

UIC CODE

571-4

4th edition, October 2004

Translation

OR

Standard wagons - Wagons for combined transport - Characteristics

*Wagons unifiés - Wagons pour le trafic combiné - Caractéristiques
Einheitsgüterwagen - Güterwagen des kombinierten Verkehrs - Merkmale*



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

Leaflet to be classified in Volumes:

IV - Operating

V - Rolling stock

Application:

With effect from 1 October 2004

All members of the International Union of Railways

Record of updates

1st edition, January 1976	First issue
2nd edition, January 1991	Reprint including 14 Amendments
3rd edition, July 1997	Not issued
4th edition, October 2004	New lay-out, inclusion of the conclusions of C5 committee and SC09 sub-committee, renumbering of points and appendices.

Important: the points of this leaflet have been renumbered in the new edition. The first digit of each point has been increased by one (i.e. 0 becomes 1, 1 becomes 2 ...). Please take account of this when using cross-references from other leaflets.

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

Contents

Summary	1
1 - General.....	2
2 - Wagons for containers and swap bodies	4
2.1 - Common provisions	5
2.2 - Type 1 wagons - Short bogie wagons (Sgmmss/Sgkkmmss/Sgjkkmmss) designed for 20 t maximum axle-loads	6
2.3 - Type 2 wagons - Bogie wagons, 60' in length (Sgss/Sgjss) designed for 20 t maximum axle-loads.....	8
2.4 - Type 2a wagons - 60' bogie wagons (Sgnss) designed for 22,5 t maximum axle-loads	9
2.5 - Type 2b wagons - Bogie wagons over 60' in length (Sggmss) designed for 22,5 t maximum axle-loads.....	10
2.6 - Type 3 wagons - Bogie wagons intended to be used for traffic with Great Britain	10
2.7 - Type 4 wagons - Bogie wagons, 80' in length (Sggrss) designed for 20 t maximum axle-load.....	11
2.8 - Type 4a wagons - Articulated bogie wagons (Sggmrss) over 80' in length designed for 22,5 t maximum axle-loads	12
2.9 - Type 5 wagons - 2-axle wagons, 40' in length (Lgss).....	12
2.10 -Type 6 wagons - Bogie wagons (Sgmss) for the transport of large containers and swap bodies designed for 18 t maximum axle-loads	13
2.11 -Type 7 wagons - Light weight bogie wagons	15
3 - Wagons for combined rail-road transport	16
3.1 - Type 1 - "Recess wagons".....	17
3.2 - Type 2 wagons	22
3.3 - Type 3 wagons	22
3.4 - Type 4 wagons - Rolling road (RR)	22
4 - Wagons for conveyance of horizontally-transferred roller-units	27
4.1 - Joint arrangements	27
4.2 - Type 1 wagons	28

Appendix A - Disposition of spigots	34
Appendix B - Loading status	38
Appendix C - Wagons for combined transport - Spigots for ISO containers and swap bodies.....	41
Appendix D - Wagons for conveyance of rail-road traffic - Dimensional characteristics	45
Appendix E - Wagons for conveyance of rail-road traffic - Inner dimensions.....	47
Appendix F - Wagons for conveyance of rail-road traffic - Loading diagram	53
Appendix G - Wagons for conveyance of rail-road traffic - Scotch profiles	56
Appendix H - Wagons for conveyance of rail-road traffic - Position of securing devices and swap-body positioning options	58
Appendix I - Markings to be applied to the upper surface of the longitudinal girders of rail-road traffic wagons (one marking per girder).....	60
Appendix J - Rolling road wagons (RR) - Dimensional characteristics.....	62
Appendix K - Rolling road wagons (RR) - Size and dimensions	64
Appendix L - Rolling road wagons (RR) - Loading positions.....	66
Appendix M - Rolling road wagons (RR) - Fittings - Additional fittings.....	67
Appendix N - Type 4 - Rolling road wagons.....	70
Appendix O - Type 1 wagons for conveyance of horizontally-transferred roller-units	71
Appendix P - Type 1 wagons for conveyance of horizontally-transferred roller units - Calculation formula for safety against overturning.....	75
Appendix Q - Wagons for conveyance of horizontally-transferred roller units - Pictogram	83
Appendix R - Light weight bogie wagon - Propelling tests - Composition of the test train.....	85
Bibliography	86

Summary

This Leaflet specifies the characteristics of the standard wagons used for road-rail traffic. It is part of the question "Intermodal traffic transfer techniques - Technical conditions for the use of wagons and load units in international traffic".

It describes:

- wagons for the transport of containers and swap bodies,
- wagons for combined traffic, both Recess wagons and "Rolling Road" wagons,
- wagons for horizontally loaded roller units.

1 - General

1.1 - It is recommended:

- that the types of wagon referred in this leaflet as being standard be built in accordance with the sets of standard drawings managed by ERRI.

ERRI document DG4 (see Bibliography - page 86) contains general information on standard/partially standardised wagons, and on standard groups and components;

- that in order to improve aerodynamic efficiency, the solutions presented in *ERRI Report B12/RP54* (see Bibliography - page 86) be used, where these are economically viable.

- 1.2 - The interchangeable parts listed in *UIC Leaflet 570* (see Bibliography - page 86) shall be used for the construction of wagons for combined transport.

- 1.3 - The wagons shall be built:

- with or without devices to pass from one vehicle to another,
- with or without a screw brake,

in accordance with the conditions laid down in *UIC Leaflet 535-3* (see Bibliography - page 86).

From 1 January 1984, all new type 1a and type 1b "recess" wagons used in rail-road combined transport must be fitted with crossing facilities in accordance with the provisions of *UIC Leaflet 535-2, point 2-E, paragraph 5.4*, (see Bibliography - page 86).

- 1.4 - The maximum tare of the wagons listed in this leaflet shall be that of air-braked wagons incorporating:

- a screw brake which can be operated from the ground,
- crossing steps complying with the provisions of *UIC Leaflet 535-2*.

The minimum tare (not specified in this leaflet) results from application of the provisions laid down in *UIC Leaflet 530-2* (see Bibliography - page 86), irrespective of whether the wagon is fitted with a screw-brake.

- 1.5 - The wagons shall not incorporate crossing gangways, and the underframe length stipulated in this leaflet shall be the distance between the buffer-fixing planes.

After manufacture, the underframe length must have a positive tolerance in all cases (complying with the relevant national standard).

- 1.6 - Permanent additional equipment may only be fitted on the wagons with the approval of UIC, who shall decide whether the presence of such equipment alters the standard characteristics of the wagon. The submission to UIC shall be accompanied by:

- a detailed description, plus
- presentation of a prototype.

- **1.7** - It must be possible for loaded wagons to be lifted either end, at the headstock:
 - in the area under the side buffers on bogie wagons (except for Type 4 wagons, where it should be under the headstock support),
 - in an extension of the sole bars for 2-axle wagons.
- **1.8** - The following wagons must be suitable for SS-Traffic:
 - wagons in accordance with point **2 - page 4**,
 - wagons in accordance with point **3 - page 16** (except for type 4 wagons),
 - newly built wagons in accordance with point **4 - page 27** as from **1.1.2001**.
- **1.9** - On wagons suitable for the conveyance of large containers and/or swap bodies:
 - the securing systems for these loading units must incorporate standard spigots whose shape and manufacturing dimensions when new comply with the indications in point **C.1 - page 41** and the materials used must be of E260/450M quality;
 - the limits applicable for the lateral distance apart of the spigots, and the operational service limits for the spigots themselves, are given in point **C.2 - page 42**.

The height of the loading plane of the wagon when empty shall be indicated by using the symbol given in point **C.3 - page 43**.

Point **C.3** shows an assembly diagram with fold-back spigots which takes account of the limit specifications as per point **C.2**.

- **1.10** - Unless otherwise specified, wagons must be able to run over a maximum break angle of 1° 30' on a 120 m-radius curve on ferry lines.

1.11 - The play in the side bearers on wagons for intermodal transport shall be between $12^{\pm 2}_0$ mm and $6^{\pm 2}_0$ mm.

It is recommended that a value of $9^{\pm 2}_0$ mm should be used for new wagons for intermodal transport, which meet the safety curves in *UIC Leaflet 530-2, Appendix 3, Part 4*.

For old wagons for intermodal transport with a side bearer play of $12^{\pm 2}_0$ mm to $6^{\pm 2}_0$ mm attempts must be made to adjust the play to the recommended values for new wagons.

If the play is $6^{\pm 2}_0$ mm evidence must be produced that the safety conditions specified in *ERRI Report B55/RP8* (see **Bibliography - page 86**) are met when the wagon is carrying one or more empty or lightly loaded units.

1.12 - It is recommended that the last five digits of the wagon number are repeated on the upper surface of the wagon's outer solebars in order for the crane operators to identify the wagon more easily. This marking shall be made in accordance with the diagram in point **I.1 - page 60**.

2 - Wagons for containers and swap bodies

Wagons suitable for conveying large containers or swap bodies shall be of the following types: 1, 2, 2a, 2b, 4, 4a, 5, 6 and 7 suitable for running over lines to the continental loading gauge only, and type 3 suitable for running additionally over lines to the British loading gauge:

Type 1 - Short bogie wagons (Sgmmss, Sgkkmmss, Sgjjkmmss).

Short bogie wagons (with or without shock absorbers) are wagons with two, 2-axle bogies suitable for 20 t maximum axle-loads.

Type 2 - Bogie wagons 60' in length (Sgss/Sgjss).

Wagons fitted with two, 2-axle bogies suitable for 20 t maximum axle-loads.

This type of wagon has been standardised in its two versions (with or without shock absorbers).

Type 2a - 60' bogie wagons (Sgnss).

Bogie wagons are wagons with two, 2-axle bogies without long-stroke shock absorbers, for use only in block trains and suitable for 22,5 t maximum axle-loads.

Type 2b - Bogie wagons > 60' in length (Sggnss).

Wagons with two, 2-axle bogies without long-stroke shock absorbers, for use only in block trains and suitable for 22,5 t maximum axle-loads.

Type 3 - Bogie wagons, to British loading gauge.

Type 4 - Articulated bogie wagons, 80' in length (Sggrss).

Articulated wagons with three, 2-axle bogies, for use only in block trains and designed for 20 t maximum axle-loads. This type of wagon has been standardised.

Type 4a - Articulated bogie wagons > 80' in length (Sggmrss).

Articulated wagons with three, 2-axle bogies, for use only in block trains and designed for 22,5 t maximum axle-loads.

Type 5 - 2-axle wagons, 40' in length (Lgss).

Type 6 - Bogie wagons for the conveyance of large containers and swap bodies (Sgmss), suitable for 18 t axle-loads.

Type 7 - Bogie wagons with low tare weight.

Wagon units, which are basically designed to run in block trains.

o 2.1 - Common provisions

2.1.1 - The axle load of these wagons on rails must not exceed the following values under S and SS running conditions:

	Wheel diameters	S conditions	SS conditions
Bogie wagons	920 mm	22,5 t	20 t
Bogie wagons	840 mm ^a	18 t	17 t ^b
Bogie wagons	760 mm	16 t	16 t
2 axle wagons	920 mm	22,5 t ^c	20 t

a. Certain railways (SNCF, Network Rail) currently accept type-6 wagons running at 140 km/h with 14 t maximum axle-loads .

b. The value of 18 t is obtainable using appropriate braking equipment (discs).

c. Under the conditions defined in Leaflets 432, 510-2 and 700.

It is recommended that, when building new stock, only types 2a, 2b and 4a be selected.

2.1.2 - The wagons shall incorporate folding away or retractable devices to secure large containers and swap bodies through their lower corner fittings or intermediate parts, and to ensure the stability of empty large containers and swap bodies against the effect of side winds. Wagons of types 2a, 2b and 4b shall only be fitted with folding away devices.

The position of these devices (spigots) must be in accordance with Appendices A Fig. 1 - page 34 to Fig. 8 - page 36 respectively.

The length and maximum gross weight of containers and swap bodies conveyed using this system are shown in points B.1 - page 38, B.2 - page 39 and B.3 - page 40.

2.1.3 - Any wagon part forming an obstacle above the loading plane must fold down or be retractable, so that loading and unloading operations can be performed.

To allow opening of the end doors of containers loaded on the wagon, the height of the headstock and of components situated at the end of the underframe with reference to the loading plane must be as low as possible, and in any case lower than 40 mm except for type 6 wagons.

2.1.4 - The wagons must incorporate braking equipment which is self-adjusting in relation to the load on each bogie, so that they can be classified in the SS category with the axle-loads defined in point 2.1.1 - page 5.

2.1.5 - If the wagons are suitable for use as standard flat wagons they shall be provided on each side with 16 securing rings (types 1 to 4a) or 12 securing rings (type 5) fixed:

- to the underframe of wagons intended for block trains working,
- to the damped loading platform for wagons fitted with shock absorbers.

2.2 - Type 1 wagons - Short bogie wagons (Sgmmss/Sgkkmmss/Sgjjkkmmss) designed for 20 t maximum axle-loads

o 2.2.1 - Main dimensions

2.2.1.1 - Wagons without shock absorbers (Sgmmss/Sgkkmmss)

Length over buffers	15,790 m
Length of underframe	14,550 m
Minimum available length	14,500 m
Maximum height of loading plane above rail level	1,180 m
Distance between bogie pivots	10,750 m
Bogie-axle wheelbase	1,800 m
Wheel diameter	0,920 m or 0,760 m

2.2.1.2 - Wagons with shock absorbers (Sgjjkkmmss)

Length over buffers	16,940 m
Length of underframe	15,700 m
Minimum available length	14,600 m
Maximum height of loading plane above rail level	1,180 m
Distance between bogie pivots	11,300 m
Bogie-axle wheelbase	1,800 m
Wheel diameter	0,760 m

o 2.2.2 - Load characteristics

2.2.2.1 - Maximum tare

- Wagons without shock absorbers:
 - for a wheel diameter of 0,920 m: 18t
 - for a wheel diameter of 0,760 m: 16 t
- Wagons with shock absorbers: 18t

2.2.2.2 - Within the limits of their load carrying capacity, it shall be possible for loads to be distributed inside wagons in any way permitted by the position of the spigots (wagons with damping device - Appendix A, Fig. 1; wagons without damping device - Appendix A, Fig. 2 - page 34).

2.2.3 - Equipment

○ **2.2.3.1** - The wagons shall be built in one of the following versions:

- wagons without shock absorbers, intended for block trains working,
- wagons with shock absorbers, intended for working in ordinary trains.

○ **2.2.3.2** - Wagons equipped with shock absorbers shall not be fitted with facilities to pass from one vehicle to another.

2.2.3.3 - Wagons fitted with shock absorbers may include a crossing facility in their middle section.

○ **2.2.3.4** - Additional conditions applicable to wagons fitted with shock absorbers:

The maximum longitudinal displacement of the loading platform permitted by the long-stroke shock absorber must be 500 mm in both directions.

During impacts at speeds of up to 15 km/h the accelerations withstood by the load - the weight of which may be between one quarter and the totality of the maximum load C of the wagon - must not exceed the value of 2 g.

2.2.3.5 - It is recommended that the value of 2 g should also, if possible apply for a single 20' large container with gross weight of 7 t.

○ **2.2.3.6** - After each impact, the loading platform must return immediately to its central balancing position and the shock absorber must then have its full efficiency in the event of another impact.

Observance of these conditions must be checked by conducting the dynamic tests defined in *UIC Leaflet 529* (see [Bibliography - page 86](#)).

○ **2.2.4 - Operating conditions**

Irrespective of their load condition, individual wagons must be capable of running through curves in sidings which have a minimum radius of:

- 75 m (wagons without shock absorbers),
- 35 m (wagons with shock absorbers).

2.3 - Type 2 wagons - Bogie wagons, 60' in length (Sgss/Sgjss) designed for 20 t maximum axle-loads

o 2.3.1 - Main dimensions

2.3.1.1 - Wagons without shock absorbers (Sgss)

Length over buffers	19,640 m
Length of underframe	18,400 m
Minimum available length	18,400 m
Maximum height of loading plane above rail level	1,170 m
Distance between bogie pivots	14,600 m
Bogie wheelbase	1,800 m
Wheel diameter	0,920 m

2.3.1.2 - Wagons with shock absorbers (Sgjss)

Length over buffers	21,000 m
Length of underframe	19,760 m
Minimum available length	18,400 m
Maximum height of loading plane above rail level	1,180 m
Distance between bogie pivots	15,800 m
Bogie wheelbase	1,800 m
Wheel diameter	0,920 m

o 2.3.2 - Load characteristics

2.3.2.1 - Maximum tare:

- Wagons without shock absorbers: 18 t
- Wagons with shock absorbers: 23 t

2.3.2.2 - Within the limits of their load carrying capacity, it shall be possible for loads to be distributed inside wagons in any way permitted by the position of the spigots (Appendix A, Fig. 4 - page 34).

2.3.3 - Equipment

o 2.3.3.1 - The wagons shall be built in one of the following alternative versions:

- wagons without shock absorbers, intended for working in block trains,
- wagons with shock absorbers, intended for working in ordinary trains.

Wagons fitted with shock absorbers shall not be provided with crossing facilities.

○ **2.3.3.2 - Additional conditions applicable to wagons fitted with shock absorbers:**

The maximum longitudinal displacement of the loading platform permitted by long-stroke shock absorbers must be 600 mm in both directions.

During impacts at speeds of up to 15 km/h, the accelerations withstood by the load - the weight of which may be comprised between one quarter and the totality of the maximum load C of the wagon - must not exceed the value of 2 g.

2.3.3.3 - It is recommended that this value of 2 g be also, if possible, complied with for a single 20' large container with a gross weight of 7 t.

○ **2.3.3.4 -** After each impact, the loading platform must immediately return to its central balancing position and the shock absorber must then have its full efficiency in the event of another impact.

Observance of these conditions must be checked by conducting the dynamic tests defined in *UIC Leaflet 529*.

○ **2.3.4 - Operating conditions**

Irrespective of their load condition, individual wagons must be capable of running through curves in sidings which have a minimum radius of 75 m.

2.4 - Type 2a wagons - 60' bogie wagons (Sgnss) designed for 22,5 t maximum axle-loads

○ **2.4.1 - Main dimensions**

Length over buffers	max. 19,830 m
Length of underframe	max. 18,500 m
Minimum available length	18,400 m
Maximum height of the loading plane above rail level	1,155 m
Distance between bogie pivots	14,200 m
Bogie wheelbase	1,800 m
Wheel diameter	0,920 m

○ **2.4.2 - Load characteristics**

2.4.2.1 - Maximum tare: 20 t.

2.4.2.2 - Within the limits of their load carrying capacity, it shall be possible for loads to be distributed inside wagons in any way permitted by the position of the spigots (Appendix A, Fig. 5 - page 35).

2.4.3 - Equipment

It is recommended that crossing facilities be provided in the middle section of these wagons.

The wagons shall be built without long-stroke shock absorbers and designed for block-train working.

o 2.4.4 - Operating conditions

Irrespective of their load condition, individual wagons must be capable of running through curves in sidings that have a minimum radius of 75 m.

2.5 - Type 2b wagons - Bogie wagons over 60' in length (Sggnss) designed for 22,5 t maximum axle-loads

o 2.5.1 - Main dimensions

Length over buffers	21,780 m
Length of underframe	20,540 m
Minimum available length	20,520 m
Maximum height of the loading plane above rail level	1,110 m
Distance between bogie pivots	15,800 m
Bogie wheelbase	1,800 m
Wheel diameter	0,920 m

o 2.5.2 - Load characteristics

2.5.2.1 - Maximum tare: 21,5 t

2.5.2.2 - Within the limits of their load carrying capacity, it shall be possible for loads to be distributed inside wagons in any way permitted by the position of the spigots (Appendix A, Fig. 6 - page 35).

2.5.3 - Equipment

Wagons shall be built without long-stroke shock absorbers and designed for block-train working.

o 2.5.4 - Operating conditions

Irrespective of their load condition, individual wagons must be able of running through curves in sidings that have a minimum radius of 75 m.

2.6 - Type 3 wagons - Bogie wagons intended to be used for traffic with Great Britain

(Reserved).

o **2.7 - Type 4 wagons - Bogie wagons, 80' in length (Sggrss) designed for 20 t maximum axle-load**

2.7.1 - Main dimensions

Length over buffers	27,100 m
Length of underframes	25,800 m
Minimum available length	12,270 m
Maximum height of the loading plane above rail level	1,170 m
Distance between bogie pivots	10,700 m
Bogie wheelbase	1,800 m
Wheel diameter	0,920 m

2.7.2 - Load characteristics

2.7.2.1 - Maximum tare: 27 t

2.7.2.2 - Within th limits of their load carrying capacity, it shall be possible for loads to be distributed inside wagons in any way permitted by the position of the spigots (Appendix A, Fig. 7 - page 36).

2.7.3 - Equipment

All wagons of this type shall be equipped, in their middle section, with a crossing facility, as per the provisions of *UIC Leaflet 535-2, point 2-E*.

2.7.4 - Operating conditions

Irrespective of their load condition, individual wagons must be capable of running through curves in sidings that have a minimum radius of 75 m.

o 2.8 - Type 4a wagons - Articulated bogie wagons (Sggmrss) over 80' in length designed for 22,5 t maximum axle-loads

2.8.1 - Main dimensions

Length over buffers	33,940 m
Length of underframes	32,700 m
Minimum available length	16,100 m
Maximum height of the loading plane above rail level	1,155 m
Distance between bogie pivots	14,200 m
Bogie wheelbase	1,800 m
Wheel diameter	0,920 m

2.8.2 - Load characteristics

2.8.2.1 - Maximum tare: 31 t

2.8.2.2 - Within the limits of their load carrying capacity, it shall be possible for loads to be distributed inside wagons in any way permitted by the position of the spigots (see Appendix A, Fig. 8 - page 36).

2.8.3 - Equipment

All wagons of this type shall be equipped, in their middle section, with a crossing facility as per the provisions of *UIC Leaflet 535-2, point 2-E*.

2.8.4 - Operating conditions

Irrespective of their load condition, individual wagons must be capable of running through curves in sidings that have a minimum radius of 75 m.

2.9 - Type 5 wagons - 2-axle wagons, 40' in length (Lgss)

o 2.9.1 - Main dimensions

Length over buffers	13,860 m
Length of underframe	12,620 m
Minimum available length	12,520 m
Maximum height of the loading plane above rail level	1,180 m
Wheelbase	9,000 m
Wheel diameter	0,920 m

o 2.9.2 - Load characteristics

2.9.2.1 - Maximum tare: 12 t

2.9.2.2 - Within the limits of their load carrying capacity, it must be possible for loads to be distributed inside wagons in any way permitted by the position of the spigots (see Appendix A, Fig. 3 - page 34).

2.9.3 - Equipment

These wagons are not equipped with long-stroke shock absorbers and are only suitable for running in block-train formations.

2.10 - Type 6 wagons - Bogie wagons (Sgmss) for the transport of large containers and swap bodies designed for 18 t maximum axle-loads

2.10.1 - Main dimensions

Length over buffers	19,340 m
Length of underframe	18,100 m
Minimum available length	15,780 m
Maximum height of loading plane above rail level	0,945 m
Distance between bogie pivots	13,500 m
Bogie wheelbase	2,000 m
Wheel diameter	0,840 m
Maximum side-bearer play	0,014 m

2.10.2 - Load characteristics

2.10.2.1 - Maximum tare: 18,5 t

2.10.2.2 - Within the limits of their load carrying capacity, it must be possible for loads to be distributed inside wagons in any way permitted by the position of the spigots (see Appendix A, Fig. 9 - page 37).

The positioning of the spigots allows a maximum usable length of 15,700 m for swap bodies.

2.10.2.3 - Available wagon cross section within the GA gauge, and the Network Rail W6A and SB1 gauges.

The maximum dimensions of containers or swap bodies that can fit into these gauges shall be as follows:

	Width (mm)		Height (mm)
	Container	Swap	
GA kinematic gauge (<i>UIC Leaflet 506</i> (see Bibliography - page 86))	2 438 (8')	2 500	2 969
	2 500		2 969 (C49) ^a
	2 590 (8'6")		2 899 (9'6")
		2 600	2 888 (C373)
W6A gauge (Network Rail)	2 438 (8')	2 500	2 488
	2 500		2 453 ^b
SB1 gauge (Network Rail) ^c	2 438 (8')	2 500	2 770 ^d
	2 500		2 770 ^d
		2 600	2 750 ^d

a. Coding of swap bodies as per Leaflet 596-6.

b. On some Network Rail Freightliner routes cleared for 8'6" containers (W6A gauge), the maximum height may attain 2 675 mm.

c. For some Network Rail routes that allow running of wagons worked through the Channel Tunnel.

d. Subject to subsequent testing.

2.10.3 - Equipment

These wagon are not fitted with long-stroke shock absorbers and are only suitable for working in block trains.

2.10.4 - Operating conditions

Irrespective of their load condition, the wagons must be capable of running through curves in sidings which have a minimum radius of 75 m.

NB : Additional rules for the curve radius on Network Rail lines are set out in *UIC Leaflet 503*.

With respect to the angle of attack on ferry tracks, attention is drawn to the special conditions set out in *UIC Leaflet 503* (see Bibliography - page 86).

2.11 - Type 7 wagons - Light weight bogie wagons

These wagon units comply with the requirements of *UIC Leaflet 572* (see Bibliography - page 86). They consist of two end units which can run coupled together or may have one or more intermediate vehicles between them.

2.11.1 - Load characteristics

2.11.1.1 - The tare weight of the vehicles must be less than 16 t.

2.11.1.2 - Within the limits of their load carrying capacity the wagons must allow any distribution of the load which the loading arrangement allows (reserved).

2.11.2 - Equipment

These freight wagons are built without longitudinal dampers. They can be used for distribution traffic and withstand the normal buffing impacts in service. To protect the load the wagon shall be marked in the loaded condition in accordance with the current regulations.

2.11.3 - Service conditions

Conditions which the wagons must comply with in order to be allowed to run freely in international traffic.

Three series of tests must be carried out:

- Propelling tests, as per *UIC Leaflet 530-2*,
- Running tests on twisted track (*ERRI Report B55/RP8* (see Bibliography - page 86)),
- Tests on the dynamic behaviour, as specified in *UIC Leaflet 518* (see Bibliography - page 86).

Propelling tests

In order to allow these wagons to be propelled, propelling tests shall be carried out for the following 3 cases:

- Use of wagons in complete trains,
- Use of wagons in conventional trains,
- Use of wagons in combined transport trains.

The test train shall be formed as specified in Appendix R - page 85.

3 - Wagons for combined rail-road transport

The following types of wagon are suitable for the conveyance of road vehicles in combined transport:

Type 1 Fixed-recess wagons for the conveyance of semi-trailers and swap bodies that can be grab-lifted, as well as large containers when appropriate; these wagons are called "Recess wagons".

"Recess wagons" are vehicles with two, 2-axle bogies.

They exist in the following versions^a:

Type 1a Wagons suitable for 16 t on-rail axle load;

Type 1b Wagons suitable for 22,5 t on-rail axle load;

Type 2 Reserved;

Type 3 Reserved;

Type 4 Bogie wagons with a low loading surface along their full length, for conveyance of road tractor + semi-trailer combinations and road trains (tractors + trailers).

They exist in the following versions:

Type 4a: Articulated bogie wagons for conveyance of road vehicles, mainly in transit through the Alps - RR_{alpine} (Saadkms).

These are multiple-unit two-part bogie wagons fitted with three, 4-axle bogies.

Type 4b: Bogie wagons for conveyance of road vehicles on lines with a large loading gauge in flat regions RR_{flat land} (Saadkms).

These wagons are each fitted with two, 4-axle bogies.

a. However, wagons with capacities in excess of these variants may be constructed. They must however meet the following requirements:

- They must be suitable for the transport of semi-trailers the characteristics of which are set out in UIC Leaflet 596-5 (they must be eligible for compatibility codes P and N and therefore comply with the dimensions given in this leaflet under points E.1 to E.4).
- They must have a base plate adjustable to two or three levels. One of the values for the height of the base plate contact plane above the contact surface of the recess must be 1 130 mm. The other measurements must be 980 mm or 850 mm. For ease of recognition, they must be systematically labelled 98 cm or 85 cm.
- They must be suitable for loading and transporting high capacity semi-trailers, as defined in point 3 of UIC Leaflet 596-5, and therefore comply with the dimensions given in Appendices E.5 and E.6 of this leaflet, and be labelled with the markings specified in Appendix 6 to UIC Leaflet 596-5.

These wagons are not fitted with shock absorbers and are designed for block-train working.

As an exemption from the provisions of *UIC Leaflet 530-1, point 2.1.1* (see Bibliography - page 86), these wagons may be designed to withstand a compressive force of:

- 1 200 kN along the automatic-coupler centre-line;
- 600 kN on each side buffer.

3.1 - Type 1 - "Recess wagons"

o 3.1.1 - Main dimensions

3.1.1.1 - Type 1a wagon

The dimensional characteristics of this wagon shall be as follows (see point D.1 - page 45):

Length over buffers	16,440 m
Length of underframe	15,200 m
Maximum height above rail level:	
- of top of solebars close to the bogie pivot	1,135 m
- of the semi-trailer loading plane	see point E.1
- of the loading plane of the securing brackets for swap bodies and large containers close to the bogie pivots	1,175 m
Distance between bogie pivots	11,200 m
Bogie wheelbase	1,800 m
Maximum wheel diameter	0,760 m ^a

a. The wear range to be taken into consideration must allow for the available loading gauge in the lower parts.

The inner longitudinal profile of the wagon shall lie within the envelope specified in point E.1 - page 47.

3.1.1.2 - Type 1b wagon

The dimensional characteristics of the wagon shall be as follows (see point D.2 - page 46):

Length over buffers	18,340 m
Length of underframe	17,100 m
Maximum height above rail level:	
- of top of solebars close to the bogie pivot	1,135 m
- of the semi-trailer loading plane	see point E.2
- of the loading plane of the securing brackets for swap bodies and large containers close to the bogie pivots	1,175 m
Distance between bogie pivots	13,300 m
Bogie wheelbase	1,800 m
Maximum wheel diameter	0,930 m ^a

a. The wear range to be taken into consideration must allow for the available loading gauge in the lower parts.

The inner longitudinal profile of the wagon shall lie within the envelope specified in point E.2 - page 48.

O 3.1.2 - Load characteristics

3.1.2.1 - Type 1a wagons

Maximum tare 16,5 t.

