel).

O **1.3.3 -** For bogies designed to run at a maximum speed not exceeding 200 km/h, the wheel rim profile shall meet the conditions specified in *UIC Leaflet 510-2*.

O **1.3.4 -** The grade of steel shall be chosen from those specified in *UIC Leaflet 813*.

R **1.3.5 -** The recommended grade is R7.

R **1.3.6 -** The wheel designs given as examples in Appendix B - page 14 represent solutions which have produced good in-service results under the normal conditions of use for bogies for passenger rolling stock.

O 1.4 - Axles

The dimensions and shape of the axle shall meet the conditions specified in *UIC Leaflet 515-3*.

The diameter and length of the journals shall enable the following two conditions to be met:

- sufficient mechanical strength, as specified in *UIC Leaflet 515-3*,
- proper functioning of the bearings, as specified in *UIC Leaflet 515-5*.

By way of an example, Appendix C - page 16 shows 130 mm-diameter journals, which have produced good in-service results on bogies used under normal conditions at maximum running speeds not exceeding 200 km/h.

1.5 - Axle boxes - Bearings - Grease

O **1.5.1 -** The axle boxes shall have roller bearings.

O **1.5.2 -** The axle boxes shall meet the conditions specified in *UIC Leaflet 515-5*.

O **1.5.3 -** The axle box bearings shall be held in position on the journals by a locking cap, the design of which is illustrated in Appendix C - page 16 for 130 mm-diameter journals.

O **1.5.4 -** The lower part of axle-box casings, below the bearings, shall be visible to hot box detection ground installations. The geometry of this area of the axle-box casing shall meet the conditions illustrated in Appendix D - page 18.

O **1.5.5 -** If systems are fitted to the axle ends (e.g. current returns, speed measuring devices, etc.), they shall be attached in such a way that they do not have any effect on the operation of the bearings, even in the event of failure. This can be demonstrated using the tests described in *UIC Leaflet 515-5*.

O **1.5.6 -** In order to avoid damage to the bearings and the grease as a result of electric current flowing through them, the bearings shall be electrically insulated with respect to the bogie frame. Earthing contacts and resistances in parallel shall be fitted in accordance with *UIC Leaflet 552*.

O **1.5.7 -** Axle boxes shall be designed in such a way that they do not hinder the use of underfloor wheel lathes when wheels are reprofiled.

O **1.5.8 -** The grease used in the axle boxes shall meet the requirements of *UIC Leaflet 814*.

R **1.5.9 -** It is recommended that the axle boxes enable additional lubricant to be applied without having to be disassembled.

1.6 - Connections between wheelsets and bogie frames

R **1.6.1 -** It is recommended that the components that connect the wheelset to the bogie frame have the mechanical strength specified in *UIC Leaflet 515-4*. If this is not the case, the expected service life of the components shall be given.

O **1.6.2 -** The components that connect the wheelset to the bogie frame shall enable the safety and ride comfort requirements to be met.

O **1.6.3 -** The bogie shall be designed and mounted in such a way that, when operating on straight track, the wheelsets are aligned (angle of attack = zero) and do not develop sustained, outwardly-directed lateral forces at the level of wheel/rail contact.

O **1.6.4 -** Should the axle box heat up, the components that connect the wheelset to the bogie frame shall retain sufficient mechanical strength to prevent the wheelset separating from the bogie and ensure wheelset guidance.

O **1.6.5 -** The components that connect the wheelset to the bogie frame shall enable the wheelsets to be lifted with the bogie frame without endangering staff or the vehicle.

2 - Conditions relating to suspension gear

2.1 - General provisions

O **2.1.1 -** Measures shall be taken to ensure that the vehicle height:

- is maintained at an even level, even when the vehicle weight is unevenly distributed across the bogie support points,

- can be adjusted to compensate for any wear or reduction in the height of components (wheels, springs, etc.) occurring in service.

R **2.1.2 -** It is recommended that the natural frequencies of the suspension be different from those of the vehicle body.

O **2.1.3 -** Measures shall be taken to enable the vehicle to be lifted with its bogies.

O **2.1.4 -** The flexibility of the primary and secondary suspension springs shall be chosen so as to meet the safety running requirements and limit as far as possible acceleration on the component parts of the bogie, in order to avoid deterioration.

O **2.1.5 -** The suspension components shall be designed to ensure that - in both the laden and tare conditions - the vehicle flexing coefficient is as low as possible, and does not exceed the value 0,4 (*UIC Leaflet 505-1*).

O **2.1.6 -** If the system for stabilising bogies which have a maximum service speed greater than 200 km/h is not of the redundant type, a device based on acceleration measurements taken on the bogie frame must enable unacceptable instability to be detected. Detection shall result in a message being transmitted to the driver's cab of the motive power unit or have a direct effect on the braking system.