The load limit of wagons for all categories of line for the conveyance of:

- 3-axle semi-trailers under S running conditions shall be	37 t
- 3-axle semi-trailers under SS running conditions shall be	35 t
- 2-axle semi-trailers under S and SS running conditions shall be	35 t
- swap bodies under S running conditions shall be	44 t
- swap bodies under SS running conditions shall be	35 t
- large containers under S running conditions shall be	44 t
- large containers under SS running shall be	35 t

Within its loading capacity limit, the wagon must be able to carry the following:

1. one road semi-trailer complying with the specifications in *UIC Leaflet 596-5* (see [Bibliography - page 86](#)), which means the recess in the wagon must be able to support a maximum load of:
 - 13 t for a one-axle semi-trailer,
 - 23 t for a two-axle semi-trailer,
 - 25,2 t for a three-axle semi-trailer
 and the bolster a maximum load of 16 t.
2. one or more swap bodies complying with the specifications in *UIC Leaflet 592-4* (see [Bibliography - page 86](#)), and fulfilling the weight and loading conditions stipulated in point [F.1 - page 53](#);
3. one or more large containers in category 20, or one large container in category 30 or 40, with the maximum weights stipulated in point [F.1](#).

3.1.2.2 - Type 1b wagons

Maximum tare 20 t.

The load limit of wagons for all categories of line for the conveyance of:

- 3-axle semi-trailers under SS running conditions shall be	38,5 t
- 2-axle semi-trailers under SS running conditions shall be	36 t
- 2-axle and 3-axle semi-trailers under SS running conditions shall be	38,5 t
- swap bodies under S conditions shall be	67 t
- swap bodies under SS conditions shall be	57 t

- large containers under S conditions shall be 67 t
- large containers under SS conditions shall be 57 t

Within its load carrying capacity, any such wagon must be capable of carrying the following:

1. one road semi-trailer complying with the specifications in *UIC Leaflet 596-5*, which means the recess in the wagon must be able to support a maximum load of:
 - 13 t for a one-axle semi-trailer,
 - 23 t for a two-axle semi-trailer,
 - 27 t for a three-axle semi-trailer
 and the bolster a maximum load of 16 t;
2. one or more swap bodies complying with the specifications in *UIC Leaflet 592-4*, and fulfilling the weight and loading positions stipulated in point **F.2 - page 54**;
3. one or more large containers in category 20 or one large container in categories 30 or 40, with the maximum weights given in point **F.2**.

o 3.1.3 - Equipment

3.1.3.1 - When semi-trailers are loaded on Type 1a wagons, insertion of the tyres into the recess must be facilitated by two guides located on either side of the recess at a set distance from the longitudinal centre line. The semi-trailer must be accurately centred in the lateral direction using two suitably shaped plates (centering plate), fitted in each of the 4 corners of the recess, and on the front of the fixed scotches of the middle crossbeam of the recess, to control the tyres at the end of their descent and centre them with an accuracy of ± 10 mm (see point **G.1 - page 56**) in relation to the wagon centre-line.

To allow centering of long semi-trailers with short three axle units (maximum wheelbase 1 150 mm) on Type 1a wagons, the back of the scotch for the middle crossbeam (as seen from the semi-trailer loading end) should be of a design with two superimposed parts with roughly parallel profiles (see points **E.1 - page 47** and **G.1**).

The same centering conditions shall be observed on Type 1b wagons, using appropriate devices (see point **G.2 - page 57**).

At the front, the knuckle pin shall fit into the groove in the bolster provided for this purpose which, because of its tapered shape, shall automatically centre it accurately in the lateral direction with a centering accuracy of ± 8 mm in relation to the wagon centre-line.

The bolster must be fitted with a simple device that locks the knuckle pin in the groove automatically and can be unlocked by hand.

The bolster must be designed to move lengthwise along guide rails (see point E.1 - page 47 for Type 1a wagons and point E.2 - page 48 for Type 7b wagons); the bolster bearing plate must be able to tilt around a horizontal axis, to adjust it to the angle at which the semi-trailer is inclined in the longitudinal direction. It must be possible to fasten the bolster at the end of the wagon to allow the transport of swap bodies and large containers.

NB : It must be possible for one man to operate these devices from the ground under any weather conditions.

The semi-trailer shall be secured longitudinally in both directions by any two of the following devices: crossbeams - fixed scotches - removable scotches. These shall be fixed in the recess, and be wedged against the tyres.

NB : The scotches shall be shaped so as to absorb the longitudinal stresses that may occur during transit.

3.1.3.2 - Swap bodies and large containers shall be fixed on the wagon by means of bearing brackets that can be moved and folded down, on which the spigots are mounted. The shape of the spigot heads must be as shown in Appendix C - page 41.

To limit vertical oscillations of swap bodies, the wagons shall be fitted with additional brackets between the bearing brackets to support these bodies in the area of their main longitudinal beams.

The working face of these brackets must be situated at the same level or a few millimetres below the level of the loading plane, stipulated to be at 1 175 mm perpendicularly to the bogie pivots.

The position of the spigots and brackets is given in point H.1 - page 58 for Type 1a wagons and point H.2 - page 59 for Type 1b wagons.

3.1.3.3 - All new wagons built from 1 January 1984 must be fitted with crossing facilities as per the provisions of *UIC Leaflet 535-2, point 2-E, paragraph 5.4*.

○ 3.1.4 - Operating conditions

3.1.4.1 - The wagons can only be loaded or unloaded vertically using gantries or other lifting appliances.

3.1.4.2 - Type 1a wagons

The wagon must be able to run unrestrictedly:

- under S running conditions, with a 60,5 t maximum on-rail gross weight; the axle-loads of the heaviest loaded bogie shall not exceed 16 t;
- under SS running conditions, with a 51,5 t maximum on-rail gross weight; the axle-loads of the heaviest loaded bogie shall not exceed 15 t.

3.1.4.3 - Type 1b wagons

Type 1b wagons may be allocated compatibility code $\triangle P$ or $\triangle C$ in accordance with *UIC Leaflet 596-6, point 2.3.2, Table 1 (see Bibliography - page 86)*.

The wagon must be able to run unrestrictedly under SS running conditions, with an 80 t maximum on-rail gross weight; the axle-loads of the heaviest loaded bogie shall not exceed 20 t.

3.1.4.4 - The wagon must be able to run without difficulty, whether empty or loaded and irrespective of the load:

- when coupled, over gravity humps profiled as per Appendix to *UIC Leaflet 522* (see Bibliography - page 86);
- individually through 75 m-radius curves in sidings, without any component needing to be dismantled.

3.1.5 - Additional arrangements for the conveyance of special semi-trailers in accordance with option 1 as defined in *UIC Leaflet 596-5, point 2.1*.

3.1.5.1 - Type 1a or 1b wagons above can be adapted for the conveyance of semi-trailers as per *UIC Leaflet 596-5, point 2.1*. In this case the rear part of the semi-trailer shall rest inside the wagon recess with the suspension deflated, and its front part shall rest, through supporting plates, on plates fixed to the wagon and incorporating UIC-type spigots.

3.1.5.2 - The plates used for securing the front part of semi-trailers shall be as strong as the supporting plates of spigots used for containers.

3.1.5.3 - Type 1a wagon

3.1.5.3.1 - The wagon must be fitted with plates incorporating UIC-type spigots, and stay within the inner dimensions given in point **E.3 - page 49**. It must no longer incorporate a bolster.

3.1.5.3.2 - The wagon, when modified as specified above to convey special semi-trailers in accordance with option 1, shall no longer carry compatibility code $\triangle P$ but shall receive instead compatibility code $\triangle N$ as per *UIC Leaflet 596-6, point 2.3.2, table 1*.

○ 3.1.5.4 - Type 1b wagon

3.1.5.4.1 - The wagon must be fitted with plates incorporating UIC-type spigots and stay within the inner dimensions given in point **E.4 - page 50**. If the presence of the bolster on the wagon is compatible with observance of these dimensions, the wagon can keep its bolster.

3.1.5.4.2 - The wagon, modified as specified above to convey special semi-trailers in accordance with option 1, must receive compatibility code $\triangle N$ as per *UIC Leaflet 596-6, point 2.3.2, table 1*. If the wagon is also fitted with a bolster, it must then receive compatibility code $\triangle P$ as per *UIC Leaflet 596-6, point 2.3.2, table 1*.

3.2 - Type 2 wagons

To be completed later.

3.3 - Type 3 wagons

To be completed later.

3.4 - Type 4 wagons - Rolling road (RR)

o 3.4.1 - Main dimensions

	Type 4a (Saadkms) RR _{Alpine}	Type 4b RR _{flat land}
	common characteristics	
	J.1	J.2
Cf. Appendix J - page 62 also		
Max. length over buffers (with headstocks in place)	20,400 m	
Length of underframe	18,350 m	
Length of load	18,800 m (in exceptional cases up to 19,000 m)	
Length between couplers	19,090 m	
Max. height of loading surface above rail level (see Appendix N - page 70)		
- above the hatches in the area of to the bogies	0,454 m ^a	0,600 m ^a
- elsewhere	0,414 m ^b	0,600 m ^b
Height of upper surface of soledar above rail level around the bogie pivots of the wagon when empty	1,060 m	1,106 m
Distance between bogie pivots	2 x 6,850 m	13,700 m
Width of load (perpendicularly to the tyres)		
- for existing road vehicles	2,520 m	
- transformable, if need be, to	2,620 m ^c	
Nominal value of the height of the coupler centre-line above rail level (empty wagon)	0,316 ^{+0,005} m	

a. For a load of at least 13 t (road train, tractor + semi-trailer combination).

b. For a load of at least 6 t (semi-trailer).

c. Loading widths can be extended by removing the side centring rods which should not be taken into consideration when calculating solebar strength.

o 3.4.2 - Running gear - Special design

	Type 4a (Saadkms)	Type 4b
	RR_{Alpine}	$RR_{\text{flat land}}$
	common characteristics	
Axle wheelbase in bogie, minimum:	0,700 m	0,900 m
Type of axles	monobloc wheels with side braking surfaces	
Max. weight per axle	7,50 t	9,75 t
Lateral play "q + w"	0,005 m	
Side bearer play "J"	0,007 m	
Wheel diameter:		
- minimum	0,335 m	0,410 m
- maximum	Depending on bogie and frame design, taking account of mandatory unification characteristics.	
Primary axle suspension:	Approx. 10 % of complete spring stroke.	
Wear components:	Visual inspection of all wear-exposed bogie parts that affect running safety should be possible without the need for an inspection pit at the side of the wagon and with the hatches open above the wheels.	
Running characteristics:	Wagons must comply with the running stability conditions laid down in <i>UIC Leaflet 432 and 510</i> (see <i>Bibliography - page 86</i>).	
Distribution of wheel loads:	The vertical suspension and superstructure support must be designed to ensure even wheel-load distribution, whatever the deformation in the wagon underframe.	

o 3.4.3 - Load characteristics

	Type 4a (Saadkms) RR _{Alpine}	Type 4b RR _{flat land}
common characteristics		
Max. tare (without headstocks)	21 t	20,5 t
Loading capacity of wagon unit or wagons under S conditions	44 t HGV: +10 % for HGV excess load due to axle position and current road-vehicle axle-loads and loading arrangements as per Appendix L - page 66.	
Wagon strength - including that of the grids in the running channels (support beam for semi-trailers) - must be suitable for the following loads, taking account of the dynamic component:	Three axle unit (3 x 9 + 10 %)	max. 30 t
	Double axle unit (2 x 11,5 t + 10 %)	max. 26 t
	Vertical loading of semi-trailer on tractor	max. 17 t
	Single axle (special tractor)	max. 20 t

o 3.4.4 - Operating conditions

Wagons should be designed for horizontal loading and unloading over end-loading platforms, with the headstocks open:

- of tractor and semi-trailer combinations and road trains, loaded forwards,
- semi-trailers (using the support beam and a special tractor), loaded backwards.

Road vehicles for loading on wagons must comply with the maximum lower dimensions shown in point K.2 - page 65 and adopt the loading position shown in Appendix L - page 66; lateral loading tolerances must not exceed ± 50 mm.

Whatever their load condition, wagons must be able to run:

- through curves with 150 m minimum radius, when coupled together,
- through curves with 80 m minimum radius, when separate, with coupling rod,
- over a ferry transition angle of at least 1°.

The lower part of these wagons should at least comply with the vehicle gauge stipulated in *UIC Leaflet 505-1* (see *Bibliography - page 86*).

Whatever the load condition, coupling and uncoupling should be possible in curves with a ≥ 500 m radius.

RR_{Alpine} and RR_{flat land} wagons should be able to be coupled via the headstock (including brakes) with any vehicle incorporating standard buffing and draw gear.

The bearing surface of the grids opening downwards and of the running channels in the underframe should be as large as possible from a constructional viewpoint to allow for winter conditions (snow).

The maximum dimensions of the central longitudinal grooves in the underframe between the running channels are shown in point [K.1 - page 64](#).

These values should be reduced to a minimum wherever possible.

For the safety of road vehicle staff, it is necessary:

- to take suitable steps to ensure that the tops of the side sills in the boarding/alighting zone have an anti-slip surface,
- to offer the possibility of boarding/alighting (anti-slip beam acting as step) adjacent to the driver's cab on the driver's side, and
- to provide for the possibility of passing through this section of the wagon by means of suitable anti-slip devices on the wagon floor.

O 3.4.5 - Brakes

GP-A brakes with braking automatically load-adjusted, for each part of the running gear.

There must be the guarantee that all brake components exposed to wear (brake pads) can be replaced and that major brake parts can be accessed, without the need for an inspection pit, simply through hatches and openings in the loading surface.

It must be possible to detect the pressure in the load-sensitive valve and brake cylinders from one side of the wagon.

The maximum braked weight should be:

- for RR_{Alpine} 61 t,
- for RR_{flat land} 52 t.

3.4.6 - Equipment/additional equipment

1. Headstocks:

Handling characteristics and the main connection dimensions are shown in point [M.1 - page 67](#).

2. Bearing plates for semi-trailer conveyance:

The characteristics and mandatory connection dimensions are shown in point [M.2 - page 68](#).

3. Wheel scotches:

For each wagon, 8 wheel scotches of the type shown in point **M.3 - page 69**, shall rest externally on the wagon solebars (underframe grids should be designed to allow for this).

4. Buffing and draw gear:

Wagons shall be coupled together by means of a short, lowered coupler. There is no need to make provision for coupling one type of RR wagon with the other.

For buffing gear, use should be made of buffers without buffer plates, placed diagonally at either end of the wagon except in the case of central-buffer couplers (for buffer contact dimensions see points **J.1 - page 62** and **J.2 - page 63**).

For RR_{flat land} wagons, the drawgear dimensions given in Appendix **N - page 70** are mandatory, in derogation from the provisions of *UIC Leaflet 520*.

For RR_{Alpine} wagons, the drawgear for short couplers and headstocks shall withstand higher hauled loads - yield strength 700 kN. It should be possible to subsequently fit normal drawgear, in which case appendix **N** shall also apply.

NB : Housings shall be provided for the headstocks at both wagon ends.

4 - Wagons for conveyance of horizontally-transferred roller-units

Wagons for the conveyance of horizontally-transferred roller-units fall into the following categories:

- Type 1 Wagons with two, 2-axle bogies (Scsns or Scsnss), fitted-out for the conveyance of horizontally-transferred roller units as per *UIC Leaflet 591* (see [Bibliography - page 86](#)), suitable for 22,5 t axle loads.
- Type 2 (Reserved)

o 4.1 - Joint arrangements

4.1.1 - The axle-load of these wagons may not exceed the following values under S and SS conditions:

	Wheel diameter	S condition	SS condition
Bogie wagons	920 mm	22,5 t	22,5 t

4.1.2 - Any wagon part likely to obstruct loading/unloading above the loading plane must be of the retractable or lowerable type.

4.1.3 - Braking equipment

4.1.3.1 - Each wagon must be fitted with a load-adjustable brake.

4.1.3.2 - Each wagon must be fitted with a parking brake that can be operated from the ground.

4.2 - Type 1 wagons

Wagons with 2 bogies (Scsns or Scsnss) for the conveyance of horizontally-transferred roller units as per UIC Leaflet 591, suitable for 22,5 t axle-loads

4.2.1 - Main dimensions

Overall length	19 990 mm
Length of underframe	18 660 mm
Number of frames	3
Frame displacement	
- Design calculation	Anlage O - page 71
- Indication of pivoted roller-unit overhang	Point Q.2 - page 84
Distance between bogie pins	14 860 mm
Distance between bogie axles	1 800 mm
Maximum height of loading plane for roller units when unloaded:	
- new wagons	1 200 mm
- converted wagon	1 370 mm

O 4.2.2 - Load characteristics

1. Maximum tare including the 3 frames: 27 t
2. Minimum load per frame: 21 t
3. Maximum width of loaded roller unit: 2 600 mm
4. Minimum load per frame for converted wagons: 16,5 t

O 4.2.3 - Buffers

4.2.3.1 - Wagons must be fitted with buffers or shock-absorbers that ensure the acceleration on the pivoted frame does not exceed 4g (filtered at 16 Hz) during impact at a speed of 12 km/h.

4.2.3.2 - When the provisions in point 4.2.3.1 are not observed, these wagons must be marked as per RIV, Plate 14, Figure 1.

O 4.2.4 - Pivoting frames

4.2.4.1 - The pivoting frames shall be designed to receive horizontally-transferred roller units as defined in one of the systems in UIC Leaflet 591. The characteristics of pivoted frames for each roller-unit system are set out in points O.2 - page 71, O.3 and O.4 - page 72.

Wagons for the conveyance of horizontally-transferred roller units may only be loaded with units that carry the compatibility code given in the compatibility index.

4.2.4.2 - It must be possible for the frame to pivot on both sides. The maximum permissible projection of the frame plus roller unit towards the adjacent track must be given in a pictogram (see point Q.2 - page 84).

4.2.4.3 - It must be possible for the rotary movement of the pivoting frame to be operated from a lorry using a sling for this purpose.

4.2.4.4 - The frames must be solidly welded or secured to the wagon.

4.2.4.5 - The maximum lateral play between roller units and underframe must not exceed 20 mm. If the ± 10 mm lateral play as prescribed in *UIC Leaflet 596-6* cannot be observed by the wagon, the wagon₀ coding must be reduced accordingly. The coding is based on an inner clearance of $1\ 080\text{--}^5$ mm between the cross-members of pivoting frames.

O 4.2.5 - Safety against overturning

The factor defining safety against overturning of the wagon V must be determined as per Appendix P - page 75. All loading situations meeting criterion $1 < V < 14$ are permissible providing they are not inconsistent with the other provisions.

For the actual design calculation, the following parameters must be taken into consideration:

- 1 roller unit with maximum height, loaded up to the maximum load of the frame, and fully pivoted;
- 2 empty roller units with maximum height, loaded on to two non-pivoted frames;
- 15 % displacement of the centre of gravity of the load towards the unfavourable side of the loaded roller unit;
- a wind pressure of 200 N/m^2 (8 Beaufort, 1/12 scale);
- the wind force on a roller unit being loaded does not need to be considered as it is absorbed by the lorry itself;
- Safety against overturning must be ensured for one or possibly several pivoted frames.

O 4.2.6 - Locking/abutments

4.2.6.1 - Locking

It must be possible for the locking system to withstand the maximum loads occurring during tests and regular service.

It must be possible to lock the frame into the central position (transport position), both in empty and in laden mode.

Two pivoting-prevention devices, which operate independently of one another, must be provided. At least one of them must be positioned in such a way that it is easily visible and checkable from the outside. If this pivoting prevention device is not in the correct position, a pneumatic monitoring system must operate on the brake system in order to prevent the departure of the train. In order to prevent the system operating when not required, a shut-off valve shall be provided to isolate the system.

Each such device must be capable, on its own, of absorbing loads occurring in service.

The roller unit, when loaded onto the wagon, must be locked to prevent uplift or displacement.

Locking systems to prevent displacement, uplift or pivoting can be combined.

It must be possible for the control levers for loading and unloading to be operated from the specified side of the wagon or from the ground.

The controls shall be as dirt-proof as possible.

4.2.6.2 - Abutments

- The abutments do not have a locking function.
- The maximum pivoting angle of the frame must be limited by an abutment.
- The frame must have at least one abutment to maintain it in its central position.

4.2.7 - Wagon identification

Wagons incorporating horizontal-transfer systems must comply with the coding conditions set out in *UIC Leaflet 596-6*.

As provided for in *UIC Leaflet 596-6, Appendix 2.2*, code "B" is the one used for wagons with such transfer systems in that it characterises the compatibility of these wagons (see paragraph below), but also the height gain achievable when the design features of wagons are more favourable than those specified in *UIC Leaflet 596-6, point 2.3.2 (Appendix 11c, figure 2)*.

The height above rail level of the bearing surface of the pivoting frame, in the case of an unladen wagon, must be indicated using the symbol in point **C.4 - page 44**.

In accordance with point **4.2.4.1 - page 28**, only one "compatibility level" digit must be different to 0 (nought) depending on the wagon system.

Options:

ACTS	100
SNCF	020
RSS	003

When the roller-unit compatibility index and the wagon compatibility index are shown in the same place, the roller unit concerned can be loaded and conveyed on the particular wagon.

O 4.2.8 - Markings

4.2.8.1 - Wagons

The RIV wagon markings on each side wall must be supplemented by the following details:

- the text in point [O.5 - page 73](#),
- the following pictograms:
 - "Height of loading plane" (point [C.4 - page 44](#)),
 - "Not to be moved with pivoted frame" (point [O.6](#), Fig. [24 - page 74](#)),
 - "Procedure for loading and unloading" (point [O.6](#), Fig. [26 - page 74](#)),
 - "Number of permissible pivoted frames for which safety against overturning shall be demonstrated" (see point [Q.1 - page 83](#)),
 - Dimension "Y" : roller-unit overlap during loading and unloading, measured from the middle of the wagon (see point [Q.2 - page 84](#)). This dimension must be calculated as per point [O.1 - page 71](#). For safety reasons use must always be made of a roller unit that is 2 600 mm wide and has a maximum height of 4 620 mm minus the height inscribed on the wagon as per point [C.4 - page 44](#),

NB : The 4 620 mm maximum height above rail level is obtained from the following values:

- the maximum IT profile for a width of 2 600 mm: 4 290 mm, and
- the height of base level above rail level: 330 mm.
- Position of locking lever during transit (see point [Q.3 - page 84](#)),
- Marking as per *UIC Leaflet 596-6*.

4.2.8.2 - Pivoting frame

- The maximum load must be shown on both sides (point [O.6](#), Fig. [25 - page 74](#)).
- Frame parts which project when the frame swings out must be marked in yellow and black.
- The control levers and locking handles shall be painted yellow and the locking device itself painted red.

O 4.2.9 - Operating conditions

4.2.9.1 - Conditions for placing in service

It must be possible for the wagons, irrespective of their loading status, to run through:

- a 75-m curve radius individually;
- a 150-m curve radius when coupled with other wagons.

4.2.9.2 - During loading and unloading, frames already loaded may not be swung out unless safety against overturning has been demonstrated for several pivoted frames. The maximum number of frames that can be simultaneously swung out must be shown using a pictogram (see point Q.1 - page 83).

4.2.10 - Tests

4.2.10.1 - Wagon testing conditions

4.2.10.1.1 - The testing arrangements described in point 4.2.10 shall comply with the conditions stipulated in *UIC Leaflet 577* (see Bibliography - page 86), the provisions of which may be adapted to the specific constructional features of systems for the "Conveyance of horizontally-transferred roller units". All pivoted frames must be loaded in a manner that ensures maximum use of wagon capacity.

4.2.10.1.2 - Wagons fitted with Category A buffers shall be impact-tested up to a speed of 7km/h.

4.2.10.1.3 - Wagons fitted with Category L buffers shall be impact-tested up to a speed of 12 km/h.

4.2.10.1.4 - Before each impact test the play between the roller units and the abutments must be at maximum level.

4.2.10.1.5 - The abutments and locking systems which transmit longitudinal forces from the roller unit to the wagon must be fitted with means to measure the stresses and extensions. The elastic limit must not be exceeded.

4.2.10.1.6 - The locking systems and abutments must operate properly after the tests.

4.2.10.2 - Special arrangements for pivoting frames

4.2.10.2.1 - Impact tests with a wagon loaded to capacity

All frames must be loaded with roller-units loaded up to the maximum limit authorised for the pivoting frame. If the maximum load for the wagon is exceeded the 2 end roller-units on the wagon shall be loaded to the maximum capacity of the frame while the frame in the centre of the wagon shall only be loaded up to its authorised load limit for the wagon.

4.2.10.2.2 - Impact tests with only one roller-unit loaded up to the maximum limit authorised for the pivoting frame

These tests are designed to check the strength of the locks when subjected to the maximum accelerations encountered in service for a loaded frame.

4.2.10.2.3 - Static tests

The pivoting frame, when in the transport position, must be able to withstand a static vertical load 1,4 times its maximum load without any apparent deformations occurring.

o 4.2.11 - Field of application

Existing wagons suitable for the conveyance of horizontally-transferred roller-units per *UIC Leaflet 591* which were built prior to the coming-into-force of this leaflet, must comply with the conditions of points **4.1 - page 27** (except point **4.1.3.1**), **4.2.3** to **4.2.10**, with effect from 1.1.1996.

Existing wagons, modified to carry horizontally-transferred roller-units after the coming-into-force of this leaflet, must at the very least comply with points **4.1** (except point **4.1.3.1**), **4.2.3** to **4.2.10**.

New wagons, which do not fully identify with type 1, must at the very least comply with points **4.1**, **4.2.2** to **4.2.10**.

Appendix A - Disposition of spigots

Type 1, 2, 4, 5, 6 and 7 container and swap-body wagons

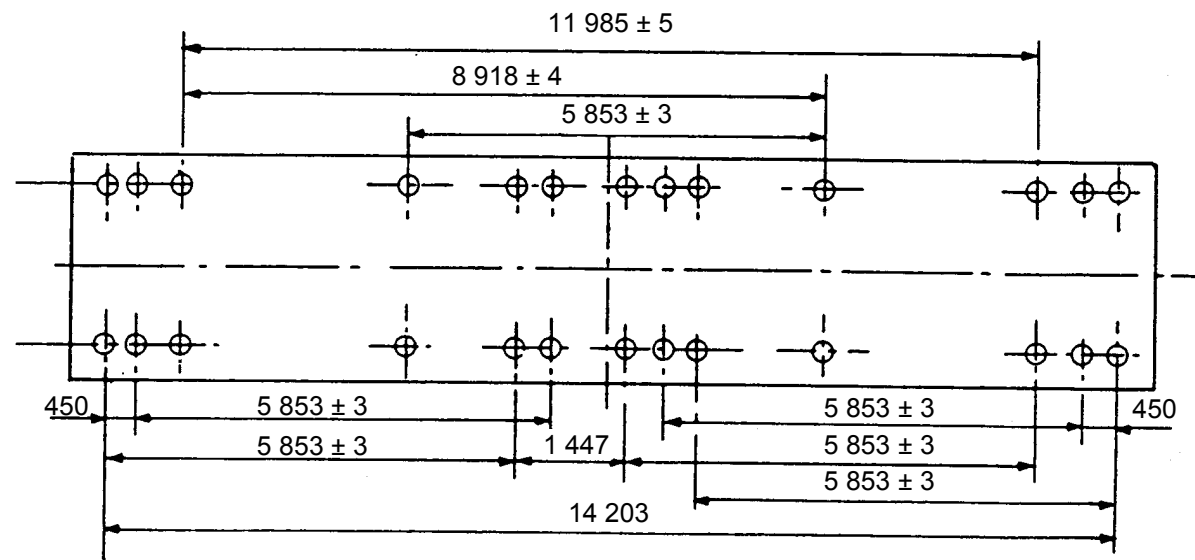


Fig. 1 - Type 1 - wagon with damping device

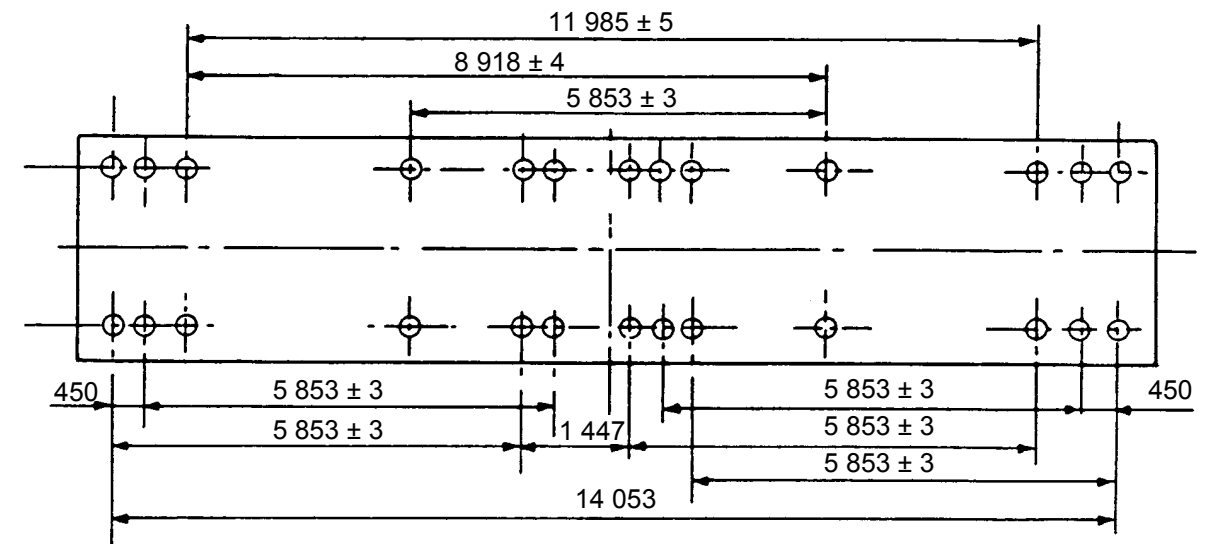


Fig. 2 - Type 1 - wagon without damping device

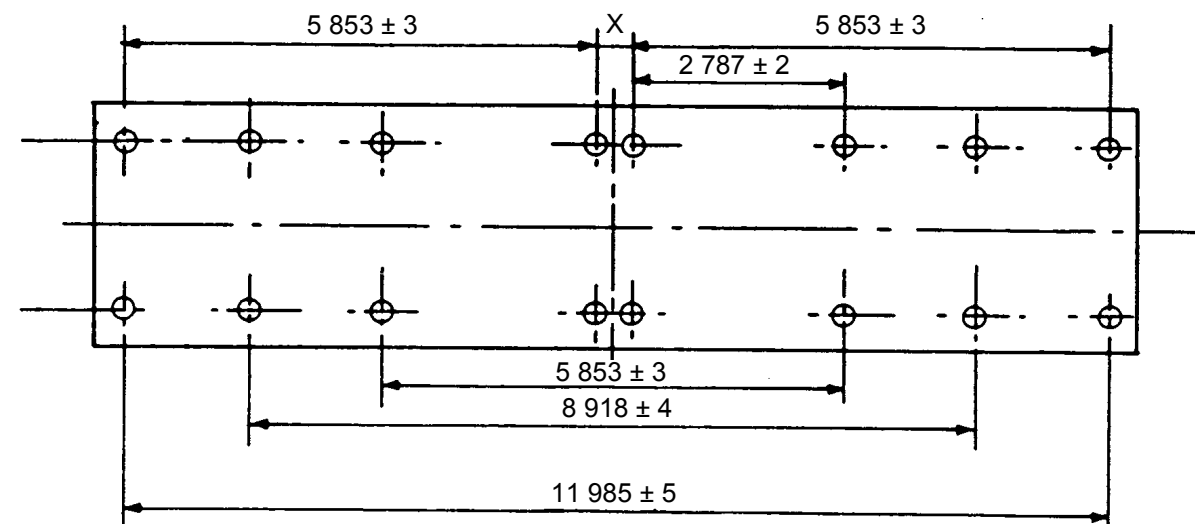


Fig. 3 - Type 5 wagon (40')

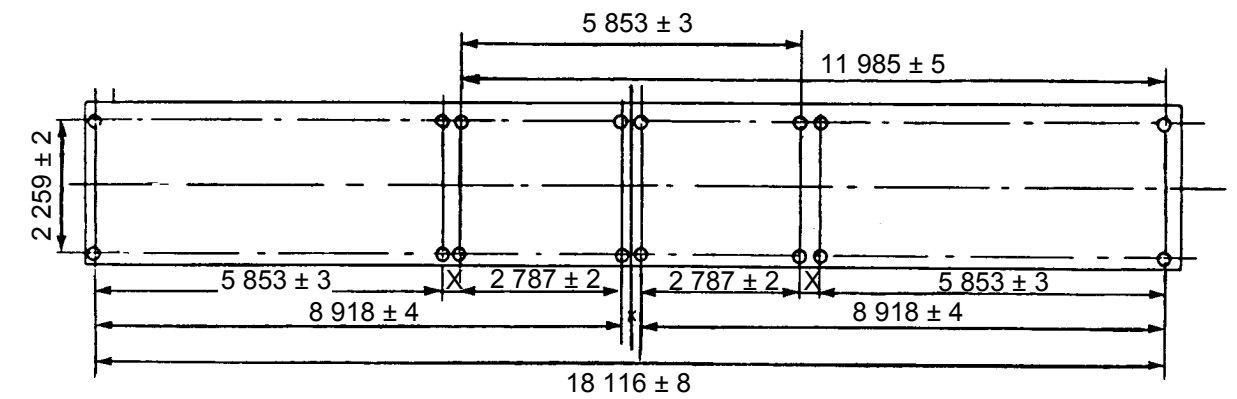


Fig. 4 - Type 2 container and swap-body wagons (60')

The length tolerances given must be applied in such a way that dimension "X" = 279 mm minimum.