Detection of instability as specified above should be carried out on new vehicles by measuring lateral acceleration $\ddot{y}_{*s}^{+}$, on the bogie frame above the wheelset, whose rms value $s\ddot{y}_{s}^{+}$ must not exceed the following value:

$$(s\ddot{y}_{s}^{+})_{lim} = 6 - \frac{M_b}{10} \; [m/s^2]$$

where M_b is equal to the bogie mass expressed in tonnes (fully-equipped bogie including axles).

The following filtering procedure shall be applied:

- band-width filtering of the instability frequency $f_0 \pm 2$ Hz, with an attenuation slope greater or equal to 25 dB/octave,

- continuous calculation of the rms value $s\ddot{y}_{s}^{+}$ over a length of 100 m (± 10 %) at 10 m intervals (± 10 %).

O **2.1.7 -** The suspension gear shall be such that it prevents, as far as possible, the direct transmission of running noise to the body.

O **2.1.8 -** The suspension gear shall be such that the difference in the height of the body between the vehicle when empty with new wheels and the vehicle under normal load with worn wheels shall be no more than 80 mm, as per the conditions laid down by the RIC and in *UIC Leaflet 567-1*.

O **2.1.9 -** The lateral displacements permitted by the lateral suspension shall respect the gauge.

R **2.1.10 -** In the case of a passive suspension, it is recommended that these displacements be as large as possible.

2.2 - Metallic coil springs

R **2.2.1 -** It is recommended that the springs have a mechanical strength that gives them a lifespan equal to that of the bogie frames. Measures shall be taken to protect them against corrosion.

O **2.2.2 -** When the springs are put in place, account must be taken of the "chasse" effect (lateral forces), either by balancing them (e.g. in the case of two springs working in parallel) or by cancelling out their forces (e.g. in the case of springs attached to a connecting rod). The direction of the lateral force shall be clearly marked in a durable way on each spring.

O **2.2.3 -** Measures shall be taken to ensure that the bogie runs safely in the event of a broken spring.

2.3 - Pneumatic springs

O **2.3.1 -** The pneumatic suspension system shall be designed so as to reduce as far as possible the consumption of compressed air.

O **2.3.2 -** The state of the pneumatic suspension (inflated, deflated) shall be easily and unequivocally recognisable to the operating and maintenance staff.

O **2.3.3 -** Isolating devices, including a minimum number of shut-off valves, shall be accessible to the operating and maintenance staff.

R **2.3.4 -** It is recommended that if one spring on a bogie becomes deflated, the other should deflate as well. If the two springs are not supposed to deflate at the same time, it shall be demonstrated that this does not introduce any risk as far as safety is concerned.

O **2.3.5 -** Leaks from the pneumatic suspension shall be as limited as possible. If the supply of compressed air to an immobilised vehicle is cut off for more than 2 hours, the buffer height shall not drop by more than 5 mm.

O **2.3.6 -** The compressed-air reservoirs shall comply with the legislation in force in the country in which the vehicle is registered.

O **2.3.7 -** The compressed air required for the pneumatic suspension shall not be taken from the main brake pipe or any pipe branching off from it.

O **2.3.8 -** Measures shall be taken to limit the vertical suspension travel should the levelling valves fail.

O **2.3.9 -** Emergency suspension devices shall be provided to ensure that the running safety conditions are satisfied should the pneumatic system fail.

O **2.3.10 -** If a self-adjusting load-proportional braking system controlled by the pneumatic suspension springs is fitted and one of these springs becomes damaged, minimal braking to the level required to brake the vehicle when empty shall be ensured, under conditions compatible with the rules set out in *UIC Leaflet 543 and 546*.

R 2.4 - Rubber springs

Such suspension components shall be subjected to a test programme to obtain type approval. The scope of these tests shall be agreed between the manufacturer of the components, the designer of the bogie and the customer railway.

R 2.5 - Dampers

It is recommended that the dampers on the primary and secondary suspension systems - apart from those intended to prevent hunting - be hydraulic and have linear characteristics according to damper velocity.

It is recommended that separate vertical and lateral dampers be fitted for damping the secondary suspension. This recommendation also applies to the primary suspension if, in addition to vertical damping, lateral damping is also required.

2.6 - Other suspension components

R **2.6.1 -** If hydraulic yaw dampers are necessary, it is recommended that they be placed as far as possible on the outside of the bogie, so that they are readily visible and easy to remove. These hydraulic yaw dampers shall then be used in pairs in order to avoid functional asymmetry.

O **2.6.2 -** If yaw dampers are necessary, their design, fixing and attachments shall be such that ride comfort requirements are met.

O **2.6.3 -** Yaw damping shall be decoupled from lateral damping.