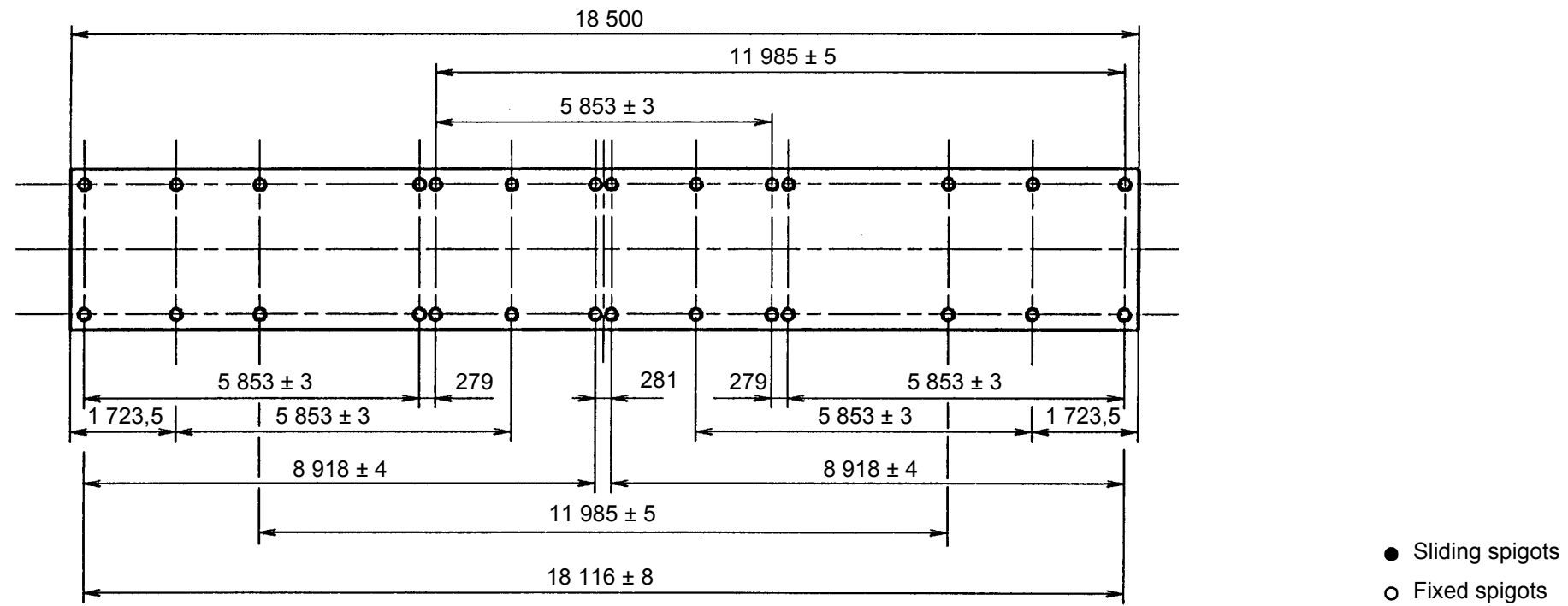


Fig. 5 - Type 2a container and swap-body wagons

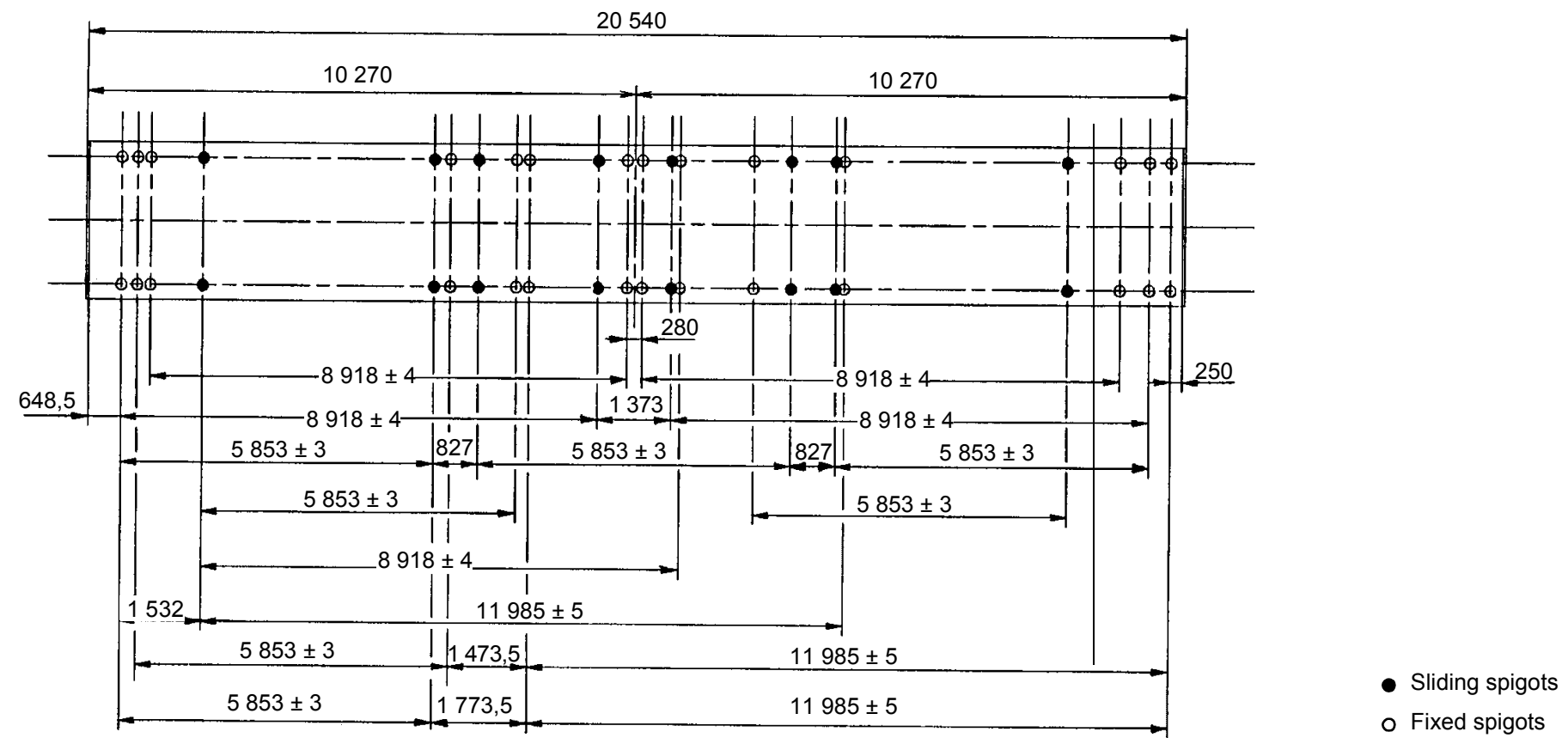
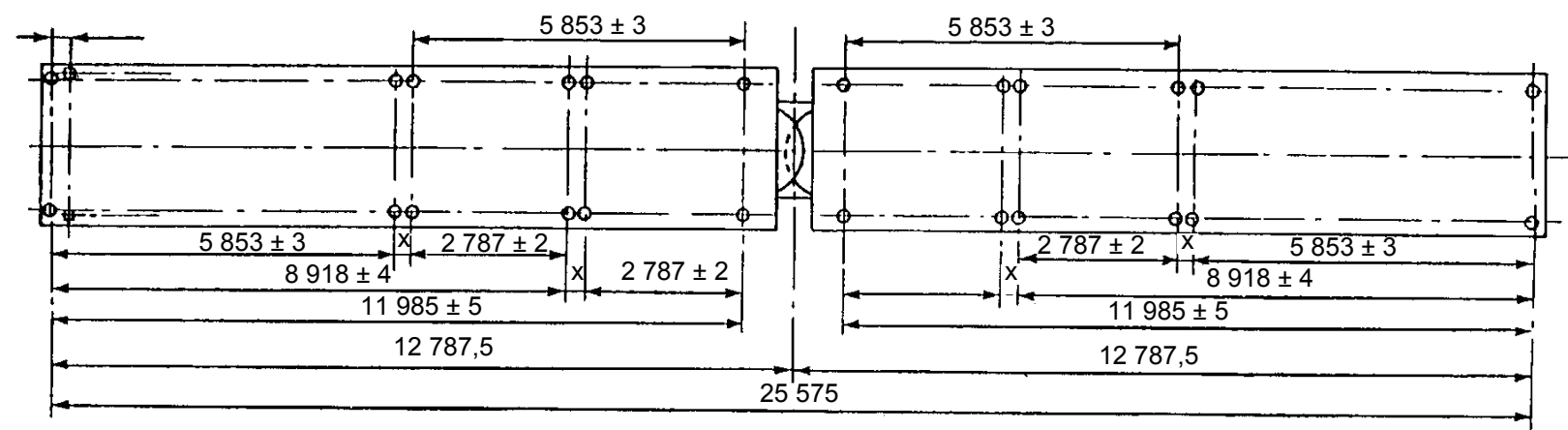


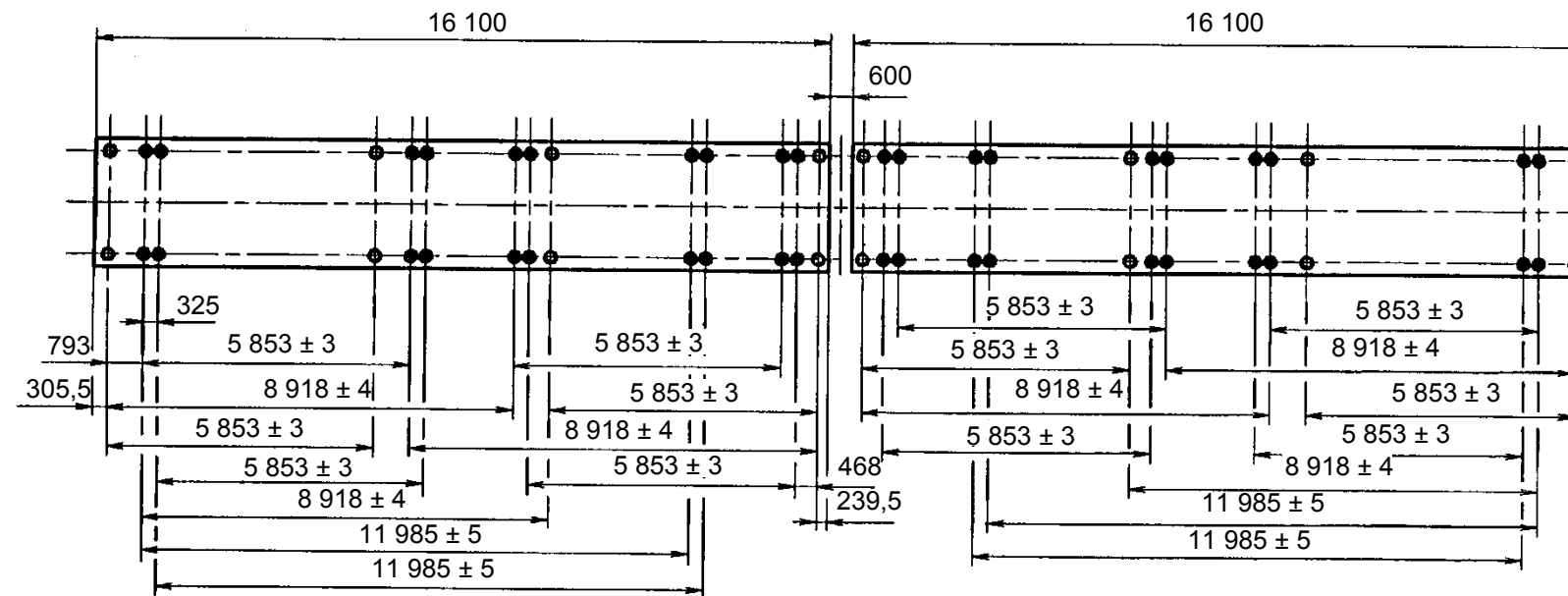
Fig. 6 - Type 2b container and swap-body wagons



○ ISO spigots

The length tolerances given must be applied in such a way that dimension "X" = 279 mm minimum.

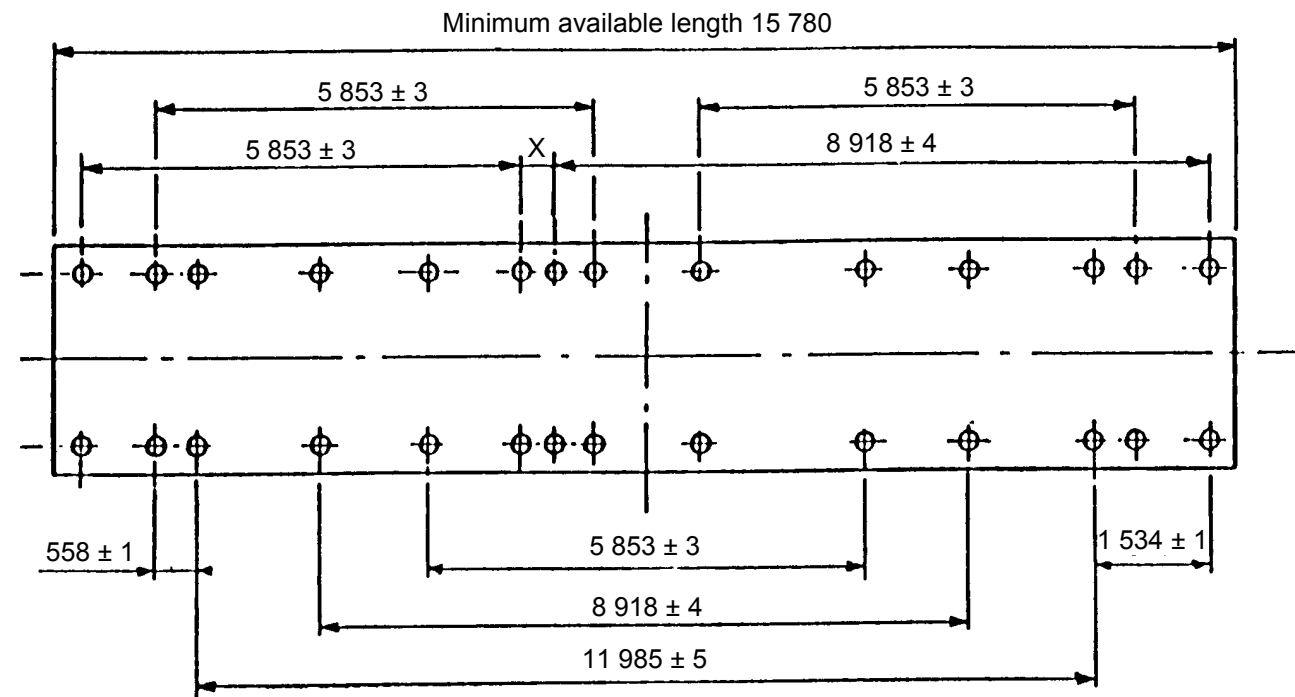
Fig. 7 - Type 4 container wagons (80')



● Sliding spigots

○ Fixed spigots

Fig. 8 - Type 4a container and swap-body wagons



o ISO spigots

The length tolerances given must be applied in such a way that dimension "X" = 279 mm minimum.

Fig. 9 - Type 6 wagons

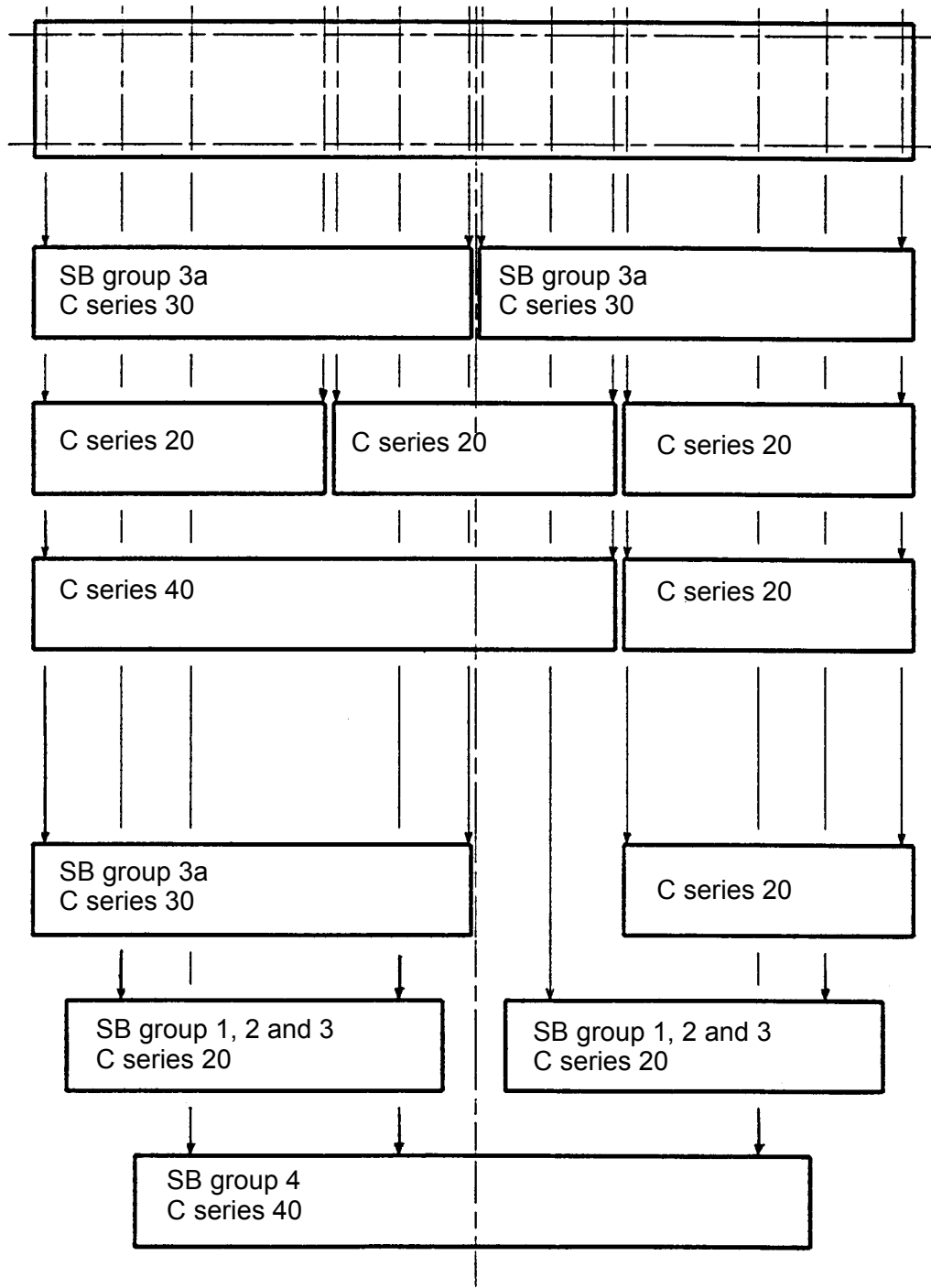
Bogie wagons for conveyance of large containers and swap bodies

Appendix B - Loading status

B.1 - Type 2a container and swap-body wagons

SB: Swap bodies as per *UIC Leaflet 592-4*

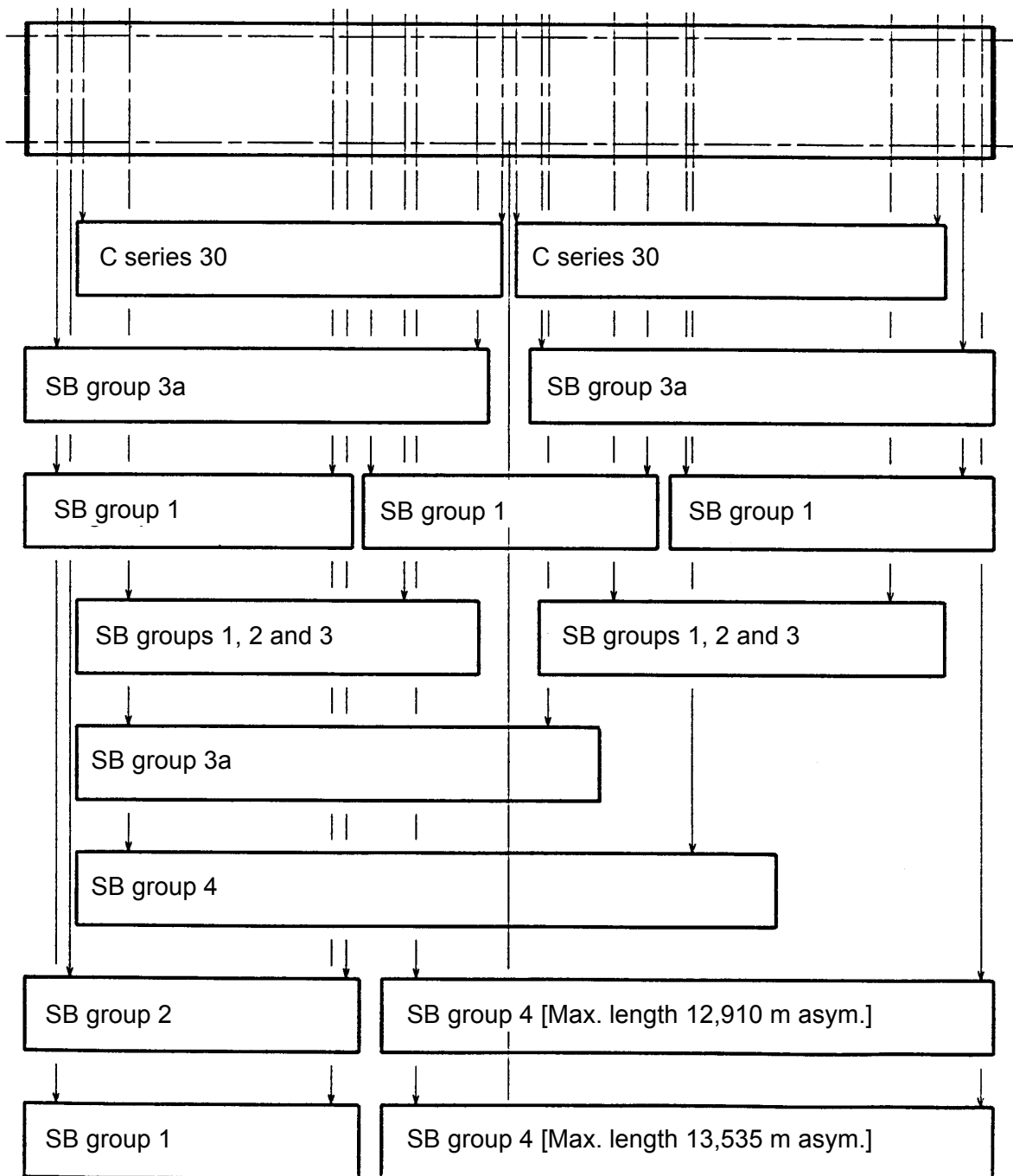
C: Large containers as per *UIC Leaflet 592-2* (see Bibliography - page 86)



B.2 - Type 2b container and swap-body wagons

SB: Swap bodies as per *UIC Leaflet 592-4*

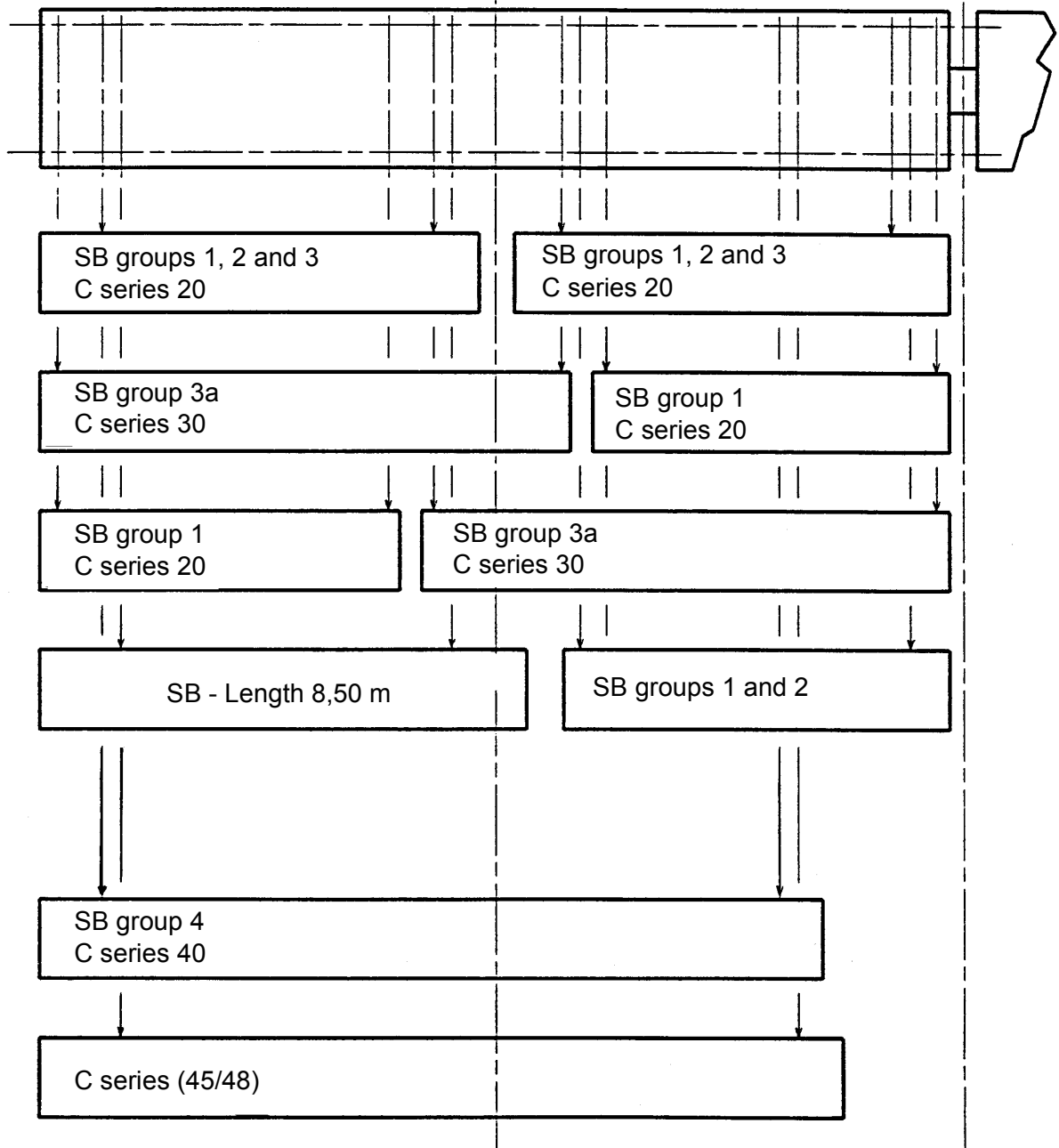
C: Large containers as per *UIC Leaflet 592-2*