3 - Conditions relating to bogie frames

3.1 - Bogie frames

O **3.1.1 -** The mechanical strength of the bogie frame shall meet the requirements of *UIC Leaflet 515-4*.

R **3.1.2 -** If the bogie frame is made of steel, it may be cast, welded or constructed using both of these techniques. The steel used shall be weldable without the need for any particular provisions (preheating, etc.). It is recommended that the steel used have a tensile strength of at least 370 N/mm^2. Depending on the design, it may be desirable for it to undergo a stress relieving treatment after being welded.

O **3.1.3 -** For straightening and checking the geometry of the bogie frame, the three coordinate axes shall be indicated by fixed, readily visible marks.

3.2 - Connections between bogies and the body

O **3.2.1 -** The connections between body and bogies shall be designed in such a way that ride comfort requirements are met.

O **3.2.2 -** The connections between body and bogies shall have a mechanical strength which meets the requirements set out in *UIC Leaflet 515-4*.

O **3.2.3 -** The mechanical strength of the connections between body and bogies, in the longitudinal direction, shall enable a force to be applied equal to the mass of the bogie multiplied by 50 m/s^2, without exceeding the elastic limit of the materials. The mechanical strength shall be sufficient so that when a shock of the type described below occurs, no breakage or permanent deformation results and the connection components continue to function normally. This shock consists of having the unladen vehicle travelling at 10 km/h hit a stationary, unbraked wagon with a mass of 80 tonnes fitted with category A buffers.

R **3.2.4 -** It is recommended that these parts be designed in such a way that if more violent shocks occur than the one described above, any parts that may be damaged can be easily replaced.

O **3.2.5 -** The electrical and pneumatic connections shall be flexible and readily accessible. They shall be designed to withstand the strain produced by the vehicle washing equipment.

4 - Conditions relating to braking equipment

4.1 - The braking equipment shall be suitable for the maximum speed at which the bogies are to be used:

- If the maximum speed is not more that 160 km/h, the braking system may consist of block brakes alone, block brakes associated with disc brakes, or disc brakes alone.

- If the maximum speed is greater than 160 km/h but not more than 200 km/h, the braking system may consist of block brakes associated with disc brakes or disc brakes alone.

- If the maximum speed is greater than 200 km/h, the braking system shall consist of disc brakes only.

4.2 - In all cases, other braking devices may be used in conjunction with the above brake types. For example, brakes that are not affected by adhesion (brakes which depend on eddy currents in the rail, etc.) or brakes that do not act on the wheels (magnetic blocks, etc.).

4.3 - If disc brakes alone are used, an anti-skid device shall be fitted in accordance with *UIC Leaflet 541-05*. The ends of the axles shall also be capable of accommodating a tachometer drive.

4.4 - The braking equipment shall be designed to meet the requirements of *UIC Leaflet 410, 543, 544-1 and 546*.

4.5 - The brake cylinders shall be fitted in the bogie.

4.6 - For bogies designed to be fitted to coaches where the payload is substantial in relation to the tare weight (coaches with a laden weight to tare weight ratio of not less than 1,2), self-adjusting load-proportional braking shall be provided.

4.7 - The bogie shall be capable of accommodating parking brakes as necessary.

4.8 - In the case of a homogeneous multiple unit train, the parking brake facility may be provided by means of spring systems.

4.9 - If the parking brake is in the form of a screw brake, it shall be connected to the body by means of a flex ball cable or brake rigging. A separation between under-body controls and bogie controls shall be provided in a readily accessible place.

4.10 - Brake cylinders with integrated brake-rod (slack) adjusters shall be capable of keeping the play on the blocks or pads within a constant range by automatically compensating for:

- potential variations in the stroke of the brake cylinder piston,

- wear on the brake blocks or pads,

- wear on the discs and treads,

- wear on the pins and bushes of the joints.

4.11 - The braking equipment shall be designed to account for the elasticity of the system and movements of the components, including the wheelset components.

5 - Conditions relating to protection against environmental attack

5.1 - Effective and durable forms of protection shall be applied to the components of the bogie in order to avoid corrosion which could be caused by ambient air, rain or products used in vehicle washing equipment.

5.2 - Measures shall be taken to prevent the ingress of rain, snow or dust into the components of the bogie where this might upset their operation or reduce their lifespan.

5.3 - Unless otherwise specified, the bogie and its components shall function satisfactorily within an external temperature range of - 25 °C to + 40 °C.

6 - Protection of the environement

6.1 - The bogies and their components shall not emit into the environment any elements which are hazardous to health.

6.2 - The vibrations and noise of the vehicle shall be as low as possible and always comply with national and international standards.

7 - Conditions intended to facilitate maintenance

O 7.1 - Handling

The design of the bogie shall make it possible to suspend the entire bogie safely in as horizontal a position as possible and transport it without risk.