B.3 - Type 4a container and swap-body wagons

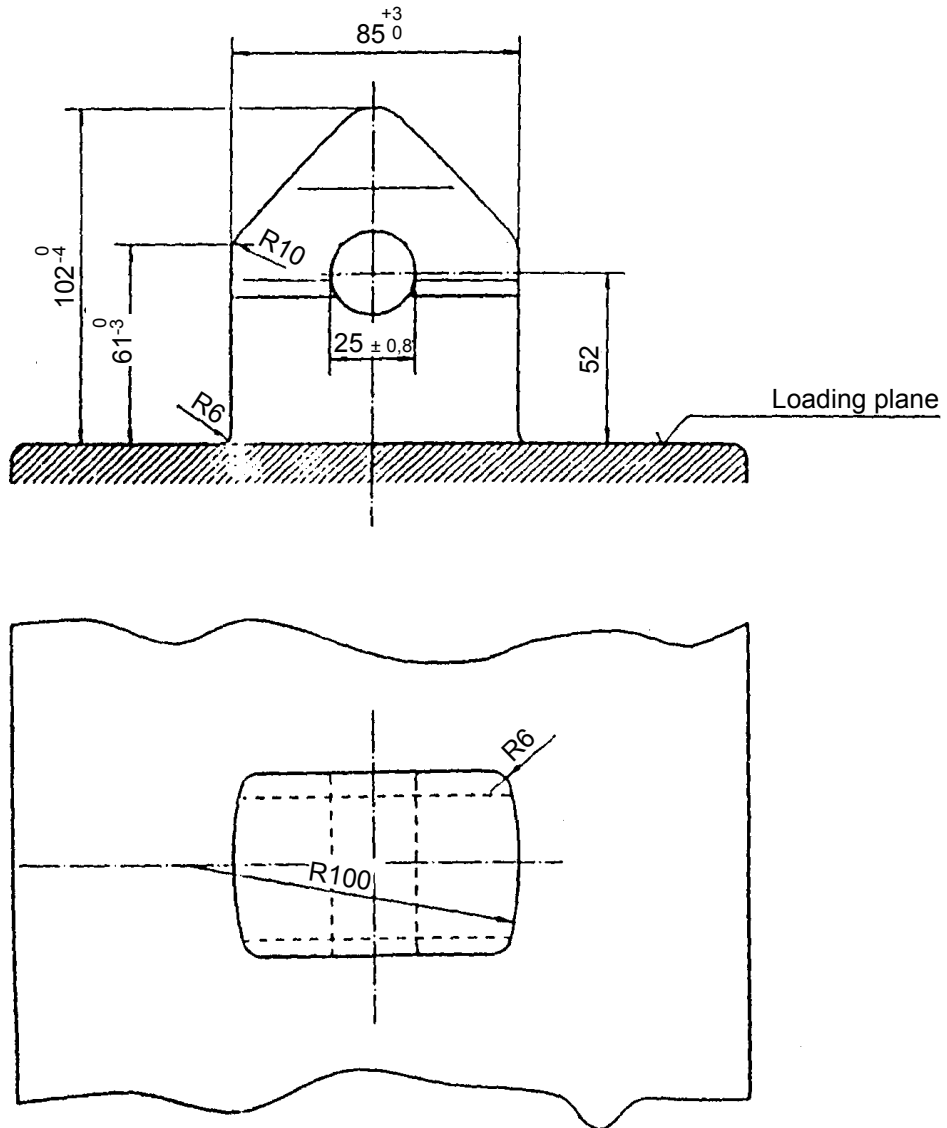
SB: Swap bodies as per *UIC Leaflet 592-4*

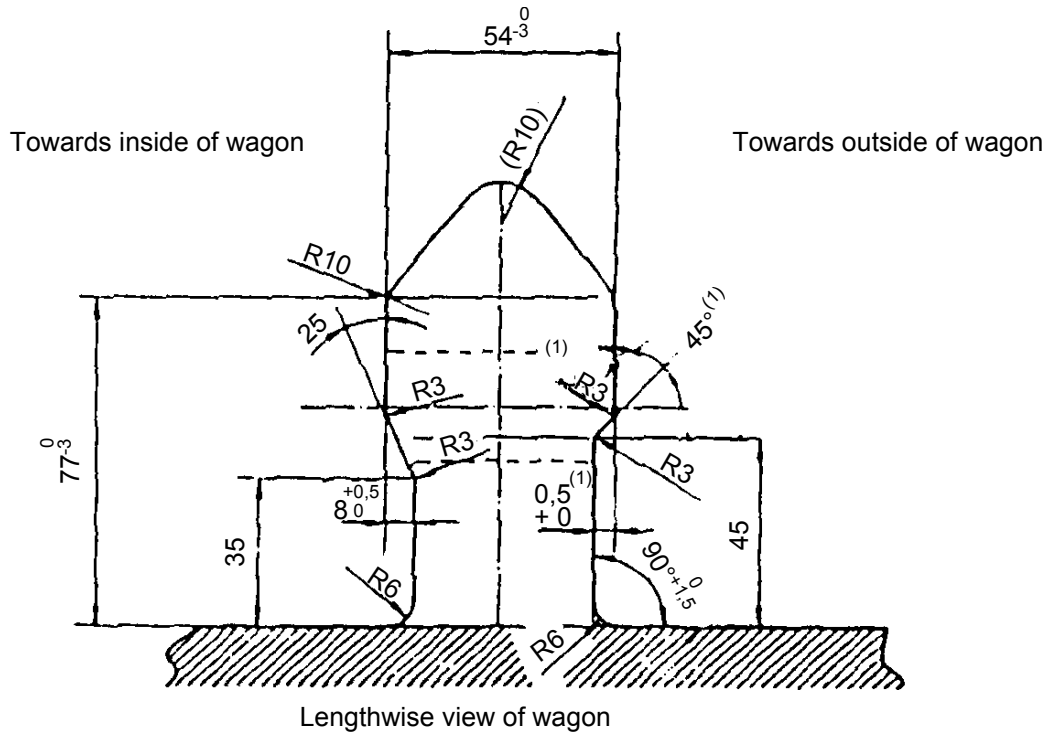
C: Large containers as per *UIC Leaflet 592-2*



Appendix C - Wagons for combined transport - Spigots for ISO containers and swap bodies

C.1 - Dimensions for manufacture

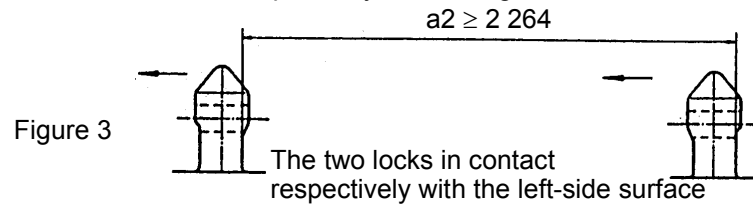
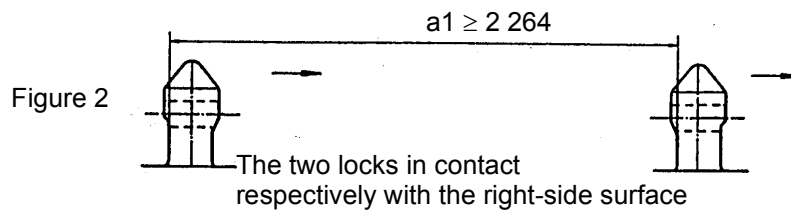
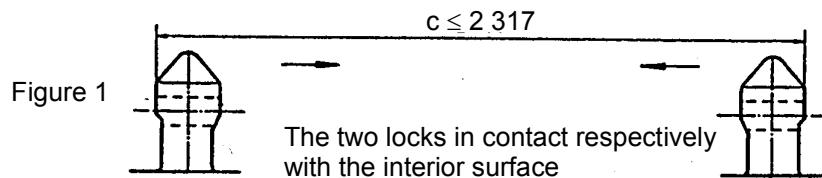




(1) Dimensions for manufacture and maximum operational dimensions resulting from wear (see point C.2)

C.2 - Functional dimensions

Functional dimensions for pairs of spigots after removal of play in the direction indicated by the arrows



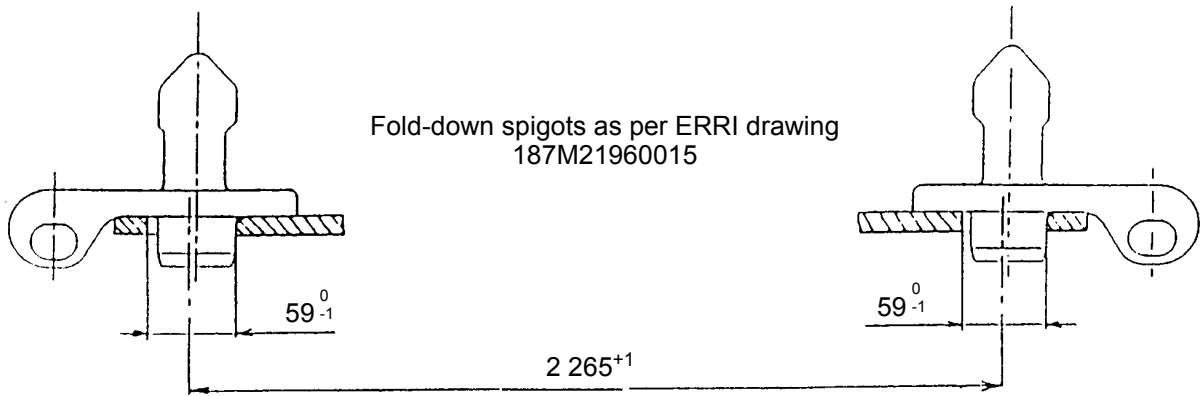
These functional dimensions shall be observed when running, irrespective of the type of spigots (fixed or fold-down) used. Fold-down spigots must be interchangeable.

Maximum operational dimensions (see point C.1 - page 41)

Dimensions as per point C.1	Maximum operational dimensions
R3	maxi. R15
45°	maxi. 65°
4+0,5/0	mini. 3,5 mm
90° ⁰ +1,5	90° ⁰ +2,0 ^a

a. When exerting a lateral force on the spigot head pointing towards the wagon centre (removal of all play), the angle shall be measured between the spigot body and a ruler placed at right angles with the sole-bars of opposing spigots.

C.3 - Assembly diagram for fold-down spigots

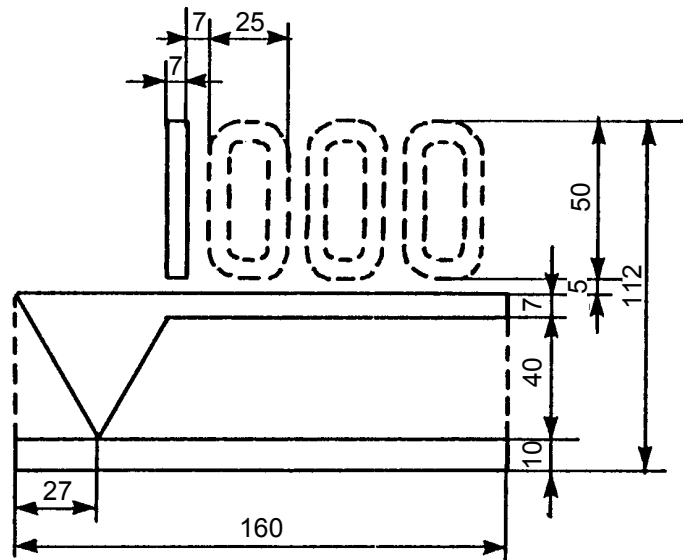


$$2264 \leq a1/a2 \leq 2274$$

$$2307 \leq C \leq 2317$$

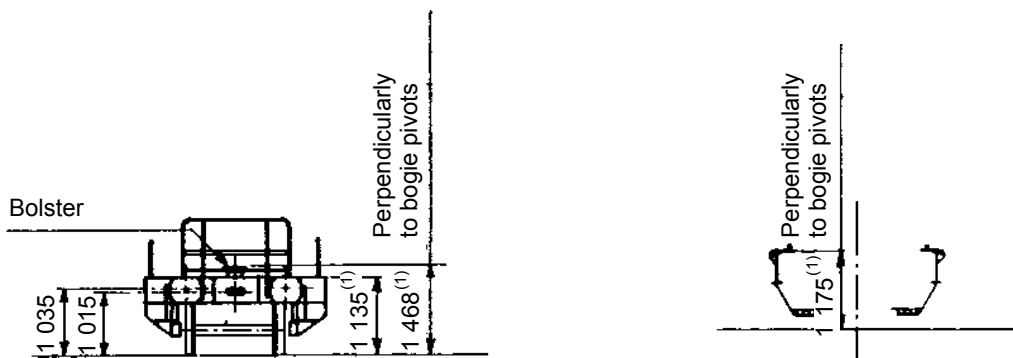
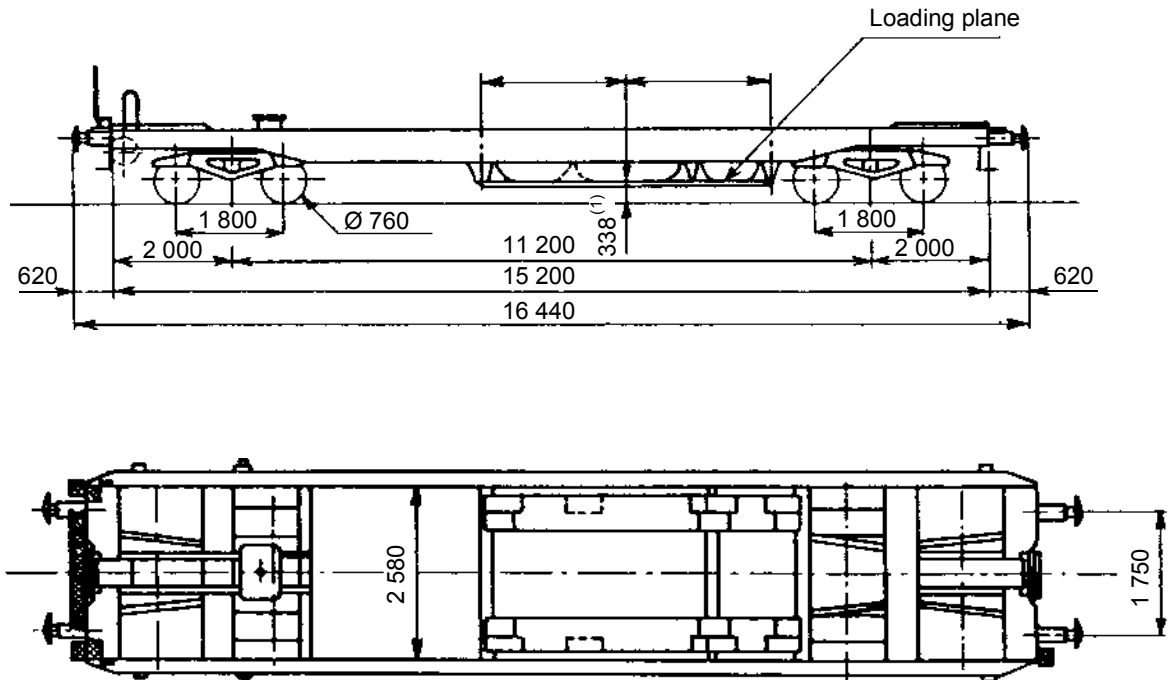
The maximum values (functional dimensions) in point C.2 shall be observed.

C.4 - Inscription of loading-plane height



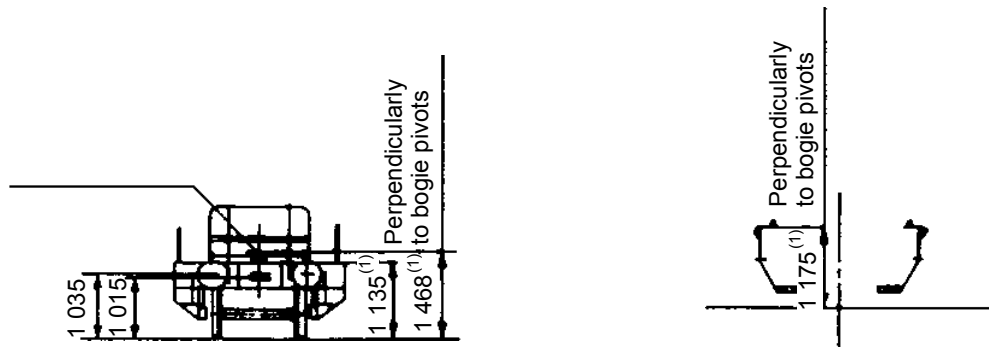
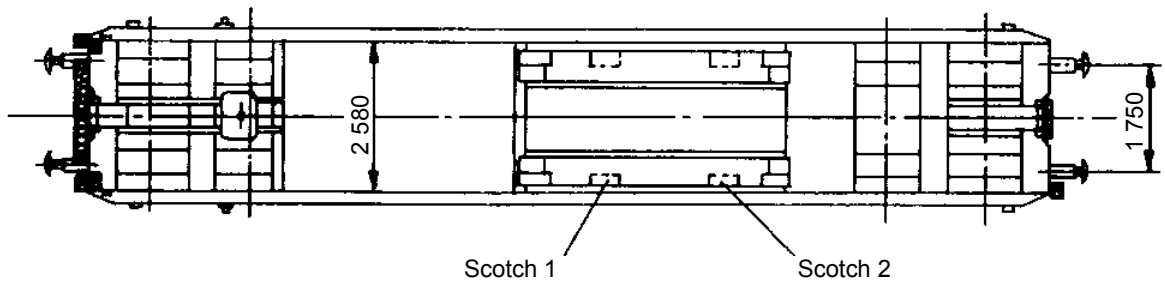
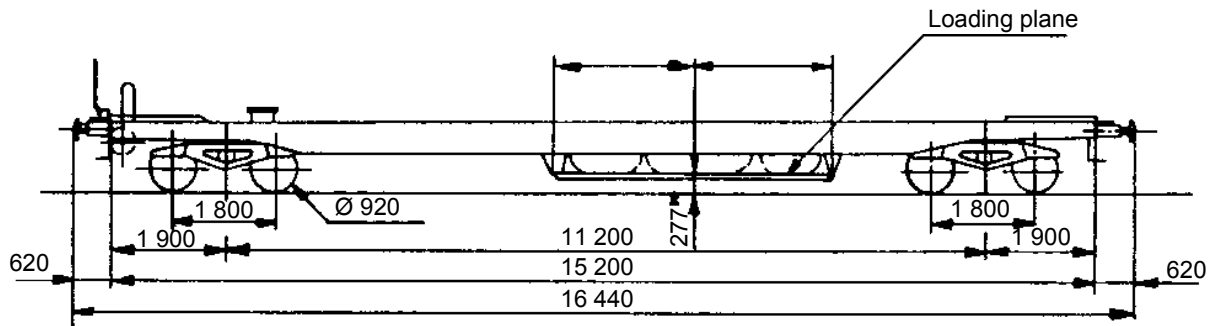
Appendix D - Wagons for conveyance of rail-road traffic - Dimensional characteristics

D.1 - Type 1a "Recess wagon" Sdgkkms



(1) Maximum heights

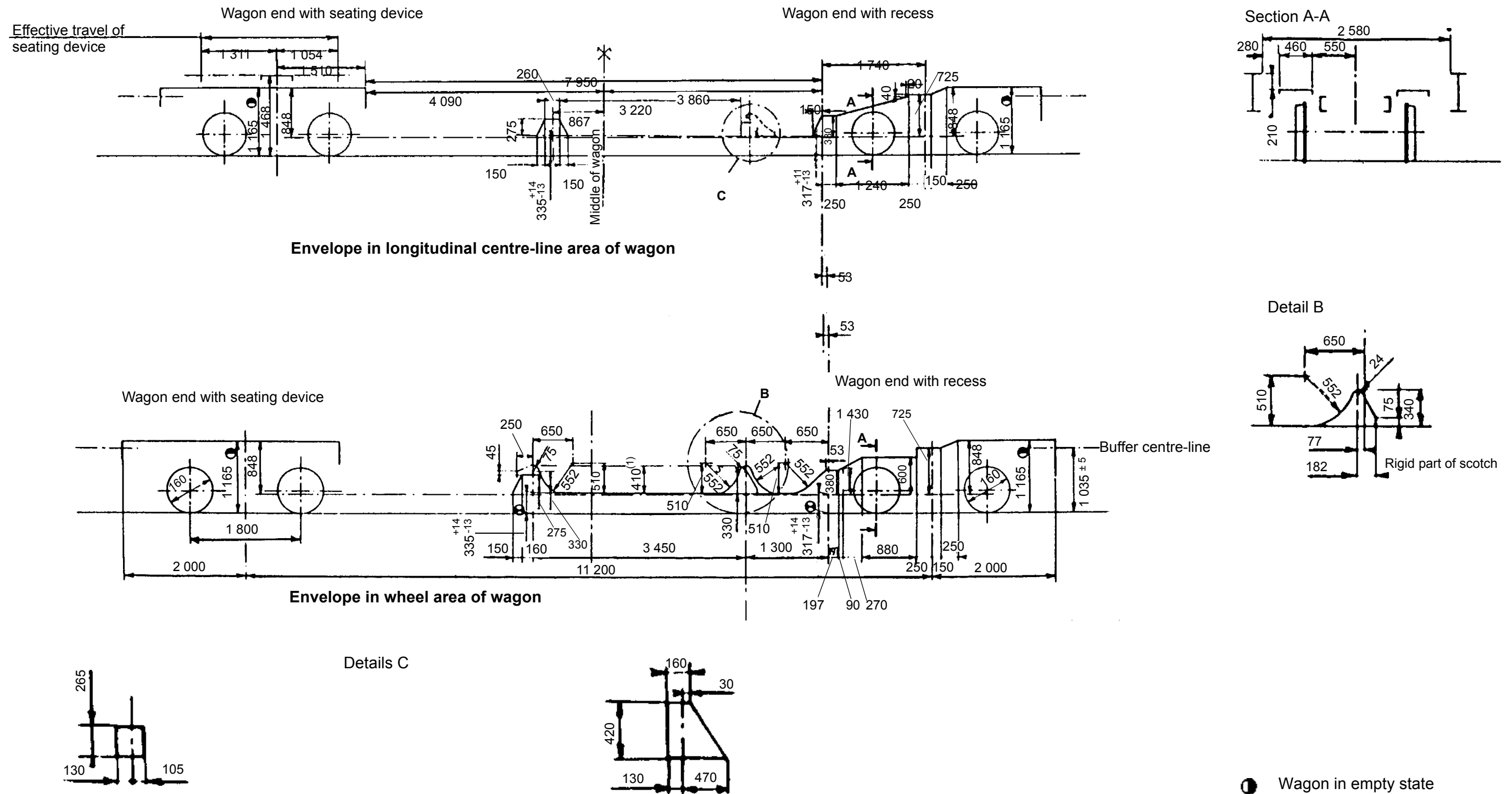
D.2 - Type 1b "Recess wagon" intermodal Sdgmss



(1) Maximum heights

Appendix E - Wagons for conveyance of rail-road traffic - Inner dimensions

E.1 - Type 1a "Recess wagon" (Sdgkkmss)

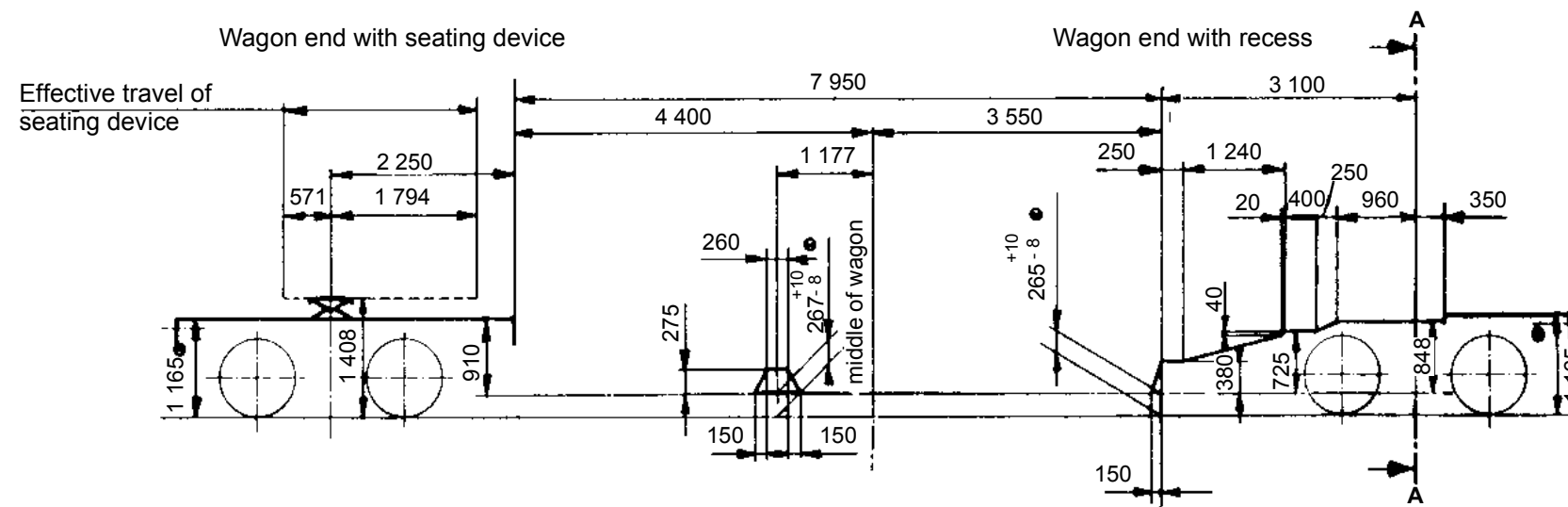


For transport:
 - of 2-axle semi-trailer,
 - of 3-axle semi-trailer with ordinary wheelbase
 (Scotch transversely movable in working position).

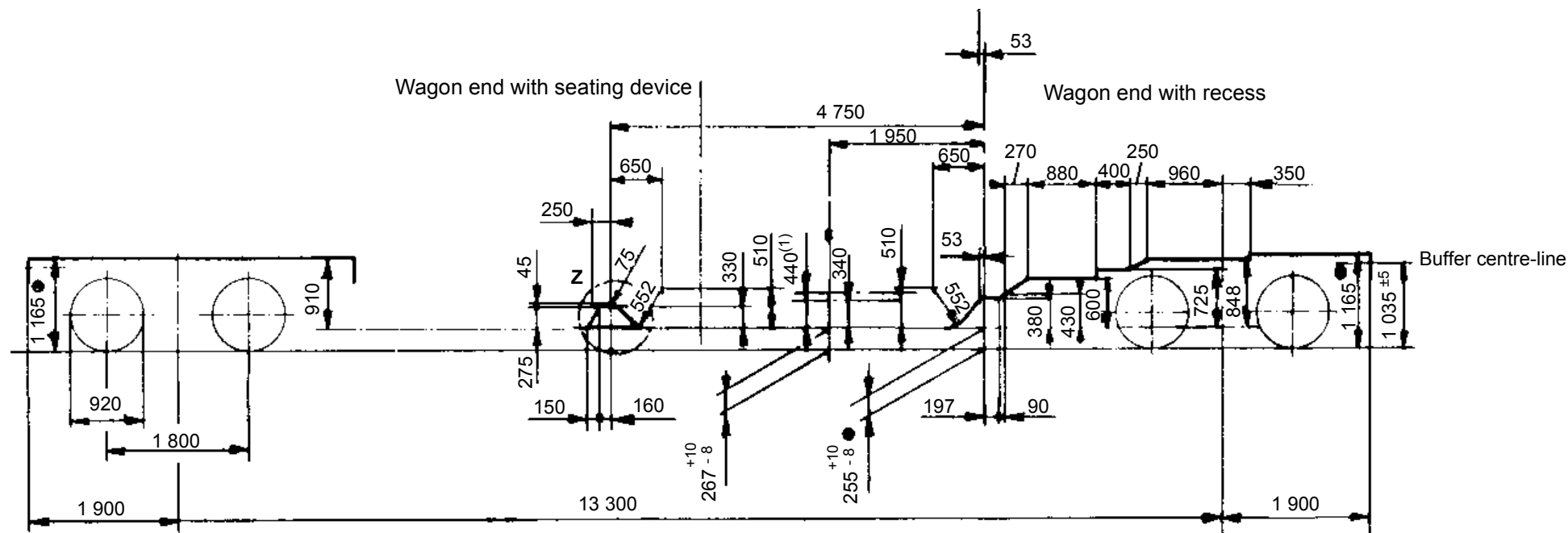
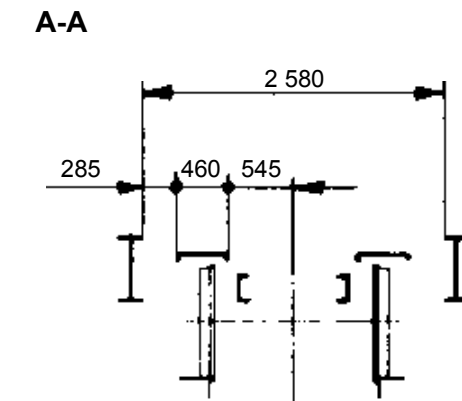
For transport:
 - of 3-axle semi-trailer with short wheelbase (max. 1 150 mm)
 (Scotch transversely movable, placed on longitudinal centre-line of wagon).

- Wagon in empty state
- Height of loading plane
- (1) Height of movable scotch in longitudinal direction of wagon

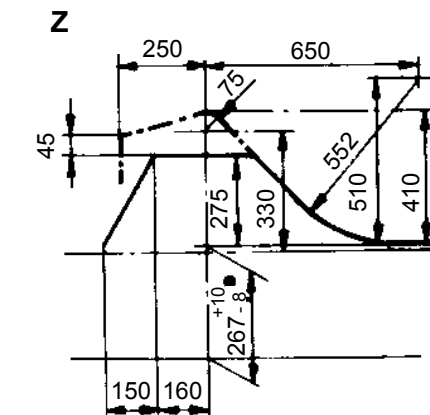
E.2 - Type 1b "Recess wagon" (Sdgmss)



Dimensions in longitudinal centre-line area of wagon

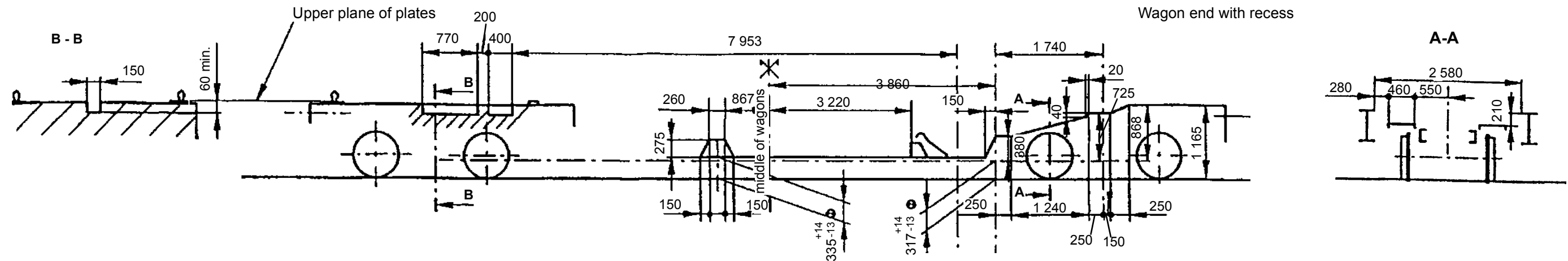


Dimensions in wheel area of wagon

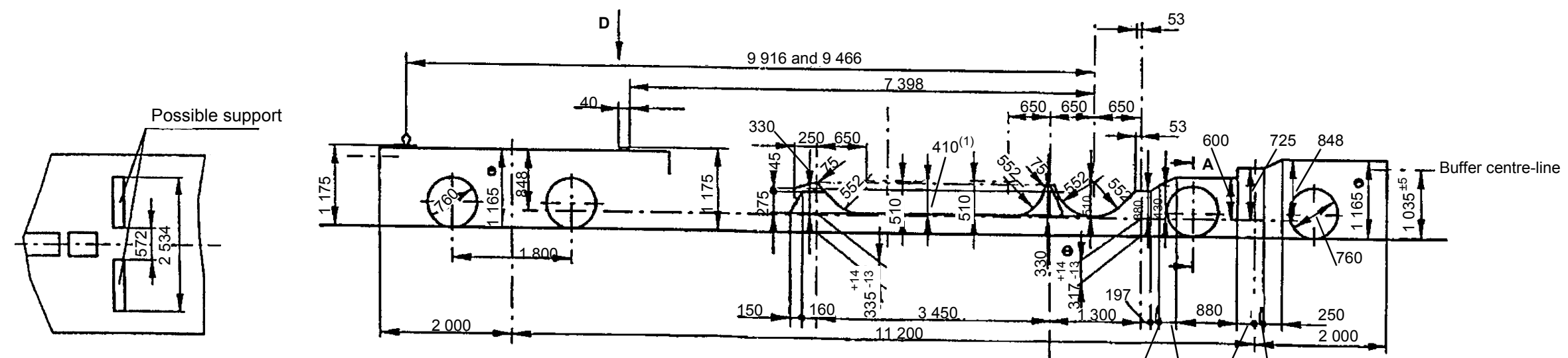


- Wagon in empty state
- Height of loading plane
- (1) Height of movable scotch in longitudinal direction of wagon

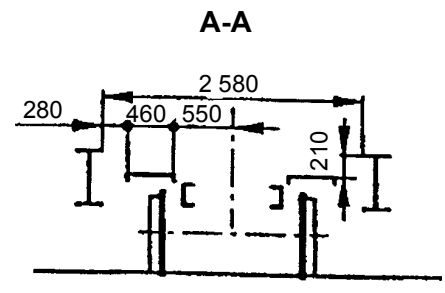
E.3 - Type 1a "Recess wagon" (Sdgkkms) for conveyance of special type 1 semi-trailers



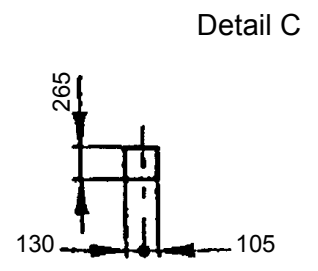
Envelope in longitudinal centre-line area of wagon



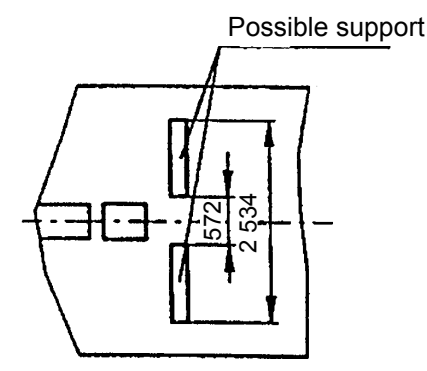
Envelope in wheel area of wagon



A-A

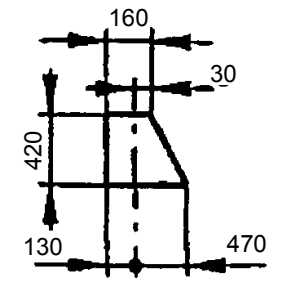


Detail C

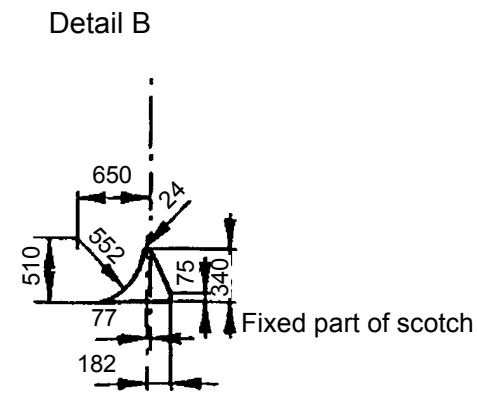


Possible support

For transport:
 - of 2-axle semi-trailer,
 - of 3-axle semi-trailer with ordinary wheelbase (transversely movable scotch in working position).



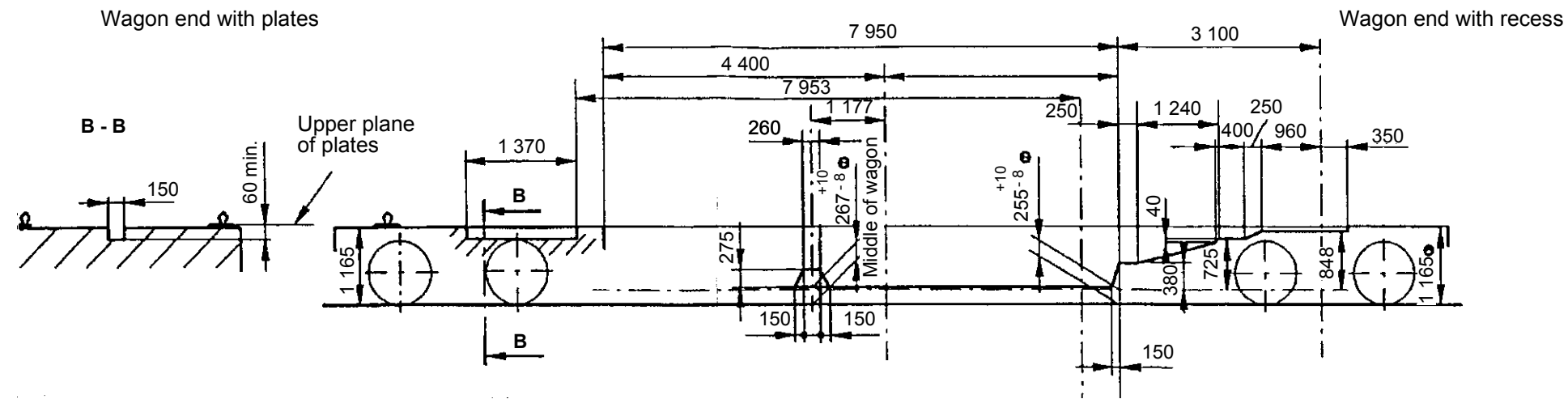
For transport:
 - of 3-axle semi-trailer with short wheelbase (maxi. 1 150 mm) (transversely movable scotch placed on longitudinal centre-line of wagon).



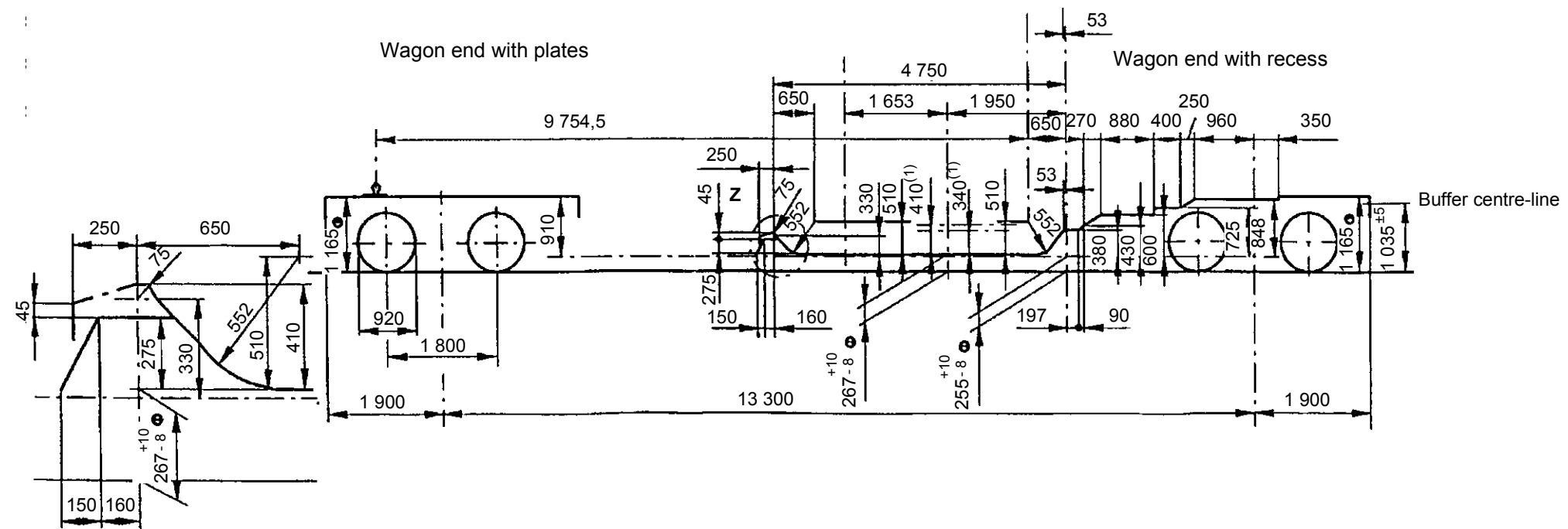
Detail B

- Wagon in empty state
- ⊙ Height of loading plane
- (1) Height of movable scotch in longitudinal direction of wagon

E.4 - Type 1b "Recess wagon" (Sdggkmss) for conveyance of type 1 special semi-trailers



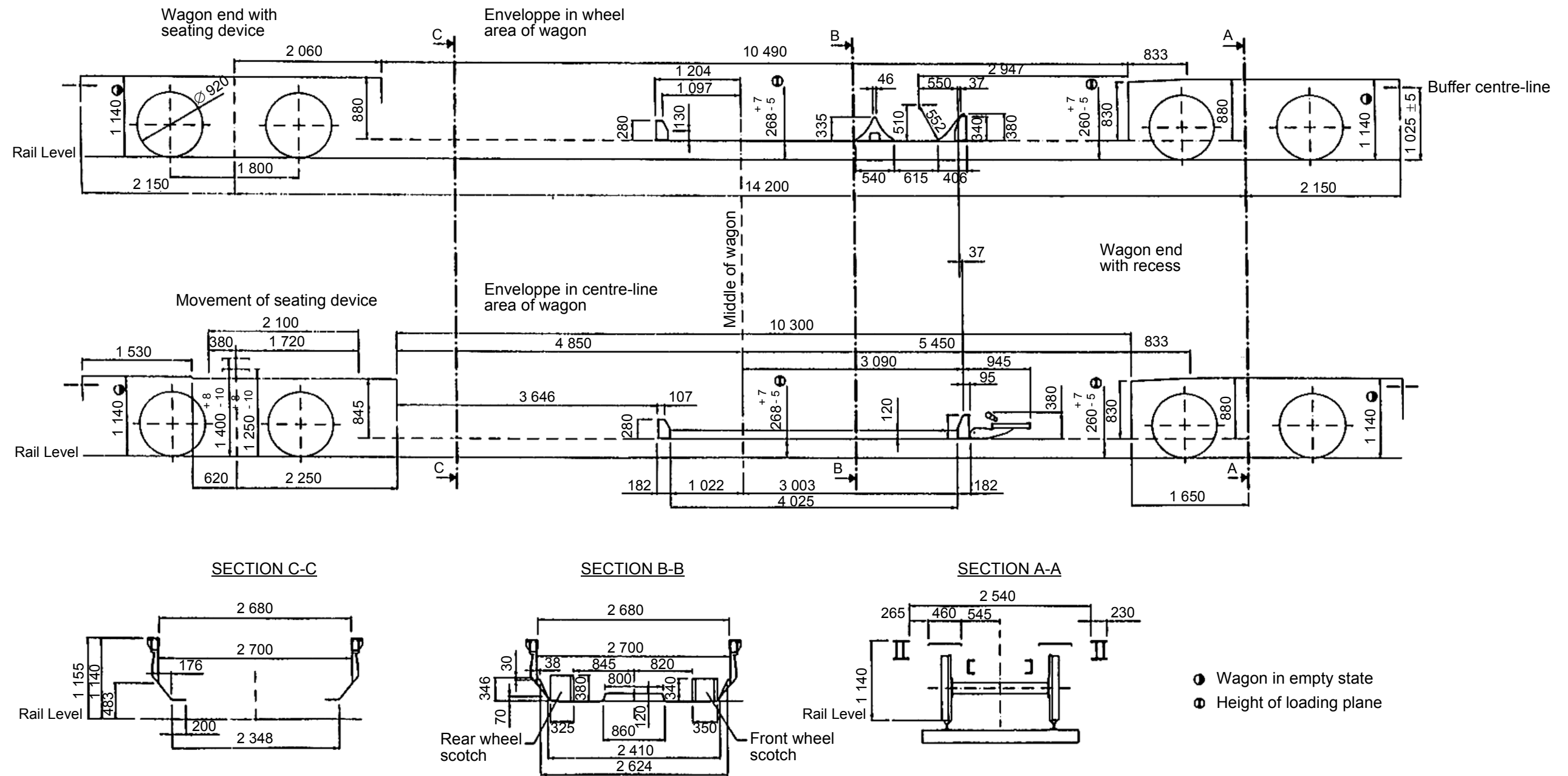
Envelope in longitudinal centre-line area of wagon



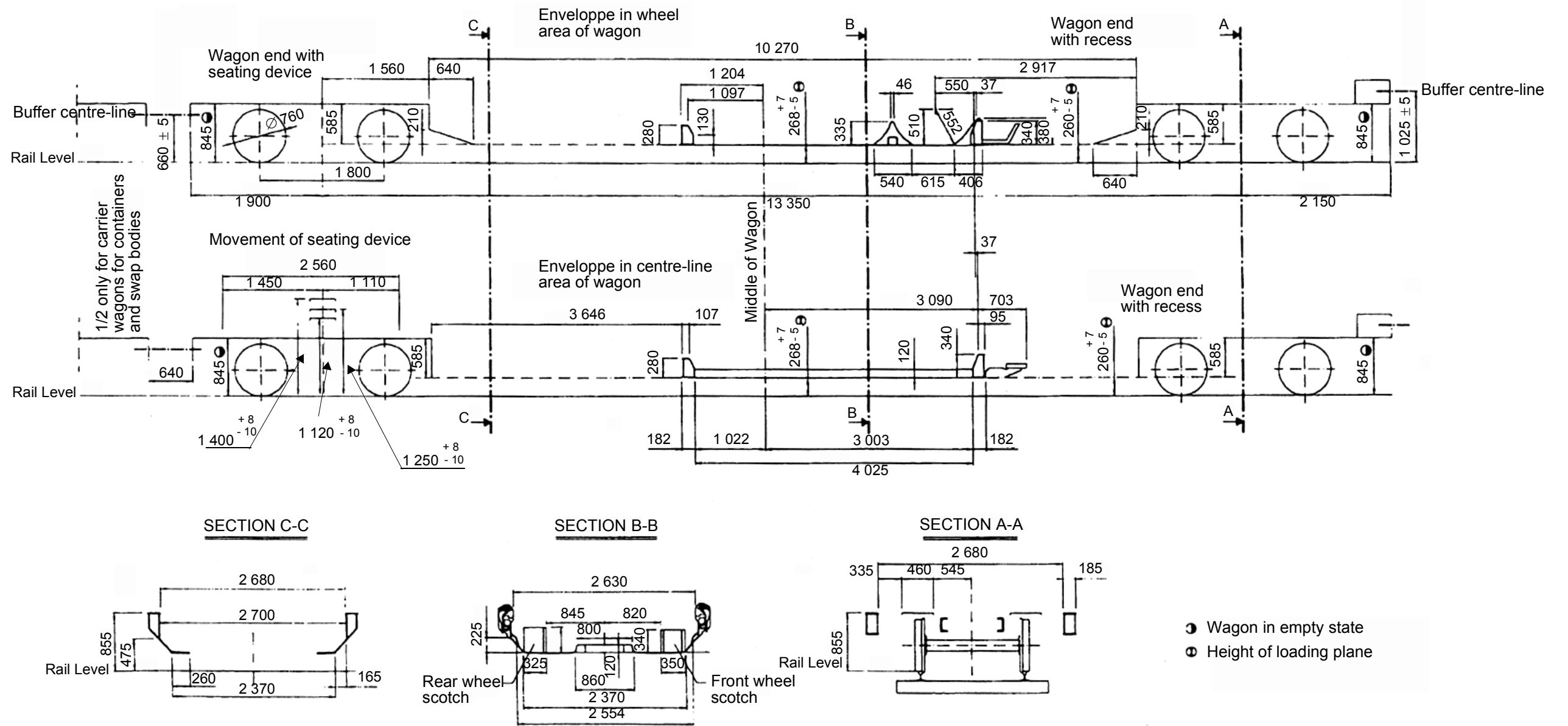
Envelope in wheel area of wagon

- ⊙ Wagon in empty state
- ⊙ Height of loading plane
- (1) Height of movable scotch in longitudinal direction of wagon

E.5 - Typ 4 "Recess wagon" for conveyance of high capacity semi-trailers, compatibility code a



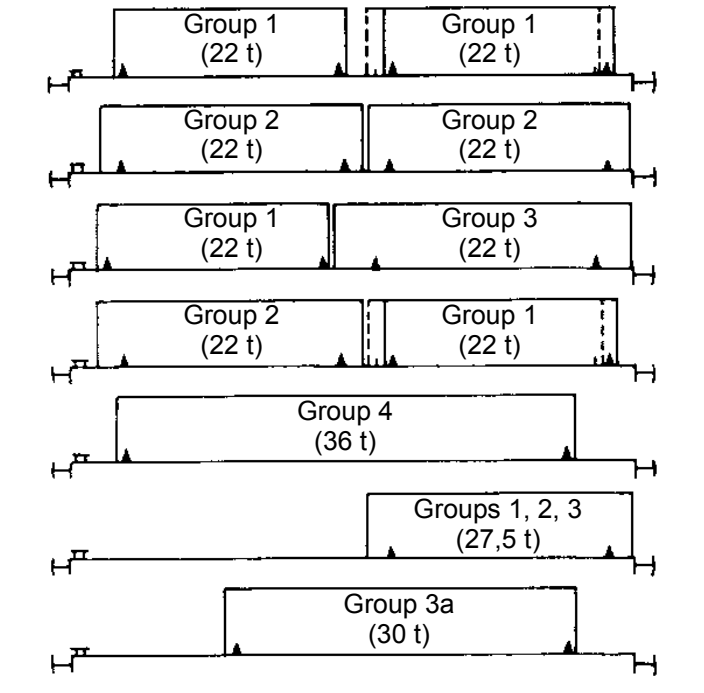
E.6 - Typ Mega 2 "Recess wagon" for conveyance of high capacity semi-trailers, compatibility code d



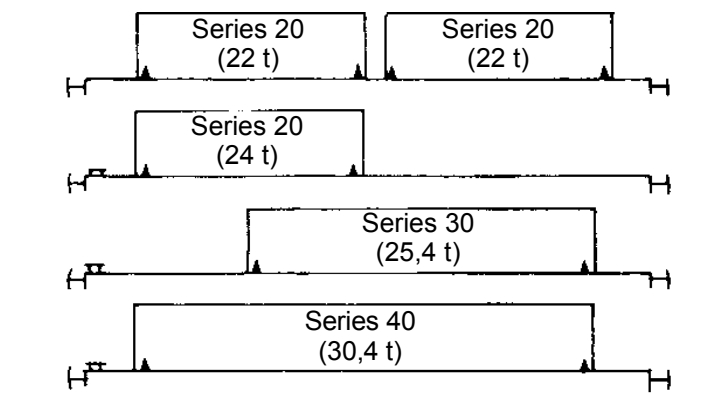
Appendix F - Wagons for conveyance of rail-road traffic - Loading diagram

F.1 - Type 1a "Recess wagon" (Sdgkkmss)

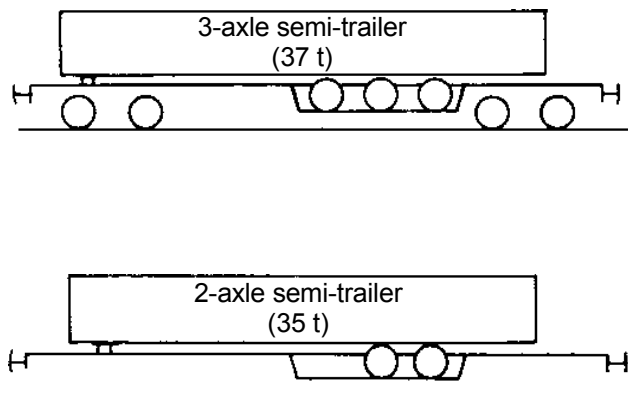
Swap bodies as per *UIC Leaflet 592-4*



Large containers as per *UIC Leaflet 592-2*

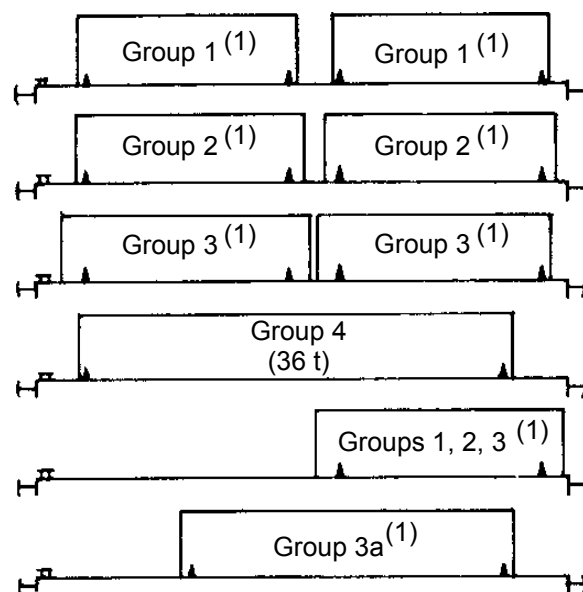


Semi-trailers



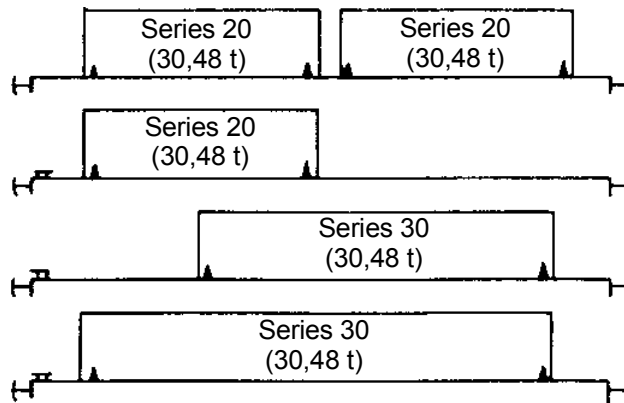
F.2 - Type 1b "Recess wagon" (Sdgmss)

Swap bodies as per *UIC Leaflet 592-4*

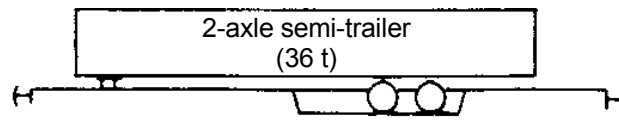
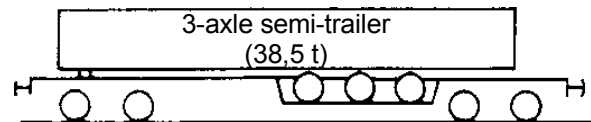


(1) Weight indication in abeyance pending modification to Leaflet 592-4 in conjunction with introduction of Type 1b wagons.

Large containers as per *UIC Leaflet 592-2*

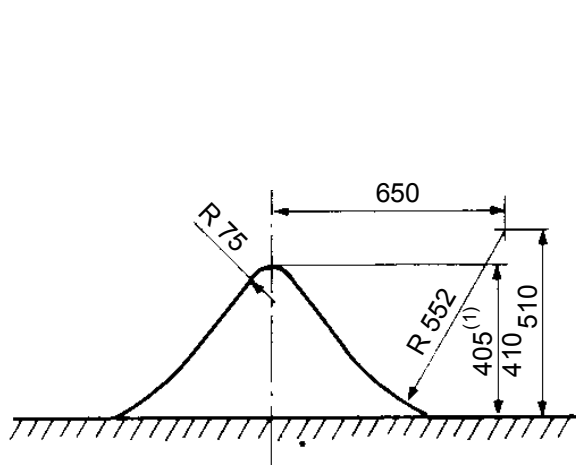


Semi-trailers



Appendix G - Wagons for conveyance of rail-road traffic - Scotch profiles

G.1 - Type 1a "Recess wagons" (Sdgkkms)



(1) Height of movable scotch in longitudinal direction of wagon

Fig. 10 - Scotch profile

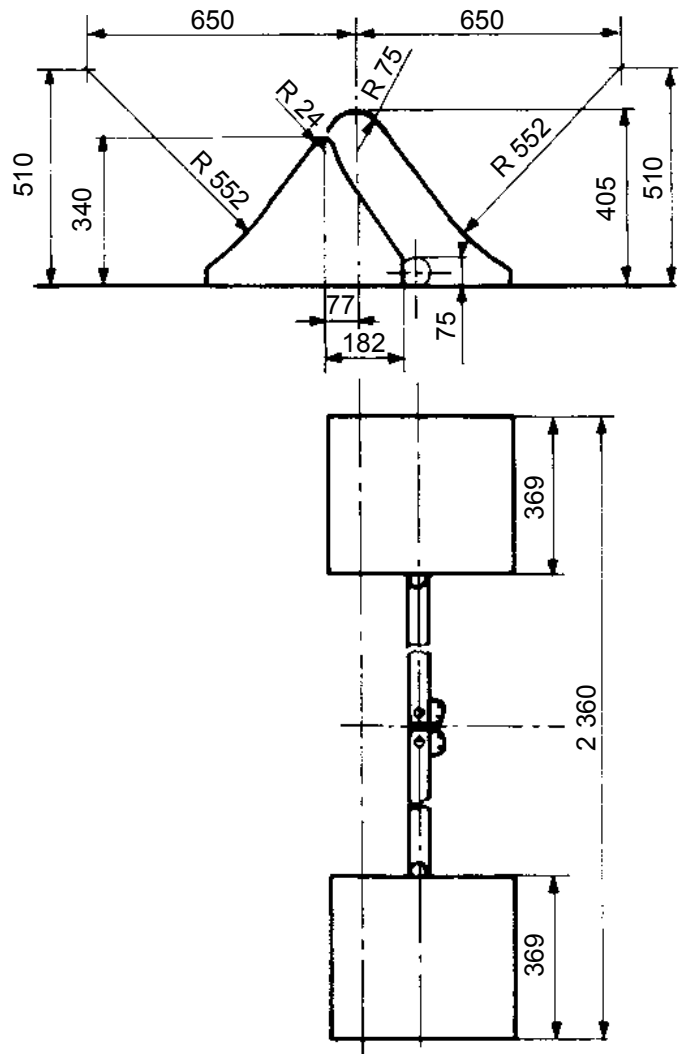


Fig. 11 - Movable part of scotch

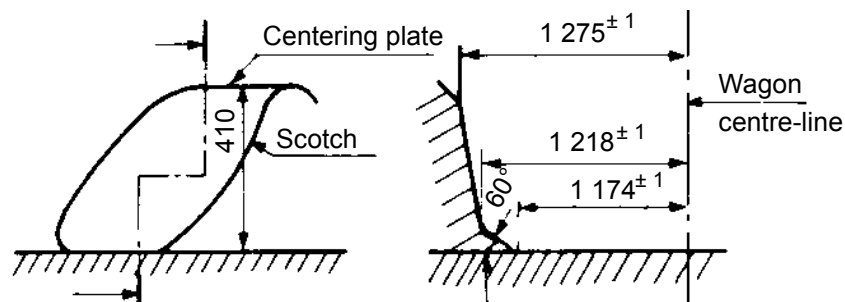
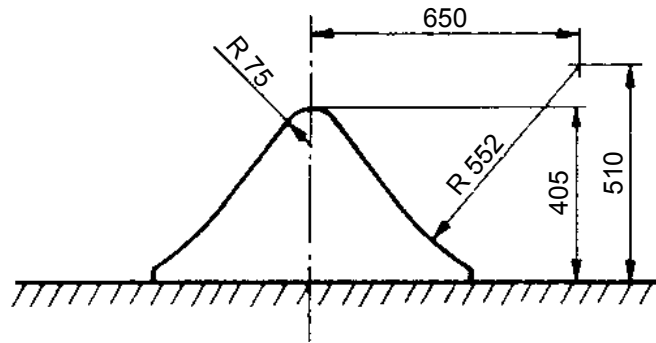


Fig. 12 - Centering plate on scotch

G.2 - Type 1b "Recess wagons" (Sdgmss)