7.2 - Wearing parts

R **7.2.1 -** It is recommended to have as few wearing parts as possible.

O **7.2.2 -** It shall be possible to inspect without difficulty all wearing parts that affect operating safety and stability.

O **7.2.3 -** All wearing parts shall be easy to replace. Their fastening systems shall be easy to remove and refit.

7.3 - Attaching wheelsets and safety components

O **7.3.1 -** It shall be possible to fit and remove wheelsets by carrying out a small number of simple operations. Any work that needs to be done on neighbouring components should be as limited as possible.

R **7.3.2 -** It is recommended that the damper and axle guide fixings be designed in such a way that they do not have to be loosened when changing an axle.

O **7.3.3 -** The fastenings of safety components shall be as simple as possible, be proven to be effective and facilitate maintenance.

O **7.3.4 -** The design of the bogie shall be such that when maintenance operations are carried out, the wheelsets remain parallel and aligned within the tolerances provided for.

O 7.4 - Attaching hydraulic dampers

7.4.1 - It shall be possible to change the vertical hydraulic dampers without having to use a pit.

7.4.2 - The lateral dampers shall be easily accessible from a pit; it shall be possible to change them without having to raise the body of the vehicle.

7.4.3 - It shall be possible to replace the hydraulic yaw dampers without having to use a pit.

7.5 - Attaching bogies to the body

O **7.5.1 -** The bogie/body attachment points shall be readily accessible to enable fast removal and refitting.

R **7.5.2 -** It is recommended that there be as few body/bogie attachment points as possible.

7.6 - Brakes

R **7.6.1 -** It is recommended that it be possible to remove all the parts of the brake rigging, including the brake cylinders, from the bogie as complete units.

O **7.6.2 -** The devices for adjusting the piston stroke or play on the brake pads and blocks shall be readily accessible.

O **7.6.3 -** It shall be possible to replace the brake pads by loosening and retightening simply constructed safety devices. The necessary operations shall be few in number.

R **7.6.4 -** For theses devices, it is recommended not to use systems which include screws.

O **7.6.5 -** In the case of disc brakes on the wheels or block brakes, it shall be possible to change the pads or blocks without having to use an external pit.

O 7.7 - Buffer height adjustment and wear compensation

7.7.1 - If buffer height adjustment systems are necessary, they shall be few in number, straight-forward and readily interchangeable.

7.7.2 - The devices used to adjust buffer height, e.g. connecting rods or pneumatic suspension levelling valve stems, etc., shall be readily accessible and give positive adjustment.