Height of movable scotches in longitudinal direction of wagon

Fig. 13 - Scotch 1 profile

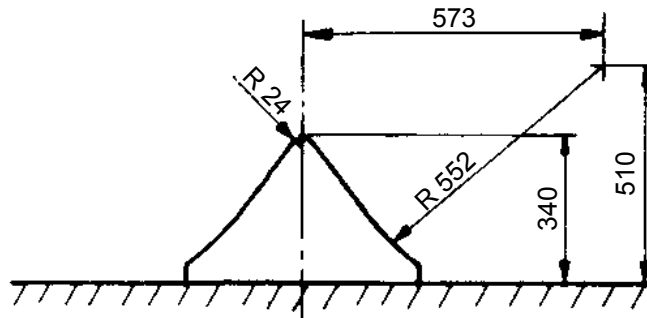


Fig. 14 - Scotch 2 profile

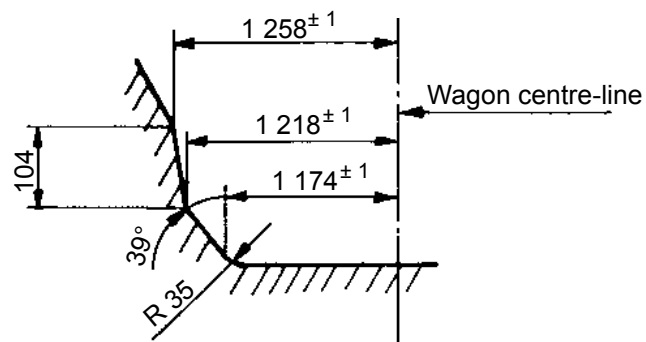
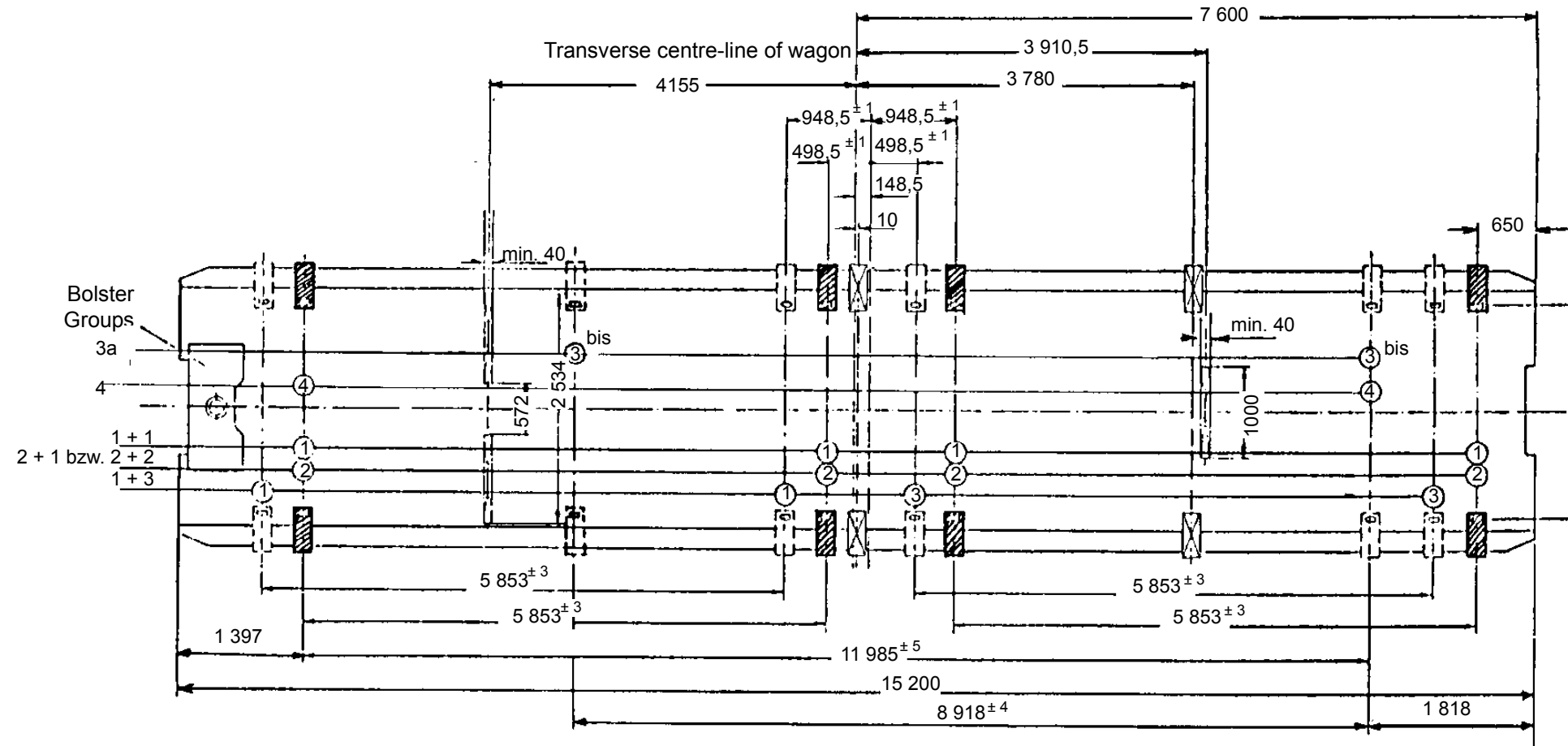


Fig. 15 - Centering plate on scotch

Appendix H - Wagons for conveyance of rail-road traffic - Position of securing devices and swap-body positioning options

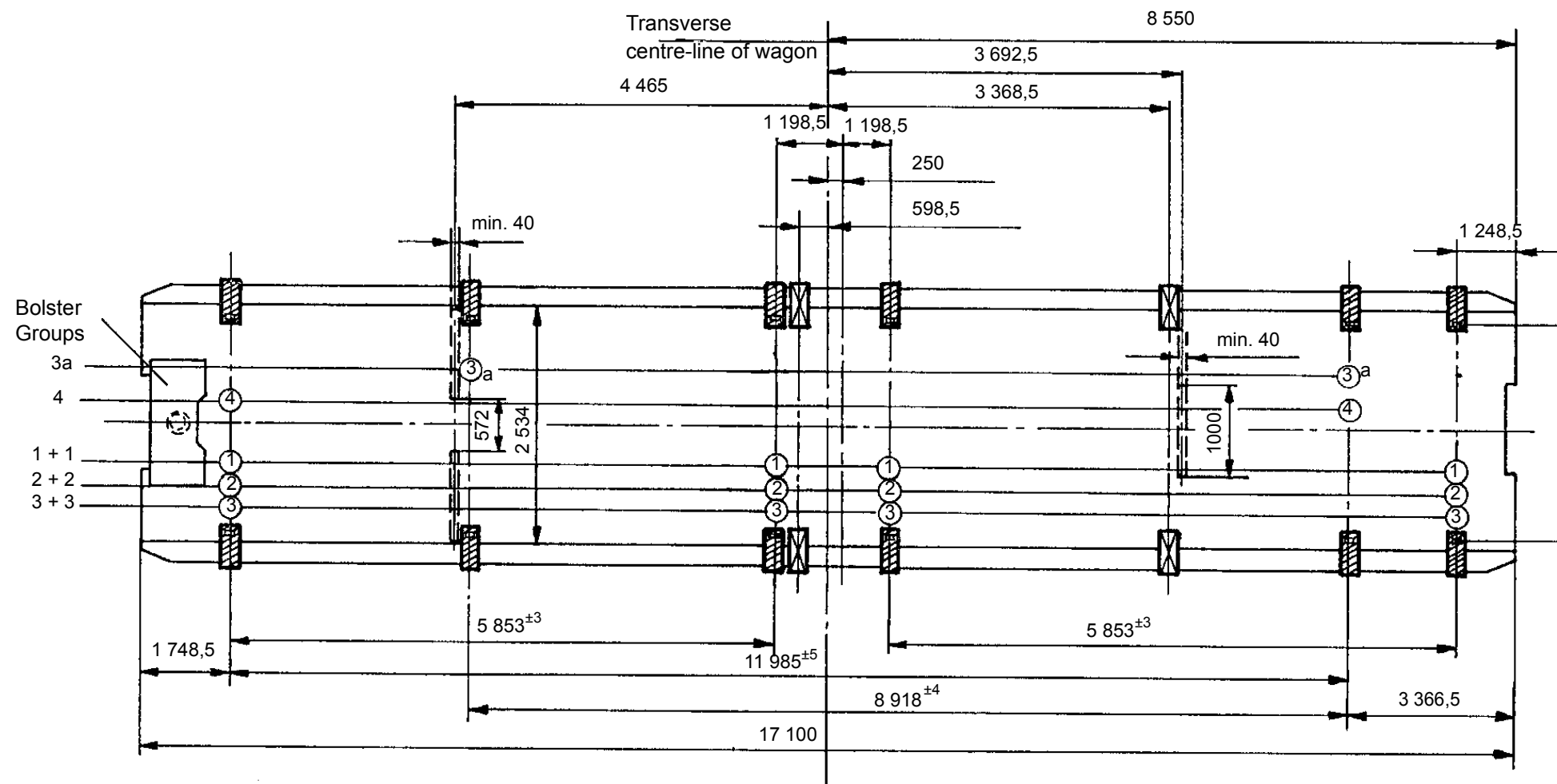
H.1 - Type 1a "Recess wagon" (Sdgkkmss)






Group	Length of swap body
1	6 250
2	7 150
3	8 050
3a	9 125
4	12 192 to 14 000

- Support for swap body
- Securing device (spigot)
- Possible position when moved

H.2 - Type 1b "Recess wagon" Sdgmss



Group	Length of swap body
1	6 250
2	7 150
3	8 050
3a	9 125
4	12 192 to 14 000

-  Support for swap body
-  Securing device (spigot)
-  Possible position when moved

The bearing surfaces of the intermediate parts and securing devices must permit swap bodies measuring 2,6 m in width at base level to be loaded over the fixing devices.

Appendix I - Markings to be applied to the upper surface of the longitudinal girders of rail-road traffic wagons (one marking per girder)

I.1 - Example of inscription

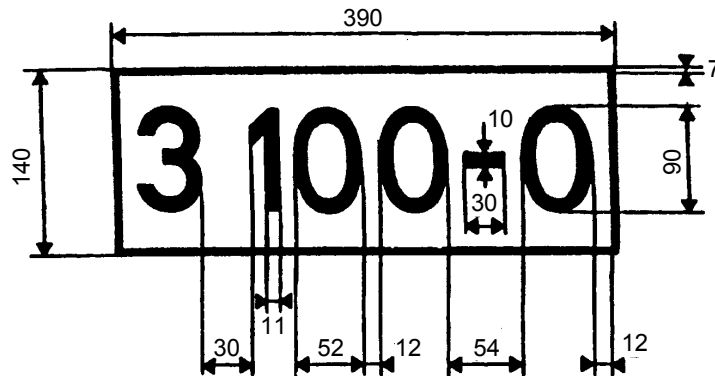


Fig. 16 - Inscription (example)

I.2 - Position of inscriptions

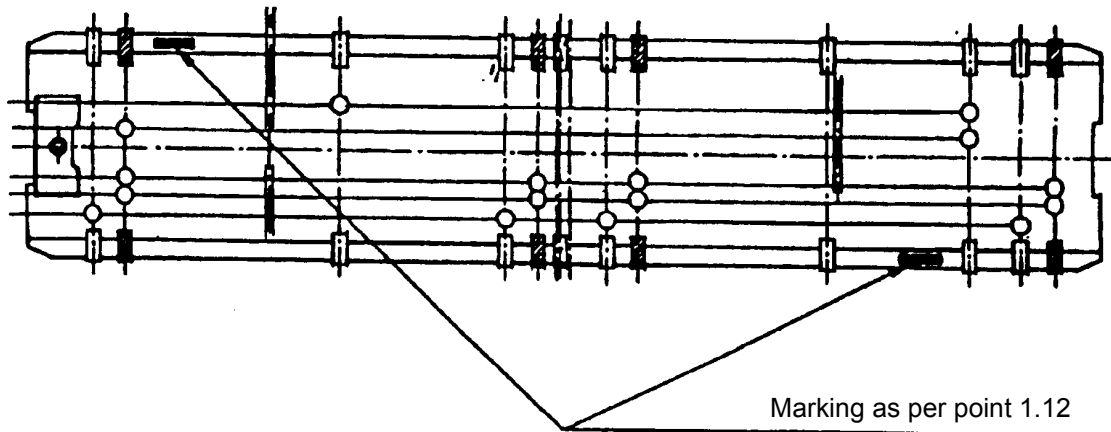


Fig. 17 - Example of markings on "Recess" wagon

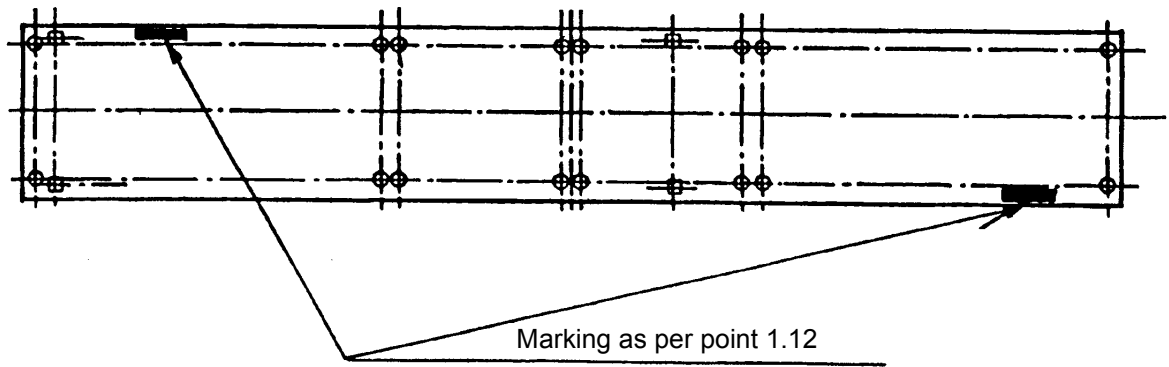
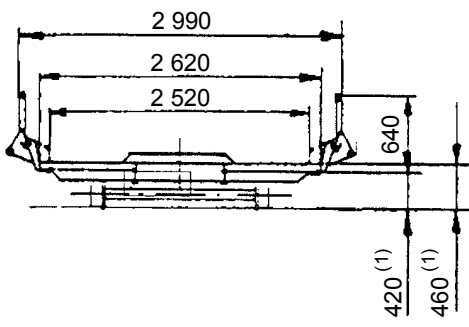
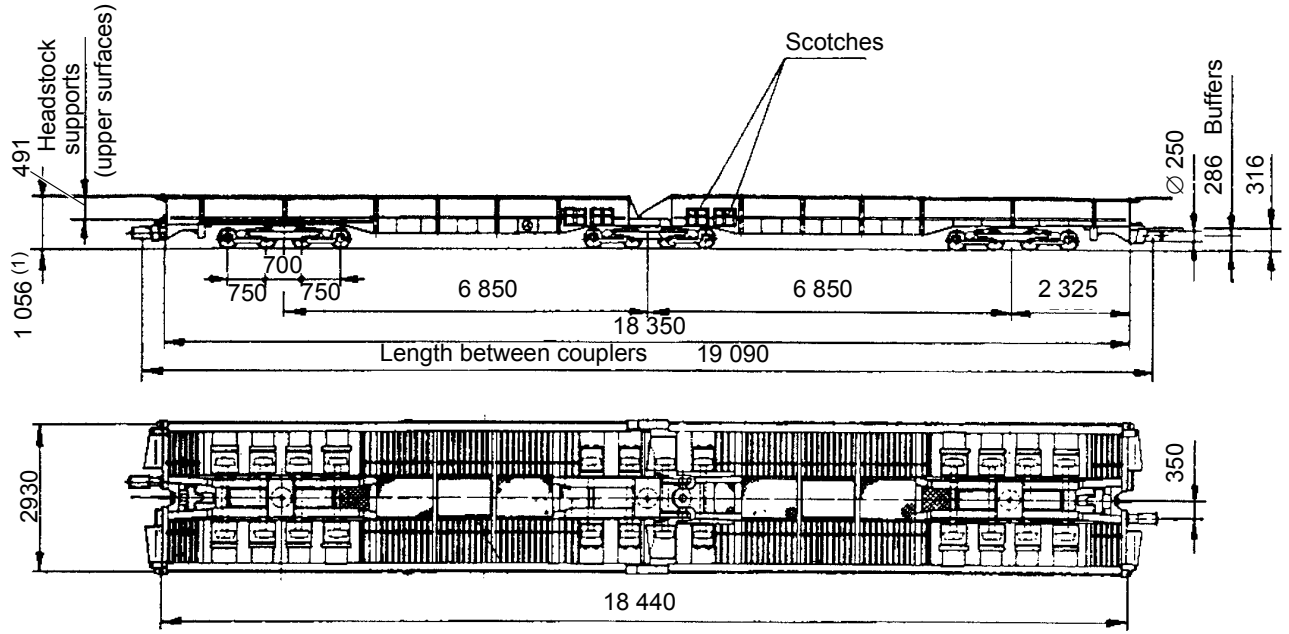


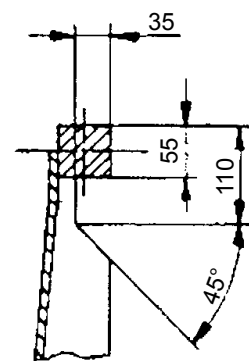
Fig. 18 - Example of markings on "Type 2 wagons"

Appendix J - Rolling road wagons (RR) - Dimensional characteristics

J.1 - Type 4 - RR_{Alpine} wagon

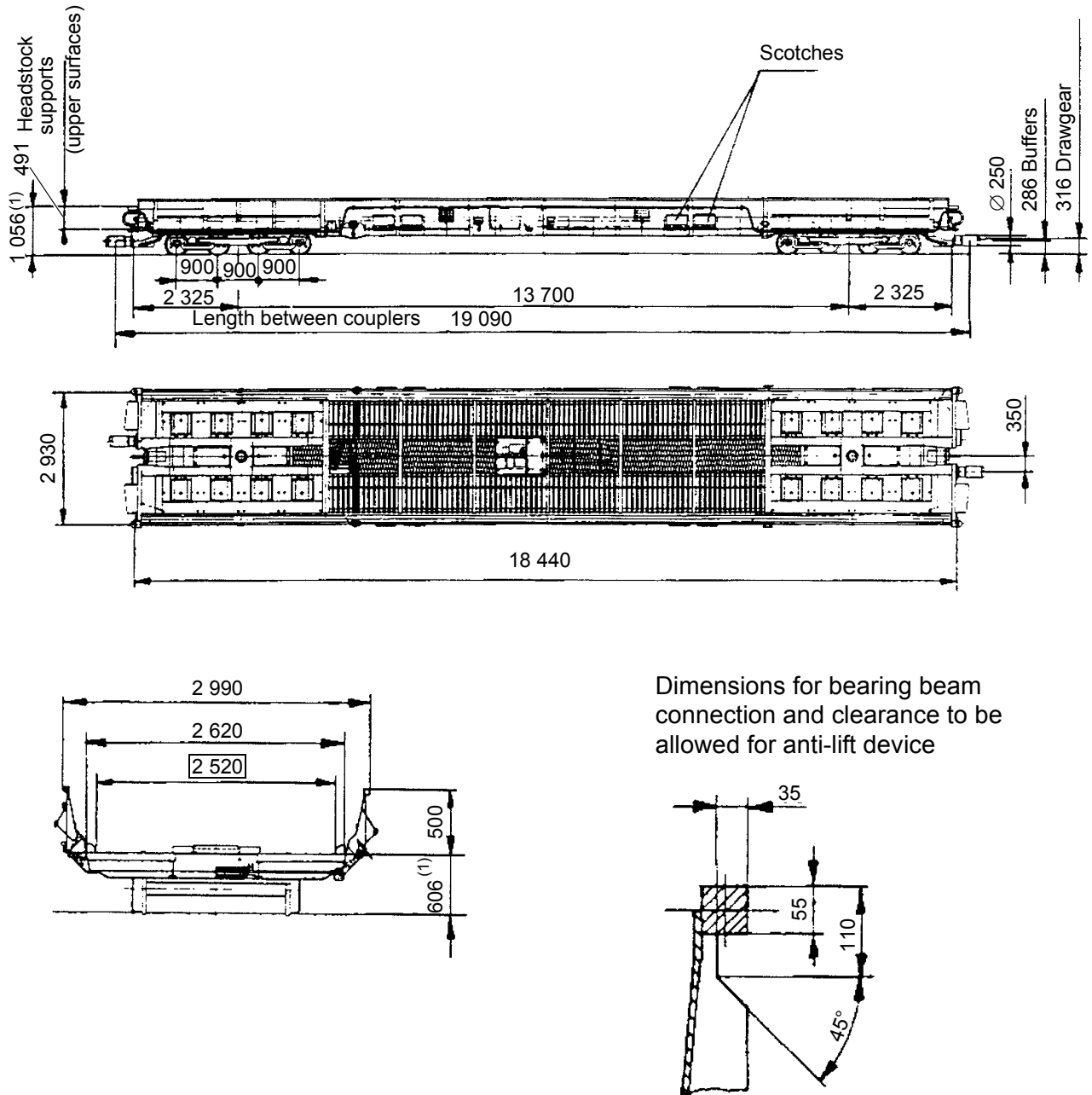


Dimensions for bearing beam connection and clearance to be allowed for anti-lift device



(1) Wagon in empty state

J.2 - Type 4 - RR_{flat} land wagon



Dimensions for bearing beam connection and clearance to be allowed for anti-lift device

(1) Wagon in empty state

Appendix K - Rolling road wagons (RR) - Size and dimensions

K.1 - Type 4 wagon - RR_{Alpine} and RR_{flat land}

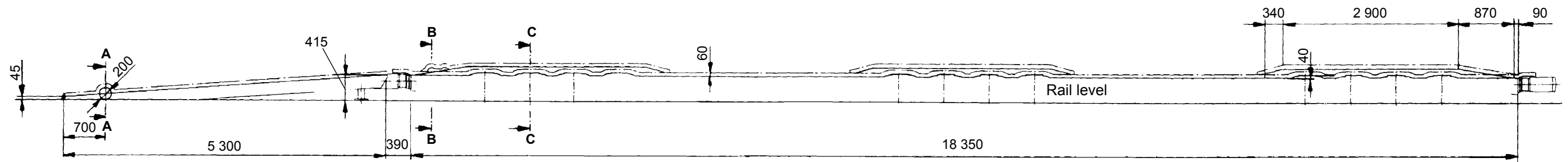


Fig. 19 - Size and dimensions RR_{Alpine} (including ramp)

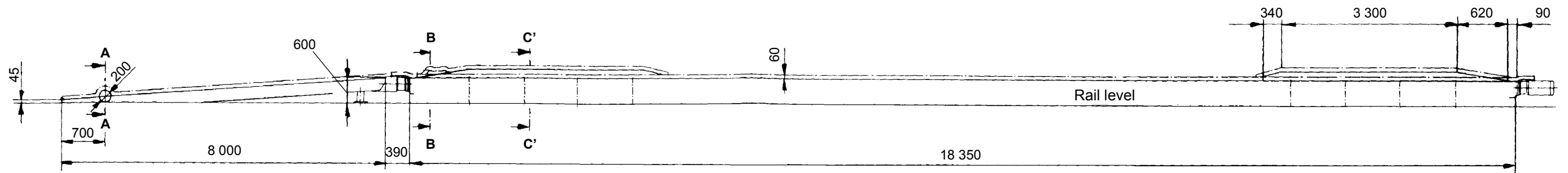
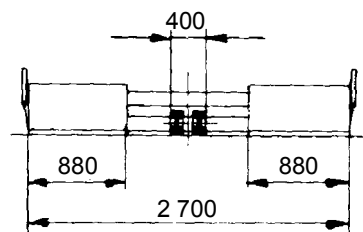
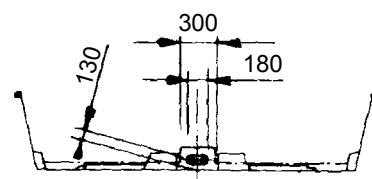


Fig. 20 - Size and dimensions RR_{flat land} (including ramp)

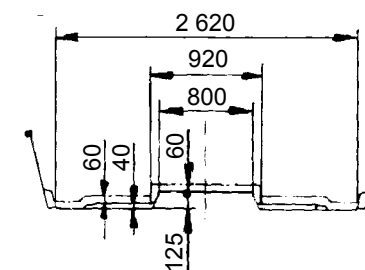
A-A



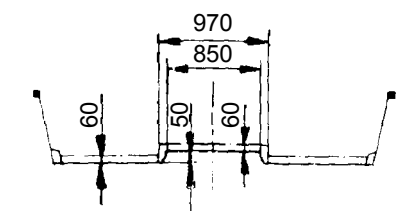
B-B



C-C

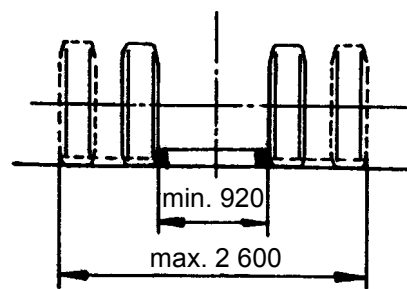
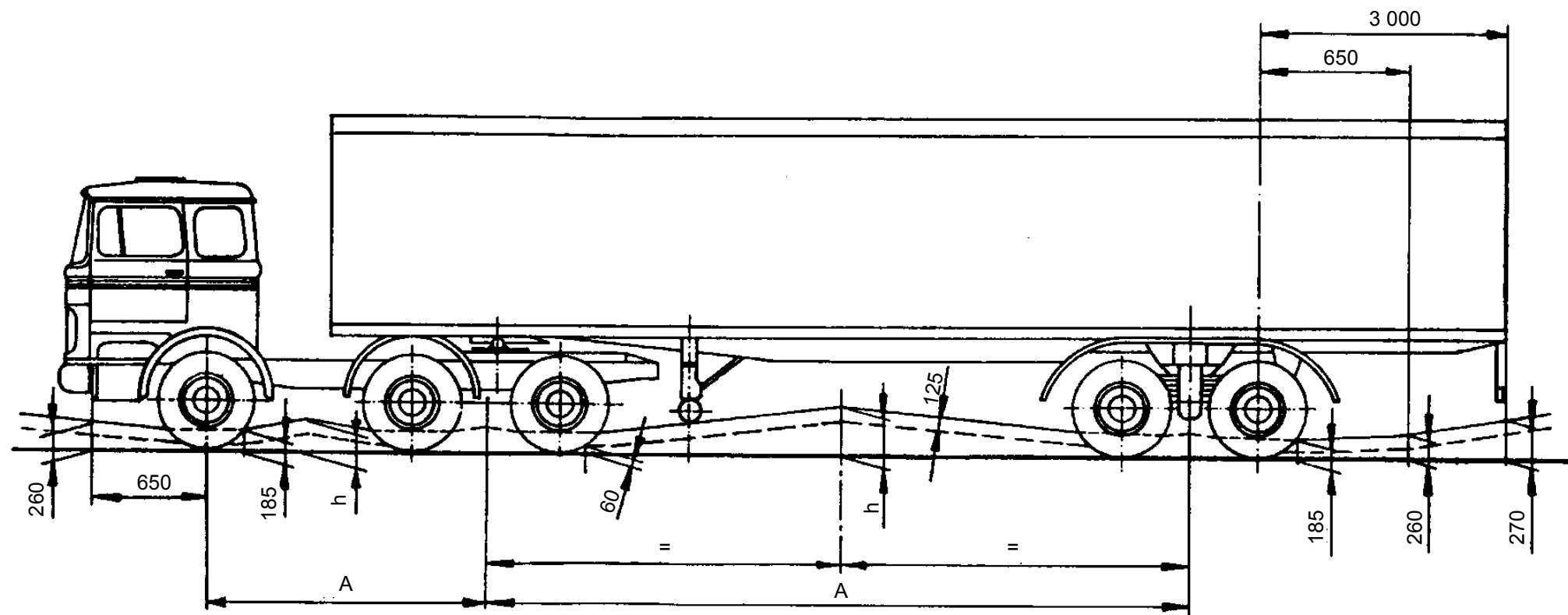


C'-C'



--- lower clearance gauge for road vehicles except wheels.

K.2 - Type 4 wagon intermodal - Size and dimensions - Road vehicles - RR_{Alpine} and RR_{flat land}



— applicable between wheels up to max. 920 mm
 - - - applicable in the wheel area up to a max. width of 2 600 mm

A	3,5 m	5,5 m	6 m	6,5 m	7 m	7,5 m	8 m	8,5 m
h	250 mm	265 mm	290 mm	300 mm	310 mm	320 mm	325 mm	340 mm

Rules transposable to all types of road vehicle.