Appendix A - Free space to be left for axle-changeover equipment

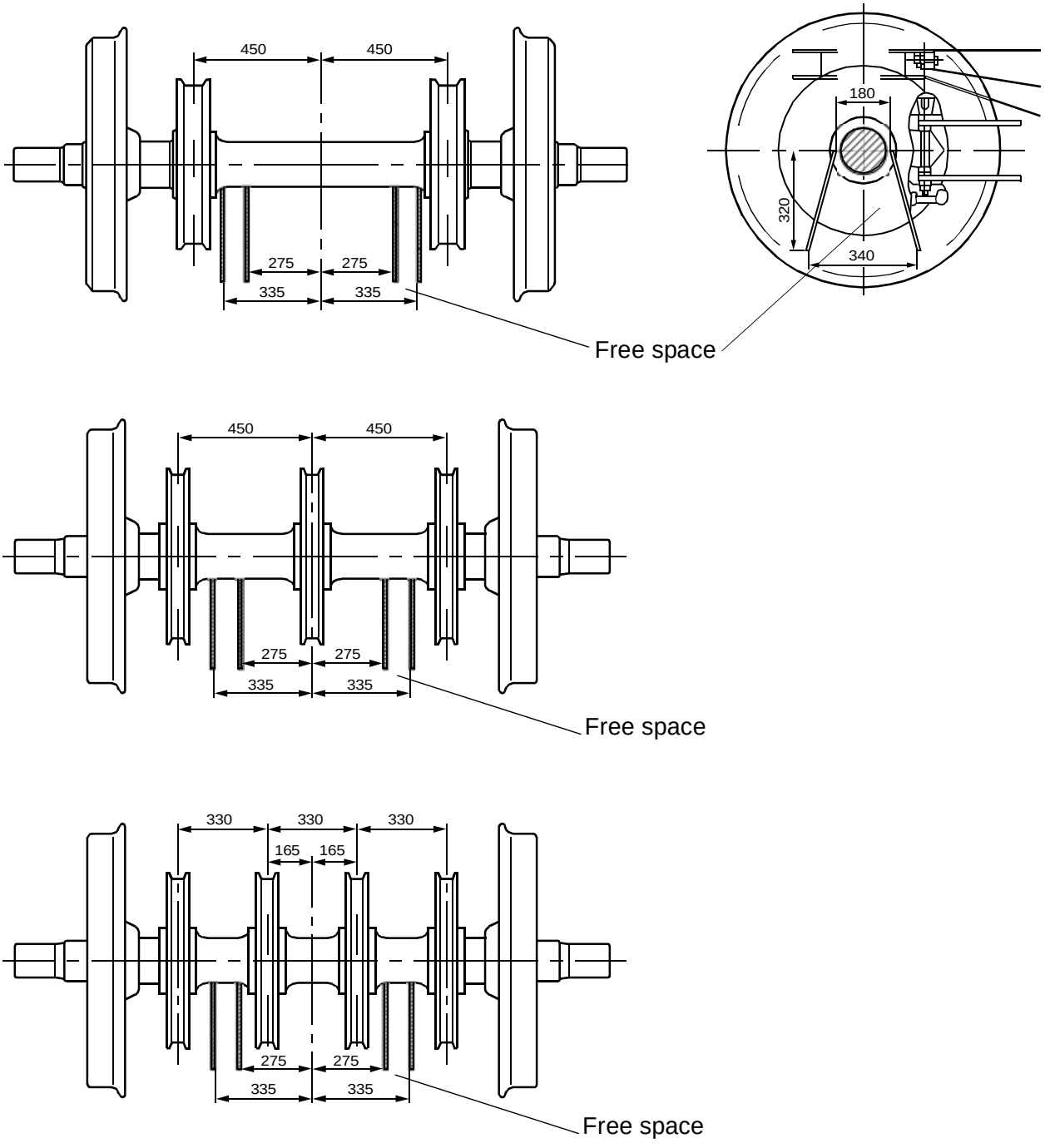


Fig. 1 - Free space on axles (with two, three or four brake discs)

Appendix B - Examples of solid wheels

B.1 - Example of 890 mm-diameter wheel

UIC/ERRI-Standard wheel profile as per *UIC Leaflet 510-2, Appendix B*.

- Solid wheel with rim-sprayed running tread of type R7 as per *UIC Leaflet 812-3*.
- Mass: approx. 307 kg.

Drawings are supplied by ERRI on request.

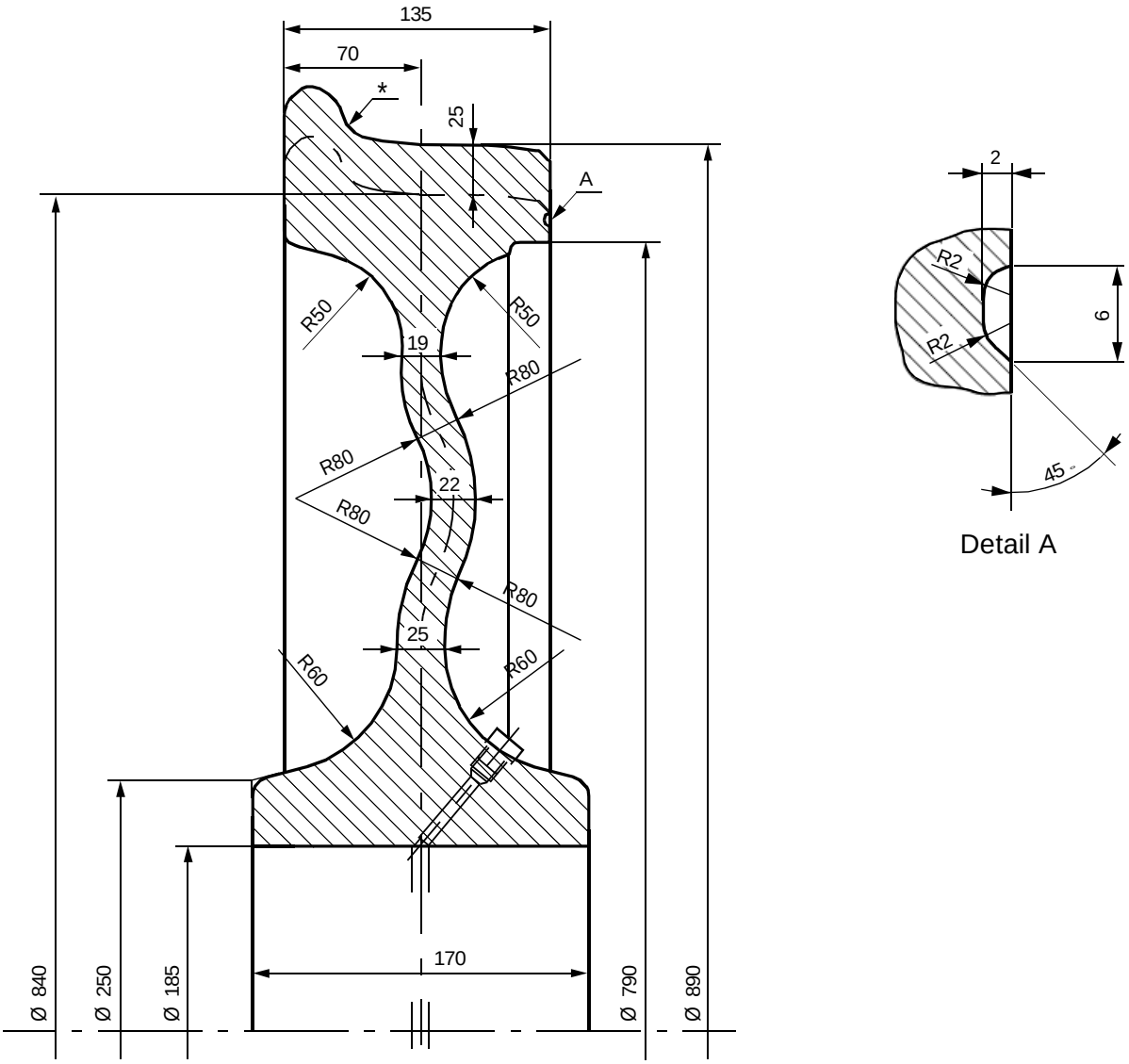


Fig. 2 - Example of 890 mm-diameter wheel

B.2 - Example of 920 mm-diameter wheel

UIC/ERRI-Standard wheel profile as per *UIC Leaflet 510-2, Appendix B*.

- Solid wheel with rim-sprayed running tread of type R7 as per *UIC Leaflet 812-3*.
- Mass: approx. 320 kg.

Drawings are supplied by ERRI on request.