Appendix L - Rolling road wagons (RR) - Loading positions

Type 4 wagon RR_{Alpine} and $RR_{\text{flat land}}$

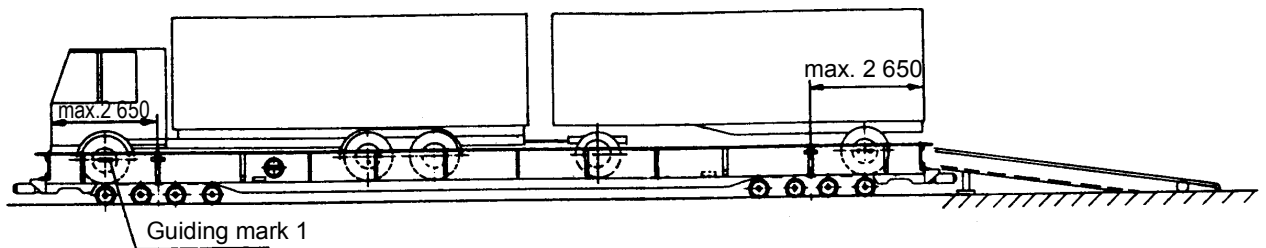


Fig. 21 - Loading position for a lorry - Guiding mark 1 -

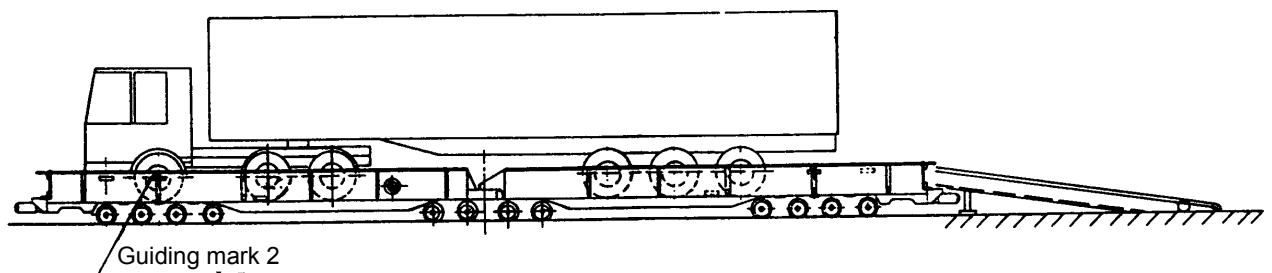


Fig. 22 - Loading position for an articulated road train - Guiding mark 2 -

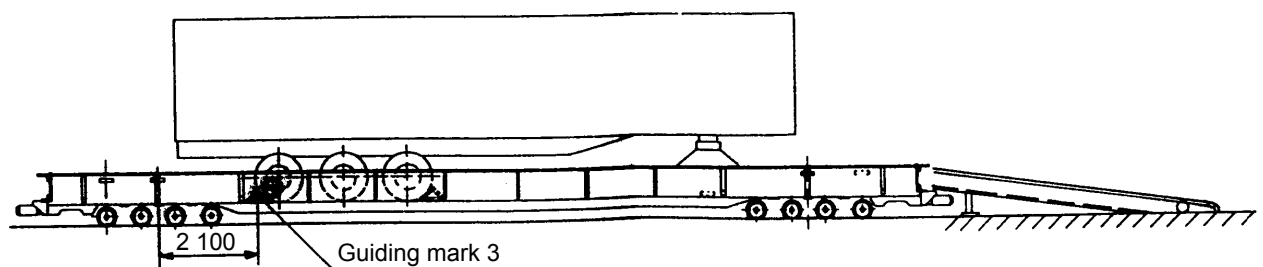
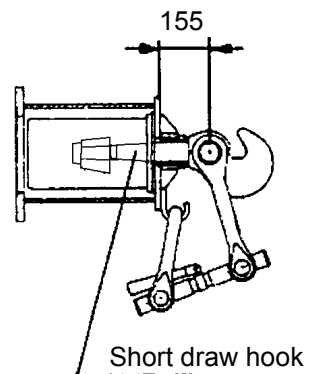
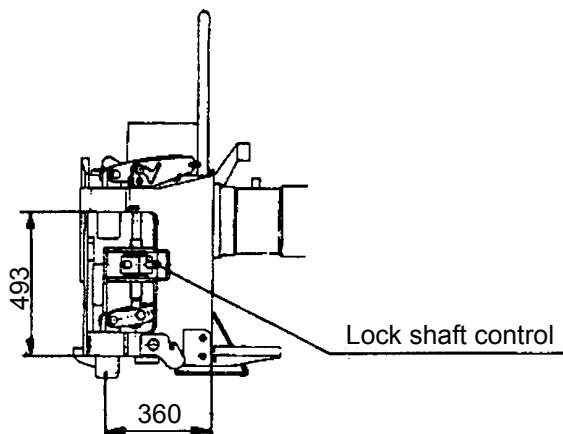
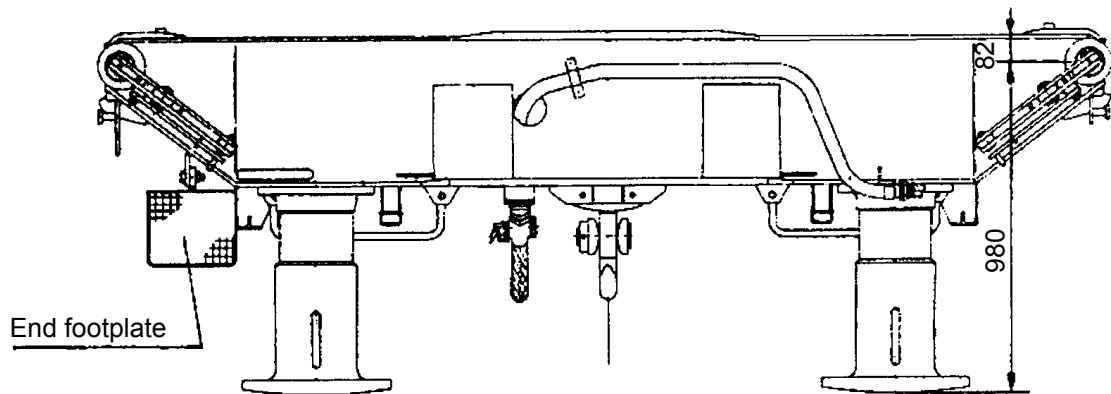
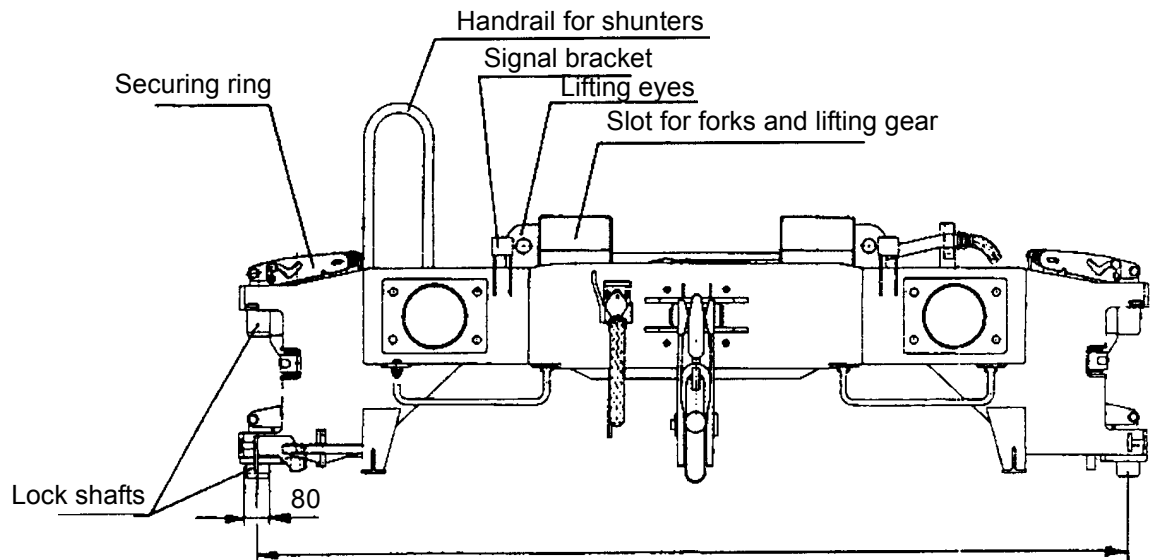


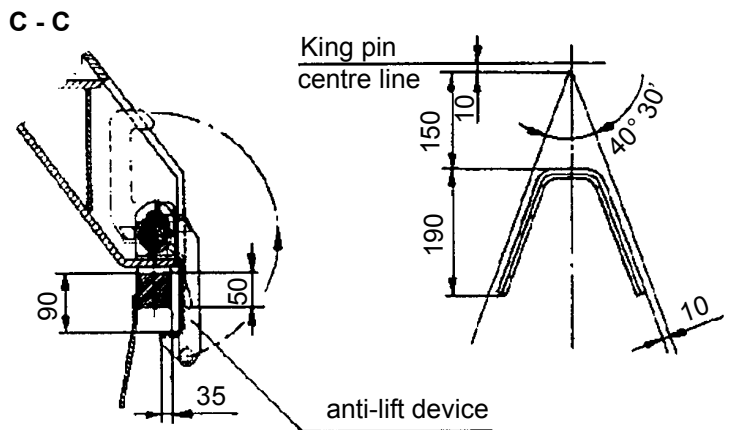
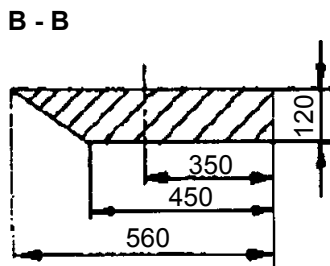
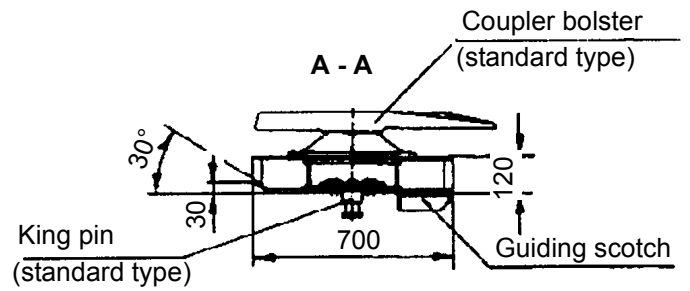
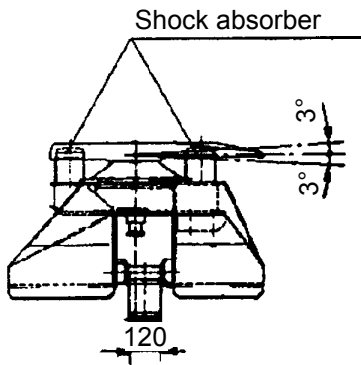
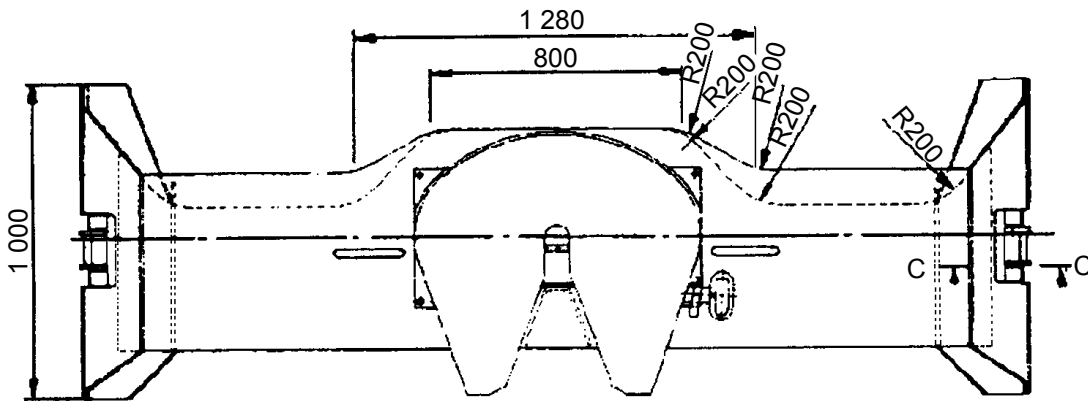
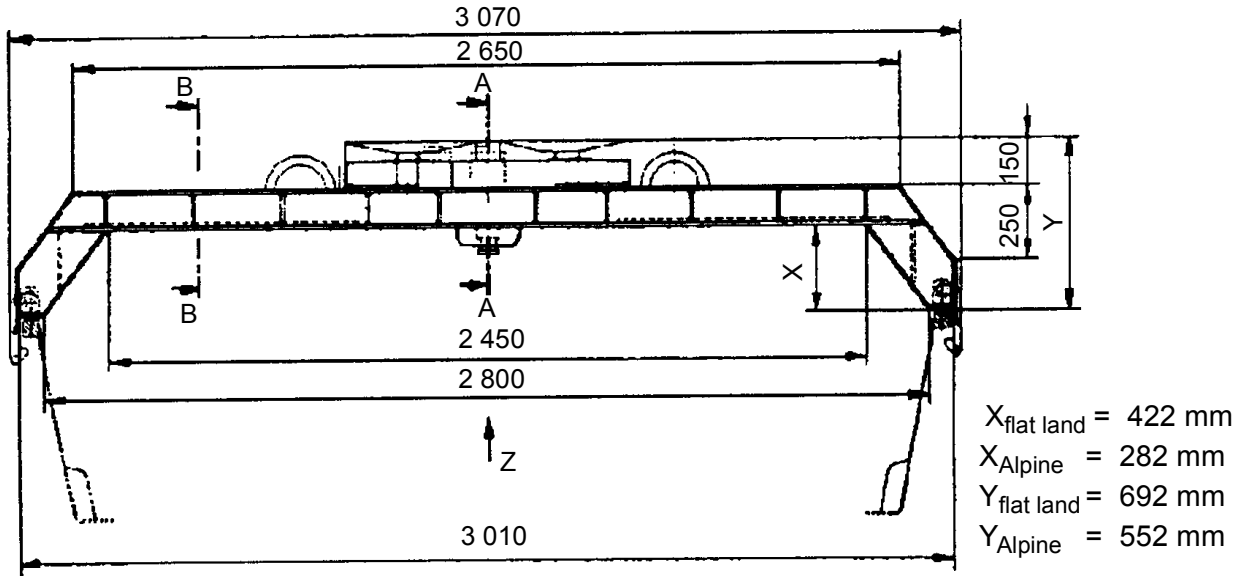
Fig. 23 - Loading position for a semi-trailer - Guiding mark 3 -

Appendix M - Rolling road wagons (RR) - Fittings - Additional fittings

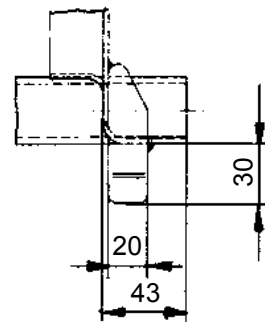
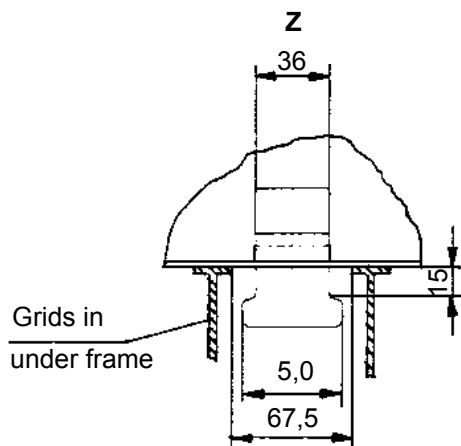
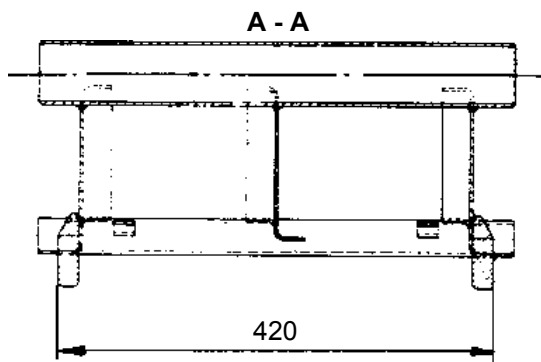
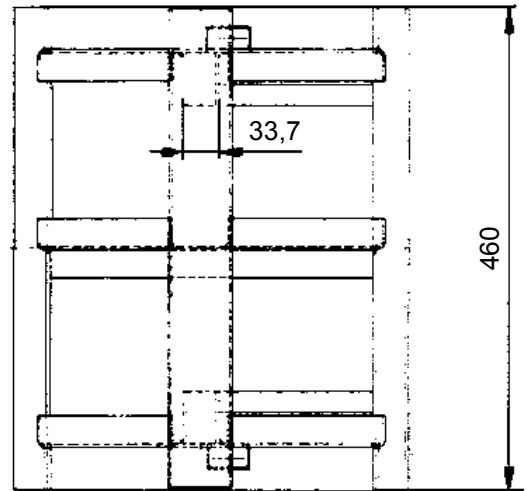
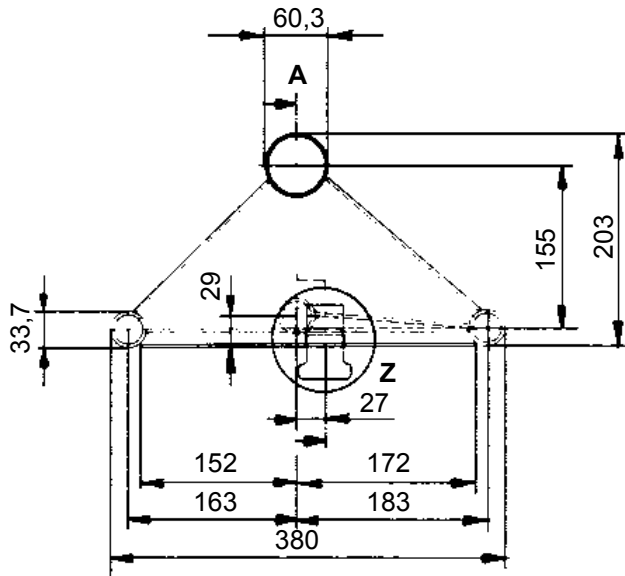
M.1 - Headstock



M.2 - Supporting beam

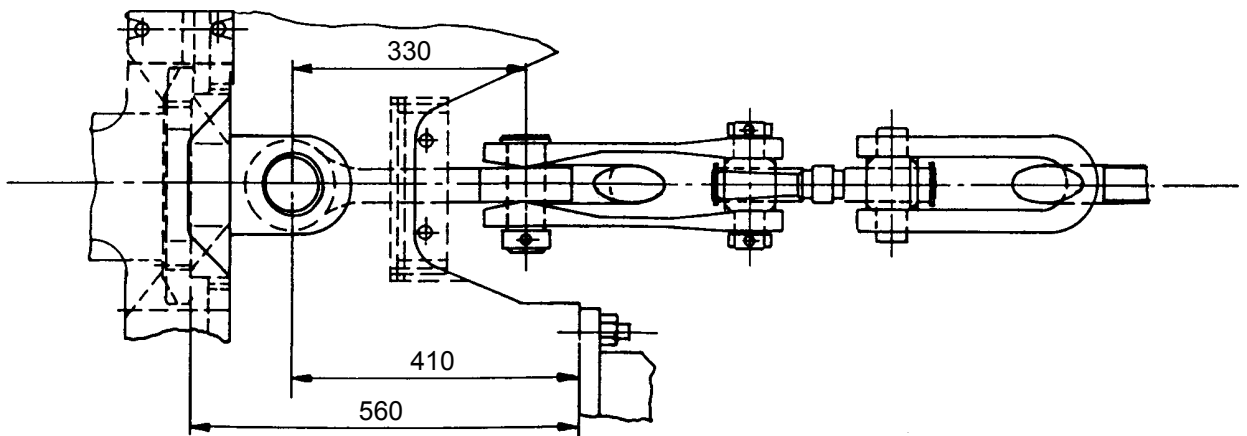
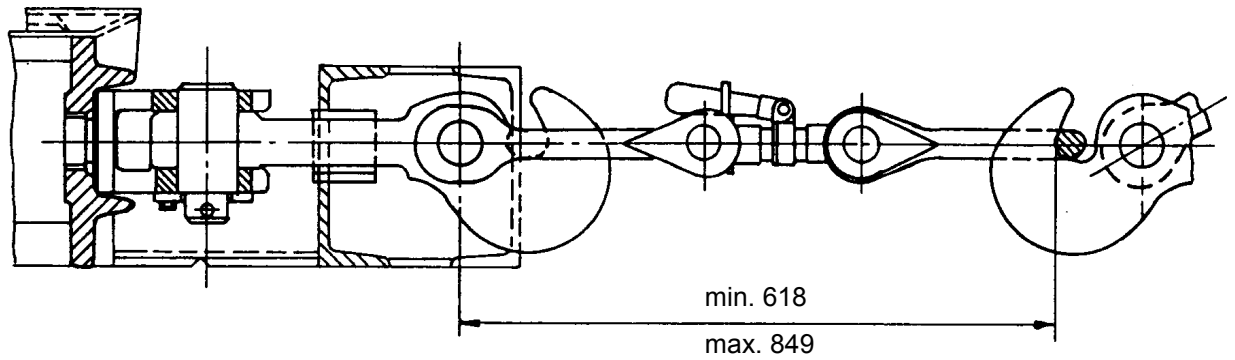


M.3 - Scotch



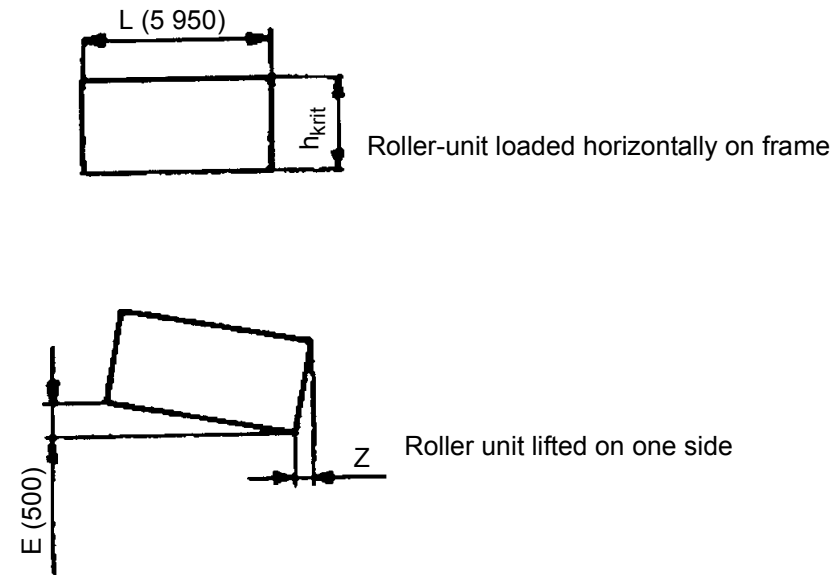
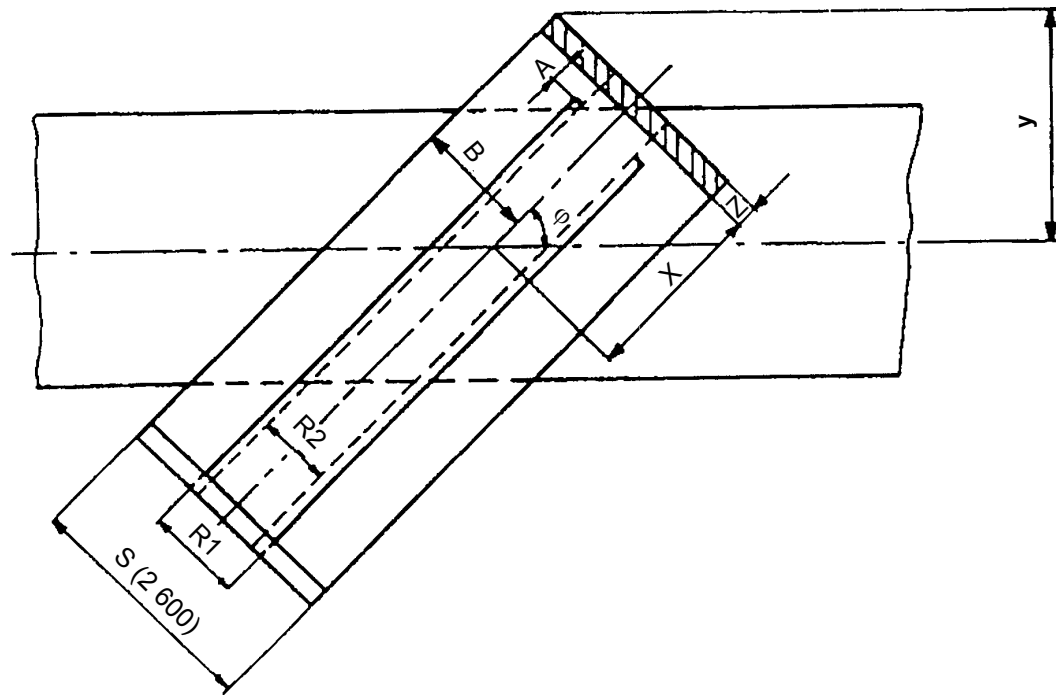
Appendix N - Type 4 - Rolling road wagons

Drawgear characteristics for the type RR_{flat land}



Appendix O - Type 1 wagons for conveyance of horizontally-transferred roller-units

O.1 - Definition of pivoted roller unit overhang



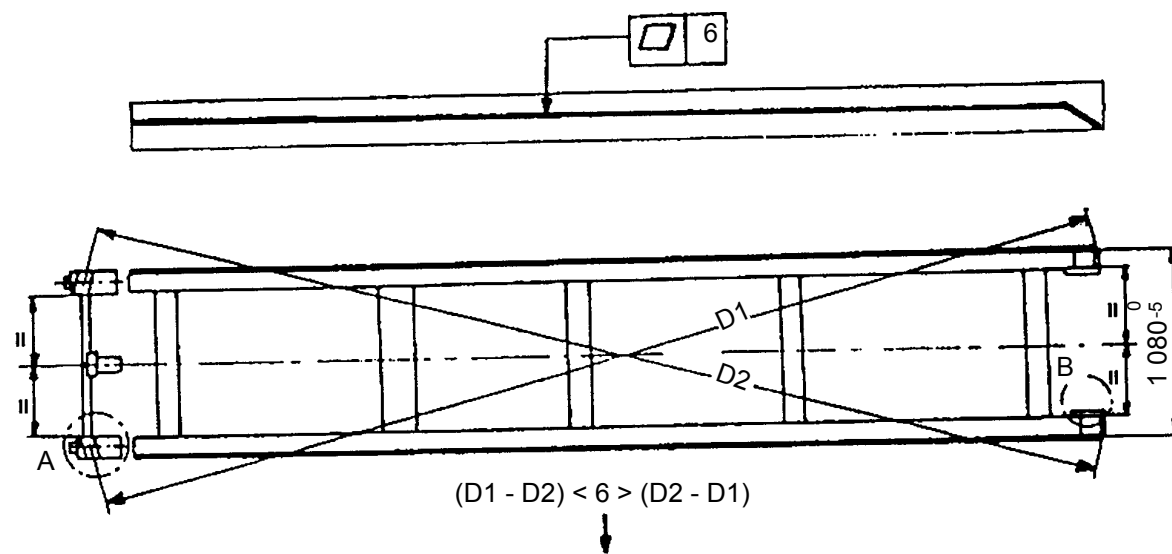
- L = Length of roller unit
- h_{krit} = Measurement of maximum height as per 4.2.7 - page 30
- S = Width of roller unit
- R1 = Width of frame
- R2 = Width of roller unit solebar
- A = Horizontal projection
- X = Clearance between pin and roller-unit extremity
- Z = Increase in length due to overthrow
- E = Lifting height
- φ = Maximum pivoting angle of frames
- Y = Overhang of pivoted roller unit

$$(1) \quad Z = \frac{E \cdot h_{krit}}{L} \quad \left[Z = \frac{500 \cdot h_{krit}}{5950} \right]$$

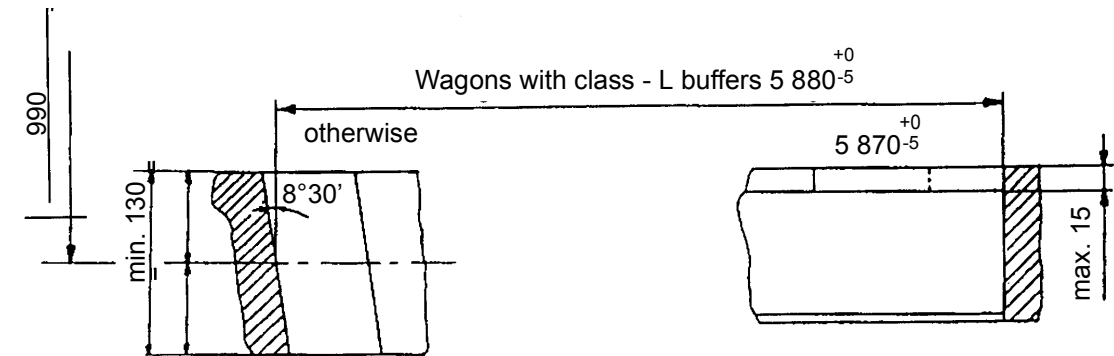
$$(2) \quad B = \frac{S + R1 - R2}{2}$$

$$(3) \quad Y = (X + Z) \sin \phi + B \cos \phi$$

O.2 - Dimensions - ACTS



During service life, can reach: 10 mm

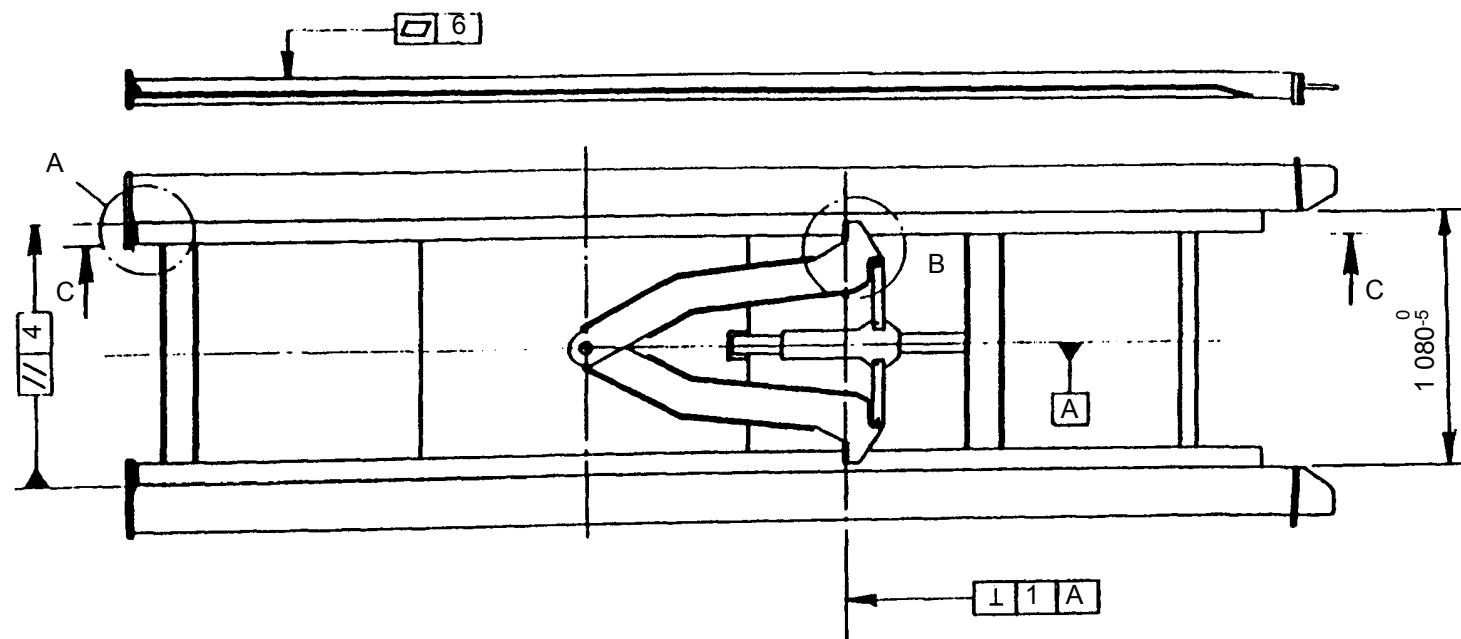


Detail "A"