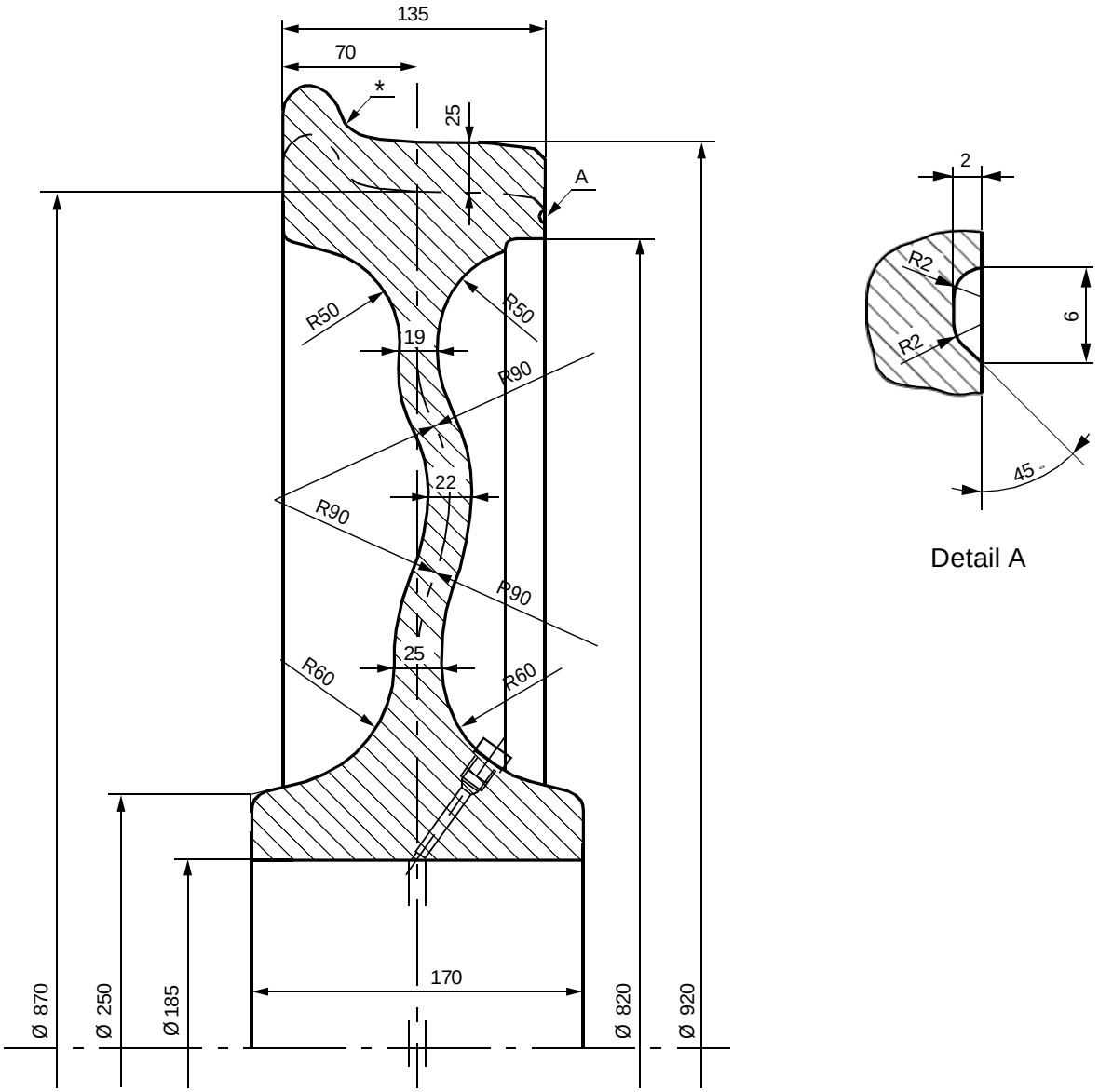
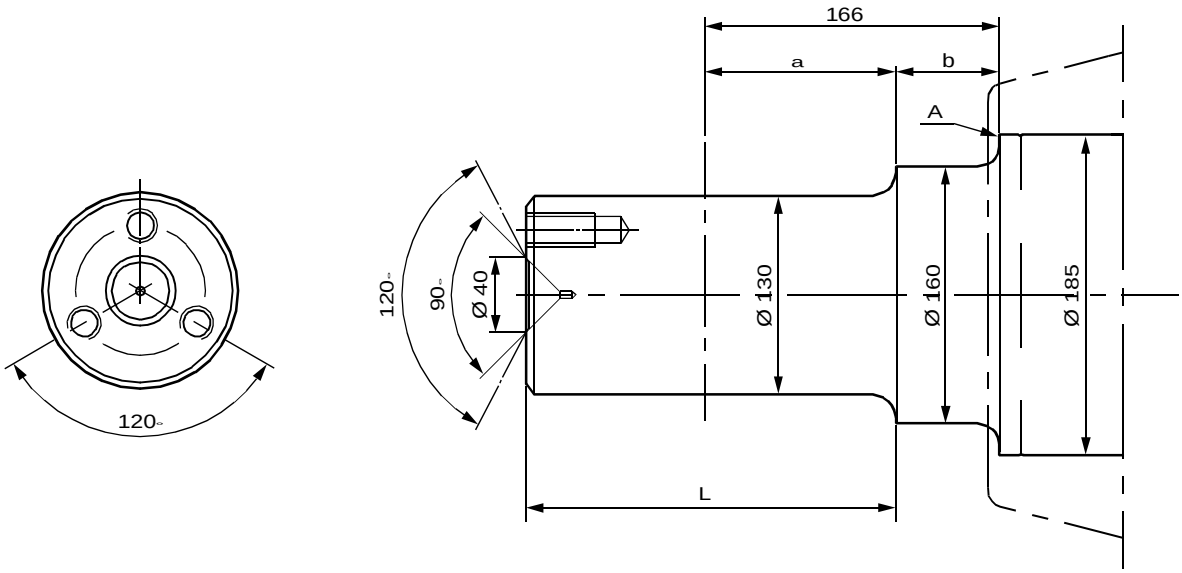


Fig. 3 - Example of 920 mm-diameter wheel

Appendix C - Example of journal designed for ≤ 200 km/h



	I	II
L	191	217
a	101	117
b	65	49

Fig. 4 - End view and side view

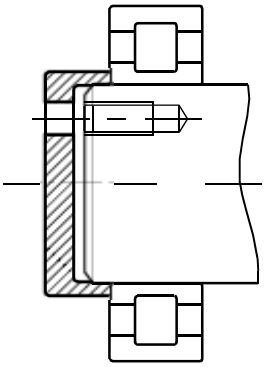
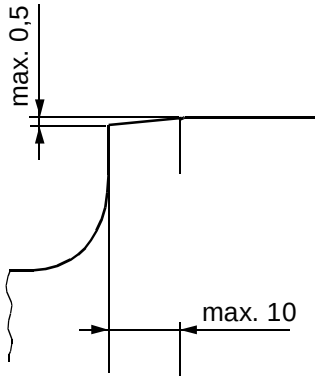


Fig. 5 - Locking device for roller bearings



The cone gate depicted in detail A must exist in the case of press-wedging of the wheels. It is not required when the wheels are hot-mounted.

Fig. 6 - Detail A

Appendix D - Visibility of passenger coach axle boxes to the hot box detector

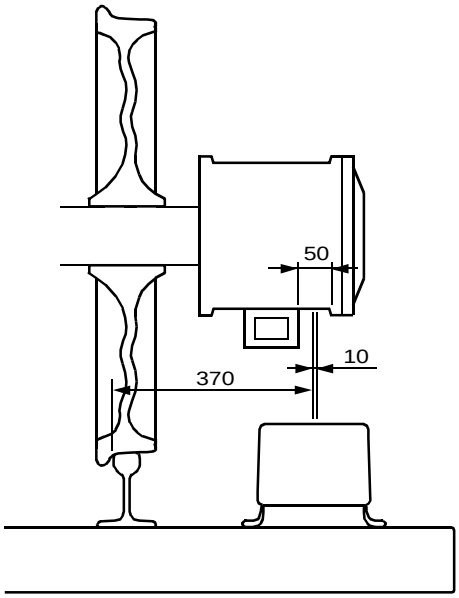


Fig. 7 - Visibility zone cross section

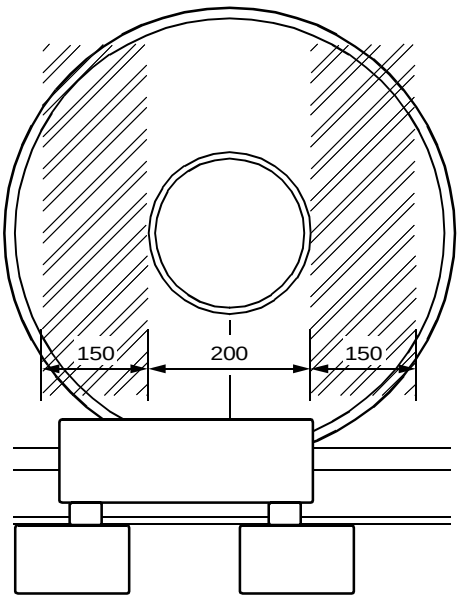


Fig. 8 - Visibility zone view

Bibliography

1. UIC leaflets

International Union of Railways
Leaflet 410: Composition and calculation of the weight and braking of passenger trains, 5th edition, August 2002

Leaflet 505-1: Railway transport stock - Rolling stock construction gauge, 9th edition under preparation

Leaflet 510-2: Trailing stock - Conditions concerning the use of wheels of various diameters with running gear of different types, 3th edition under preparation

Leaflet 512: Rolling stock - Conditions to be fulfilled in order to avoid difficulties in the operation of track circuits and treadles, 8th edition of 1.1.79 and 2 Amendments

Leaflet 515-3: Rolling stock - Bogies - Running gear - Axle design calculation method, 1st edition of 1.7.94

Leaflet 515-4: Passenger rolling stock - Trailer bogies - Running gear - Bogie frame structure strength tests, 1st edition of 1.1.93

Leaflet 515-5: Powered and trailing stock - Bogies - Running gear - Tests for axle-boxes, 1st edition of 1.7.94

Leaflet 541-05: Brakes - Regulations concerning the construction of the various brake components - Wheel slip prevention equipment, 1st edition of 1.1.85 and 8 Amendments

Leaflet 543: Brakes - Regulations governing the equipment of trailing stock, 11th edition, December 2001 (12th edition under preparation)

Leaflet 544-1: Brakes - Braking power, 3rd edition of 1.1.66 - Reprint dated 1.3.79 incorporating 9 Amendments

Leaflet 546: Brakes - High power brakes for passenger trains, 5th edition of 1.1.67 - Reprint dated 1.1.80 incorporating 5 Amendments

Leaflet 552: Electric power supply for trains - Standard technical characteristics of the train bus, 9th edition of 1.1.97

Leaflet 567-1: Standard X and Y coaches accepted for running on international services, 4th edition of 1.1.78 and 7 Amendments

Leaflet 812-3: Technical specification for the supply of solid wheels in rolled non-alloy steel for tractive and trailing stock, 5th edition of 1.1.84 with sulphur prints and 1 Amendment

Leaflet 813: Technical specification for the supply of wheelsets for tractive and trailing stock - Tolerances and assembly, 1st edition of 1.1.89

Leaflet 814: Technical specification for the official testing and supply of greases intended for the lubrication of railway vehicle roller bearing axle boxes, 2th edition of 1.7.88

2. Minutes of meetings

International Union of Railways
Traction and Rolling Stock Committee (Study 45/A/25 - Revision of leaflets. Item 25 - Approval of Leaflet No. 515-1 "General provisions applicable to the components of idle bogies"), May 1993

Technical and Research Commission (Item 7.07.202 - Expansion of point 2.1), May 2002

Warning

Printed by the International Union of Railways (UIC)
16, rue Jean Rey 75015 Paris - France, March 2003
Dépôt Légal March 2003

ISBN 2-7461-0499-7 (French version)
ISBN 2-7461-0500-4 (German version)
ISBN 2-7461-0501-2 (English version)