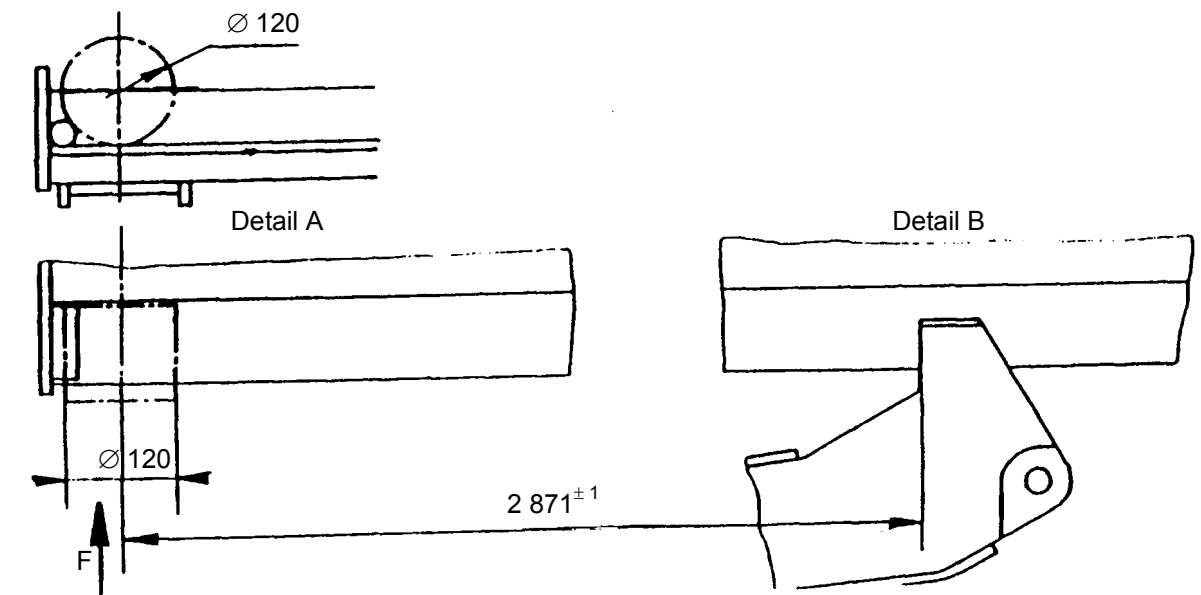
Detail "B"

O.3 - Dimensions - SNCF

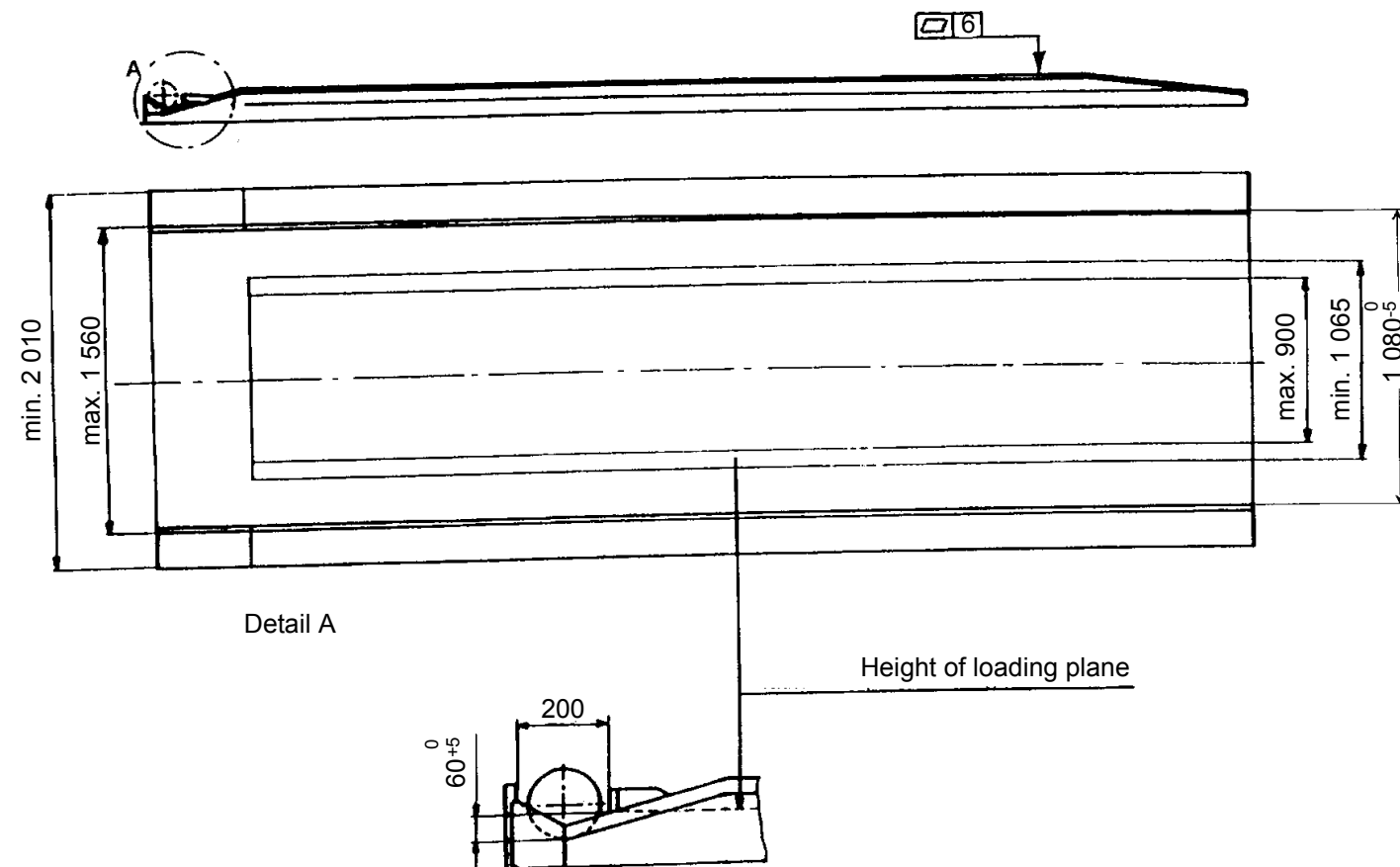
Section C - C



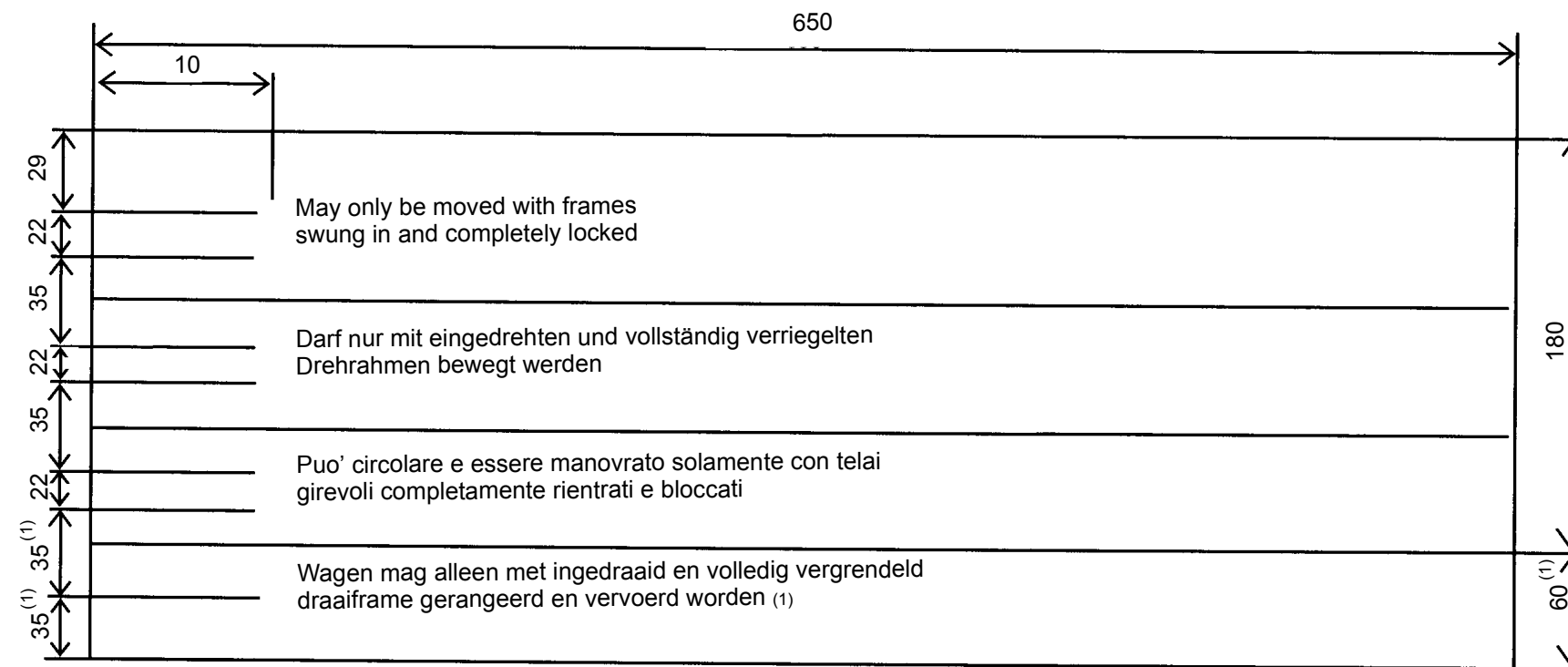
View F



O.4 - Dimensions - RSS



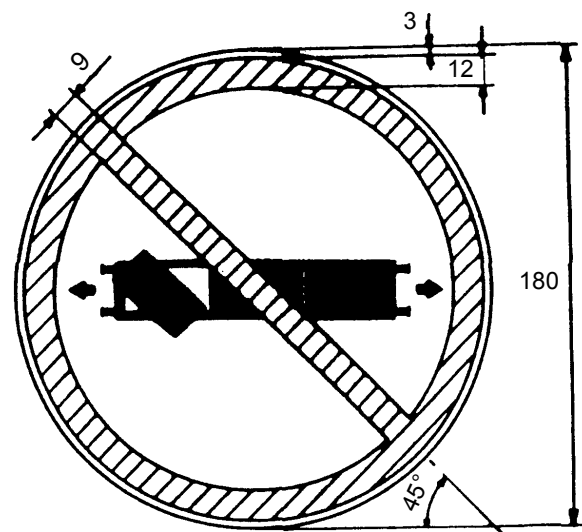
O.5 - Marking and example "Not to be moved with pivoted frame swung out"



(1) Country's language, if necessary

Background : White
Text : Black

O.6 - Markings and pictograms



- white
- red
- black

Fig. 24 - Pictogram - "Not to be used with frame swung out"

10 Max. Tragfähigkeit
35 Maximum load

21.0 35 70

Fig. 25 - Marking "maximum load" per frame

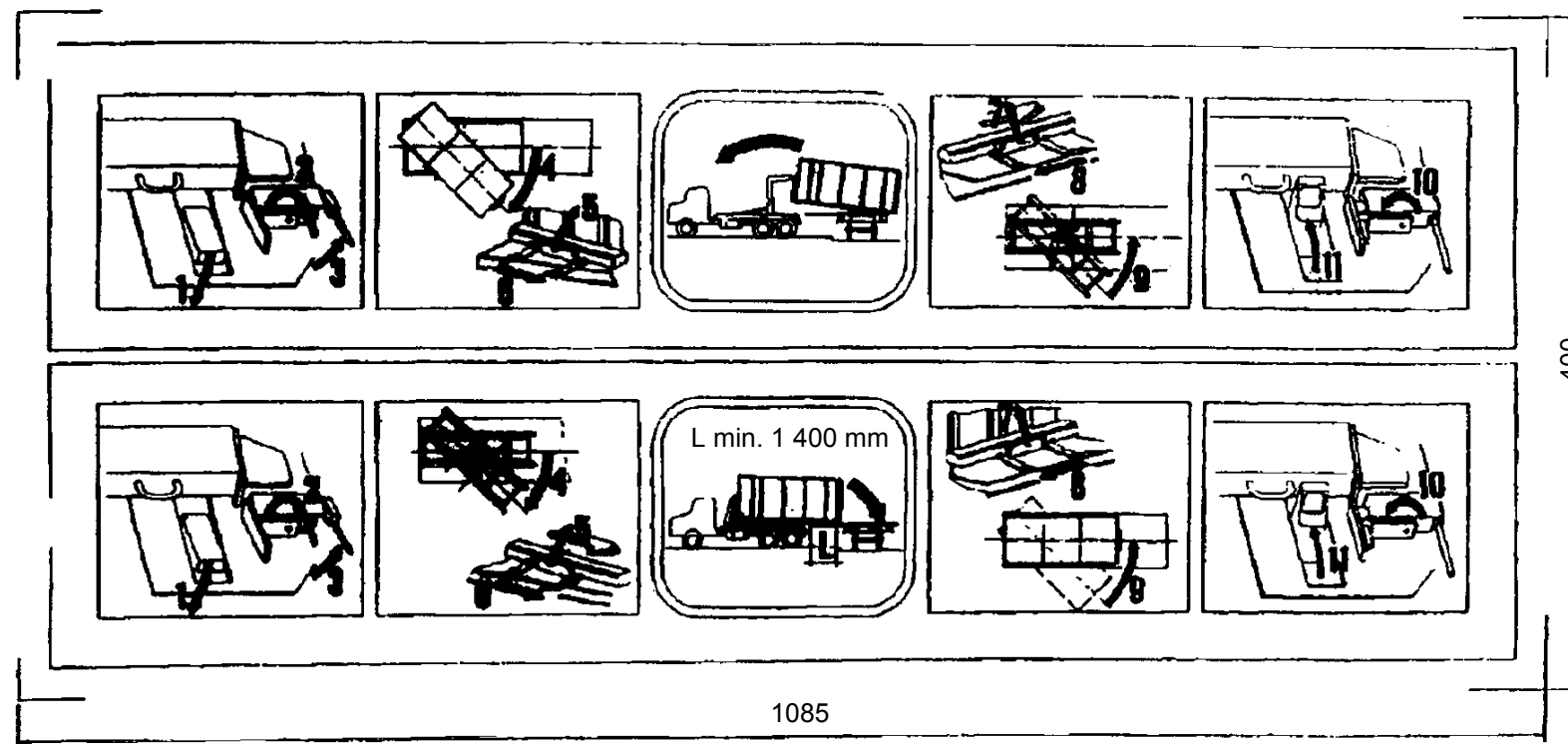


Fig. 26 - Example of "Method of operation" pictogram

Appendix P - Type 1 wagons for conveyance of horizontally-transferred roller units - Calculation formula for safety against overturning

The safety factor against overturning v is defined as follows:

$$v = W_l/W_r \quad (1)$$

Where:

W_l Represents the total load on wheels on the "left side" of the roller unit

W_r Represents the total load on wheels on the "right side" of the roller unit

The safety factor v is thus the ratio between the wheel loads. When calculating the safety factor against overturning below, the wagon is assumed to tend to overturn on its left side. The safety factor cannot exceed a given value. The maximum value has been set at 14.

The model (see Fig. 27 - page 82) is used to perform the comparison to define the safety factor against overturning.

For calculation purposes, the following assumptions (restrictions) are made:

- The wagon (excluding the pivoting frames) is symmetrical with respect to the central part. This means that the centre of gravity of the wagon and the pivoting points of the rotating frames are located on the longitudinal centre line of the wagon.
- On the wagon itself, a number "n" of roller units can be loaded. The roller units already loaded on the wagon are identified by means of index "i". The dimensions, which relate to the i^{th} roller unit are thus assigned index "i". In other words, allowance can be made for any number of roller units, which can each have different dimensions and positions on the frames.
The roller units which are loaded onto the wagon are assigned index "j". The dimensions, which relate to the j^{th} roller unit are assigned index "j". In other words, allowance can be made for any number of roller units, which can be loaded simultaneously on the wagon and which can each have different dimensions and positions (roller unit "i" \neq roller unit "j").
- The pivoting points of the frames are located on the longitudinal centre line of the roller unit (in other words viewed in terms of the width (b_j) of the roller unit centrally). The rotary points of the frames can take on any position in the longitudinal direction of the roller unit with respect to roller unit (a_i).
- The wagon suspension as well as the "slanting suspension" of the pivoting frames with respect to the wagon body (due to slack in the fixture of the pivoting frame on the wagon, the wagon torsional stiffness and the play, etc.), are not included. A slanting position of the wagon due to cant or track subsidence, etc. is not taken into consideration.

- The weight of the frames is included in the wagon weight.

The balance achieved between vertical loads is expressed as follows:

$$m_{tot} \times g + j \sum F_j = W_r + W_l \tag{2}$$

Where:

- g Acceleration due to gravity (9,81 m/s²).
- j∑ (sigma) the "summation" sign. The term behind this sign must be calculated for each roller unit "j" present and aggregated afterwards.
- m_{tot} Overall weight of the wagon plus the weight of the roller units loaded on them ("i").

$$m_{tot} = m_w + i \sum [m_{c,i} + m_{l,i}] \tag{3}$$

Where:

- m_w Weight of wagon
- m_{c,i} Weight of roller unit "i" (excluding the load)
- m_{l,i} Weight of load in roller unit "i"
- i∑ (sigma) the "summation" sign. The term behind this sign must be calculated for each roller unit "i" present and aggregated afterwards.
- F_j Load exerted on the end-part of frame "j" when the roller unit is loaded using a hook-type mechanism on the frame. (Where stability is concerned, loading with a hook-type device is less favourable than loading using a chain-type system).

F_j must be calculated as follows:

$$F_j = \left(\frac{1}{2} + \left(\frac{e_j}{l_j} \right) \right) \times m_{l,j} \times g + \frac{1}{2} \times m_{c,i} \times g \tag{4}$$

Where:

- l_j Length of roller unit "j"
- e_j Distance of the centre of gravity of the load in roller unit "j" from the centre (see Fig. 27 - page 82). The prescribed value e_j represents 15 % of the roller-unit length.
(This implies: F_j = 0,65 x m_{l,j} x g + 0,5 x m_{c,j} x g)
- m_{c,j} Weight of roller unit "j" (excluding the load)
- m_{l,j} Weight of the load inside roller unit "j"

Taking moments around the left-side rail (see Fig. 27 - page 82):

$$m_w \times g \times \frac{1}{2}s + \sum_i [m_{l,j} \times g \times \left(\frac{1}{2}s - e_i \times \sin \varphi_i\right) + m_{c,i} \times g \times \left(\frac{1}{2}s - \left(\frac{1}{2}l_j - a_i\right) \times \sin \varphi_i\right)] + \sum_j [F_j \times \left(\frac{1}{2}s + -t_j \times \sin \varphi_j\right)] = M_{Wind} + W_r \times s \quad (5)$$

Where:

- φ_i Pivoting angle of the frame of roller unit "i"
- φ_j Pivoting angle of the frame of roller unit "j"
- e_i Distance from the pivot of the frame to the centre of gravity of the load of roller unit "i"; e_i is positive if the centre of gravity is located in front of the pivot (see Fig. 27).

e_i is calculated as follows:

$$e_i = \left(\frac{1}{2} + \frac{x}{100}\right) \times l_i - a_i \quad (6)$$

Where:

- x Prescribed percentage of 15 %.
This implies: $e_i = 0,65 \times l_i - a_i$
- a_i Position of the pivot of frame "i" with respect to the roller unit loaded onto the frame (see Fig. 27).
- t_j Distance from the pivot of frame "j" to the extreme loading point on the frame
- s Track gauge
- M_{Wind} Total overturning moment due to wind force.

M_{Wind} is calculated as follows:

$$M_{Wind} = \sum_i [P_w \times A_{p,i} \times q_i] \quad (7)$$

Where:

- P_w Wind force (same for all roller units on the wagon). The prescribed value for P_w is 200 N/m².
- $A_{p,i}$ Projected surface of roller unit "i" vertically to the direction of the wind (assumed to be blowing across the wagon).

$A_{p,i}$ is calculated as follows:

$$A_{p,i} = h_i \times (b_i \times \sin \varphi_i + l_i \times \cos \varphi_i) \quad (8)$$

h_i , b_i and l_i represent the dimensions of the roller unit "i" (see Fig. 27).

q_i Height of the point of pressure of the wind force on roller unit "i".

q_i is calculated as follows:

$$q_i = z_i + \frac{1}{2}h_i \quad (9)$$

z_i represents the height of the pivoting frame for roller unit "i" (see Fig. 27 - page 82).

To determine M_{Wind} , the wind force is assumed only to affect the roller units loaded on the wagon. It is also assumed that the wind force on the roller unit(s) "j" which are being loaded on the wagon will be absorbed by the lorry. The moment of the wind-force on the wagon is minimal compared with the moment of the wind-force on the roller units, because of the relatively short overhang and of the low pressure point of the wind-force of the wagon (in addition, both the projected surfaces of the wagon and the pressure point of the wagon are difficult to calculate/determine).

As a result of equations 2, 3 and 5, the following values are obtained for W_r and W_l :

$$W_r = \sum_i \left[m_{l,i} \times g \times \left(\frac{1}{2} - \frac{e_i}{s} \sin \varphi_i \right) + m_{c,i} \times g \times \left(\frac{1}{2} - \frac{\frac{1}{2}l_i - a_i}{s} \right) \times \sin \varphi_i \right] + \sum_j \left[F_j \left(\frac{1}{2} - \frac{t_j}{s} \sin \varphi_j \right) \right] + \frac{1}{2} m_w \times g - \frac{M_{Wind}}{s} \quad (10)$$

$$W_l = m_{tot} \times g + \sum_j F_j - W_r \Rightarrow$$

$$W_l = m_{tot} \times g + \sum_j F_j - \left[\sum_i \left[m_{l,i} \times g \times \left(\frac{1}{2} - \frac{e_i}{s} \sin \varphi_i \right) + m_{c,i} \times g \times \left(\frac{1}{2} - \frac{\frac{1}{2}l_i - a_i}{s} \right) \sin \varphi_i \right] + \sum_j \left[F_j \times \left(\frac{1}{2} - \frac{t_j}{s} \sin \varphi_j \right) \right] + \frac{1}{2} m_w \times g - \frac{M_{Wind}}{s} \right] \quad (11)$$

W_l and W_r can also be written as follows:

$$W_l = A + B \quad (12)$$

$$W_r = A - B \quad (13)$$

A represents half the total vertical load whereas B represents transmission of the load from the right side to the left side of the wagon.

$$A = \frac{1}{2} m_{tot} + \frac{1}{2} \sum_j F_j \quad (14)$$

$$B = \sum_i \left[m_{c,i} \times g \times \left(\frac{1}{2} l_i - a_i \right) \times \sin \varphi_i + m_{l,i} \times g \times \left(\frac{e_i}{s} \right) \times \sin \varphi_i \right] + \sum_j \left[F_j \times \left(\frac{t_j}{s} \right) \times \sin \varphi_j \right] + \frac{M_{Wind}}{s} \quad (15)$$

When W_r is negative, this means that the wagon will overturn. When W_r is positive, the safety factor against overturning v can be determined as follows:

$$v = \frac{W_l}{W_r} = \frac{(A + B)}{(A - B)} \quad (16)$$

The complete formula is as follows:

$$v = \frac{m_{tot} \times g + \sum_j F_j}{\frac{1}{2} m_w \times g + \sum_i \left[m_{l,i} \times g \times \left(\frac{1}{2} - \frac{e_i}{s} \sin \varphi_i \right) + m_{c,i} \times g \times \left(\frac{1}{2} - \frac{1}{2} \frac{l_i - a_i}{s} \right) \sin \varphi_i \right] + \sum_j \left[F_j \times \left(\frac{1}{2} - \frac{t_j}{s} \sin \varphi_j \right) \right] - \frac{M_{Wind}}{s}} - 1 \quad (17)$$

Example:

Notional wagon, used solely to illustrate the calculation method.

Loading scenario:

2 roller units for loading; 2 units already loaded on wagon.

Loaded roller units ("i")				Roller units for loading ("j")			
Roller unit 1		Roller unit 2		Roller unit 1		Roller unit 2	
Weight of roller unit:	4 t	Weight of roller unit:	1 t	Weight of roller unit:	2 t	Weight of roller unit:	3 t
Length:	5 m	Length:	6 m	Length:	a	Length:	a
Width:	2 m	Width:	2 m	Width:	a	Width:	a
Height:	2 m	Height:	1 m	Height:	a	Height:	a
Load:	20 t	Load:	5 t	Load:	10 t	Load:	15 t
φ_1	10°	φ_2	50°	φ_1	40°	φ_2	30°
a_1	2 m	a_2	1 m	a_1	a	a_2	a
z_1	1 m	z_2	1 m	z_1	a	z_2	a
t_1	a	t_2	a	t_1	3 m	t_2	2 m

a. Means (in this scenario) that these variables are not used for calculating "v".

Wagon mass: 30 t

Track gauge: 1,435 m

Acceleration due to gravity: 9,81 m/s²

$$m_{\text{tot}} = m_w + \sum_i [m_{c,i} + m_{l,j}] = 30\,000 + [(4\,000 + 20\,000) + (1\,000 + 5\,000)] = 60\,000 \text{ kg}$$

$$m_{\text{tot}} \times g = 60\,000 \times 9,81 = 588\,600 \text{ N}$$

$$F_j = \left(\frac{1}{2} + \frac{e_j}{l_j} \right) \times m_{l,j} \times g + \frac{1}{2} \times m_{c,j} \times g ; e_j = 0,15 \times l_j \Rightarrow F_j = 0,65 \times m_{l,j} \times g + 0,5 \times m_{c,j} \times g$$

$$F_1 = 0,65 \times 10\,000 \times 9,81 + 0,5 \times 2\,000 \times 9,81 = 73\,575 \text{ N}$$

$$F_2 = 0,65 \times 15\,000 \times 9,81 + 0,5 \times 3\,000 \times 9,81 = 110\,362,5 \text{ N}$$

$$\sum_j F_j = F_1 + F_2 = 183\,937,5 \text{ N}$$

$$\frac{1}{2} \times m_w \times g = \frac{1}{2} \times 30\,000 \times 9,81 = 147\,150 \text{ N}$$

$$i \sum \left[m_{l,i} \times g \varphi_i \times \left(\frac{1}{2} - \frac{e_i}{s} \sin \varphi_i \right) + m_{c,i} \times g \times \left(\frac{1}{2} - \left(\frac{\frac{1}{2} l_i - a_i}{s} \right) \right) \times \sin \varphi_i \right]$$

$$= \left[m_{l,1} \times g \times \left(\frac{1}{2} - \frac{e_1}{s} \sin \varphi_1 \right) + m_{c,1} \times g \times \left(\frac{1}{2} - \left(\frac{\frac{1}{2} l_{i1} - a_1}{s} \right) \right) \times \sin \varphi_1 \right]$$

$$+ \left[m_{l,2} \times g \times \left(\frac{1}{2} - \frac{e_2}{s} \sin \varphi_2 \right) + m_{c,2} \times g \times \left(\frac{1}{2} - \left(\frac{\frac{1}{2} l_2 - a_2}{s} \right) \right) \times \sin \varphi_2 \right]$$

$$e_i = \left(\frac{1}{2} + \frac{x}{100} \right) \times l_i - a_i$$

$$e_i = \left(\frac{1}{2} + \frac{15}{100} \right) \times 5 - 2 = 1,25 \text{ m}$$

$$e_2 = \left(\frac{1}{2} + \frac{15}{100} \right) \times 6 - 1 = 2,9 \text{ m} \Rightarrow$$

$$i \sum \left[m_{l,i} \times g \times \left(\frac{1}{2} - \frac{e_i}{s} \sin \varphi_i \right) + m_{c,i} \times g \times \left(\frac{1}{2} - \left(\frac{\frac{1}{2} l_i - a_i}{s} \right) \right) \times \sin \varphi_i \right]$$

$$= 20\,000 \times 9,81 \times \left(\frac{1}{2} - \left(\frac{1,25}{1,435} \right) \times \sin 10^\circ \right) + 4\,000 \times 9,81 \times \left(\frac{1}{2} - \left(\frac{\frac{1}{2} \times 5 - 2}{1,435} \right) \times \sin 10^\circ \right)$$

$$+ 5\,000 \times 9,81 \times \left(\frac{1}{2} - \left(\frac{2,9}{1,435} \right) \times \sin 50^\circ \right) + 1\,000 \times 9,81 \times \left(\frac{1}{2} - \left(\frac{\frac{1}{2} \times 6 - 1}{1,435} \right) \times \sin 50^\circ \right) = 28\,690,086 \text{ N}$$

$$\begin{aligned}
 \sum_j \left[F_j \times \left(\frac{1}{2} - \frac{t_j}{s} \sin \varphi_j \right) \right] &= F_1 \times \left(\frac{1}{2} - \frac{t_1}{s} \sin \varphi_1 \right) + F_2 \times \left(\frac{1}{2} - \frac{t_2}{s} \sin \varphi_2 \right) \\
 &= 73\,575 \times \left(\frac{1}{2} - \frac{3}{1,435} \sin 40^\circ \right) + 110\,362,5 \times \left(\frac{1}{2} - \frac{2}{1,435} \sin 30^\circ \right) = -83\,809,504 \text{ N}
 \end{aligned}$$

$$M_{\text{Wind}} = \sum_i [P_w \times A_{p,i} \times q_i] = P_w \times A_{p,1} \times q_1 + P_w \times A_{p,2} \times q_2$$

$$A_{p,i} = h_i \times (b_i \times \sin \varphi_i + l_i \times \cos \varphi_i)$$

$$A_{p,1} = 2 \times (2 \times \sin 10^\circ + 5 \times \cos 10^\circ) = 10,54267 \text{ m}^2$$

$$A_{p,2} = 1 \times (2 \times \sin 50^\circ + 6 \times \cos 50^\circ) = 5,3888145 \text{ m}^2$$

$$q_i = z_i + \frac{1}{2} h_i$$

$$q_1 = 1 + \frac{1}{2} \times 2 = 2 \text{ m}$$

$$q_2 = 1 + \frac{1}{2} \times 1 = 1,5 \text{ m}$$

$$(P_w = 200 \text{ N/m}^2) \Rightarrow$$

$$M_{\text{Wind}} = 200 \times 10,54267 \times 2 + 200 \times 5,3888145 \times 1,5 = 5\,833,7124 \text{ N} \times \text{m}$$

$$\frac{M_{\text{Wind}}}{s} = \frac{5\,833,7124}{1,435} = 4\,065,3048 \text{ N}$$

$$\begin{aligned}
 W_r = \sum_i \left[m_{l,i} \times g \times \left(\frac{1}{2} - \frac{e_i}{s} \sin \varphi_i \right) + m_{c,i} \times g \times \left(\frac{1}{2} - \left(\frac{\frac{1}{2} l_i - a_i}{s} \right) \right) \times \sin \varphi_1 \right] \\
 + \sum_j \left[F_j \times \left(\frac{1}{2} - \frac{t_j}{s} \sin \varphi_j \right) \right] + \frac{1}{2} m_w \times g - \frac{M_{\text{Wind}}}{s}
 \end{aligned}$$

$$W_r = 28\,690,086 - 83\,809,504 + 147\,150 - 4\,065,3048 = 87\,965,277 \text{ N}$$

$$W_l = m_{\text{tot}} \times g + \sum_j F_j - W_r \Rightarrow$$

$$W_l = 588\,600 + 183\,937,5 - 87\,965,277 = 684\,572,22 \text{ N}$$

$$v = \frac{W_l}{W_r} = \frac{684\,572,22}{87\,965,277} = 7,78$$

$$v < 14$$

This loading scenario can be accepted.

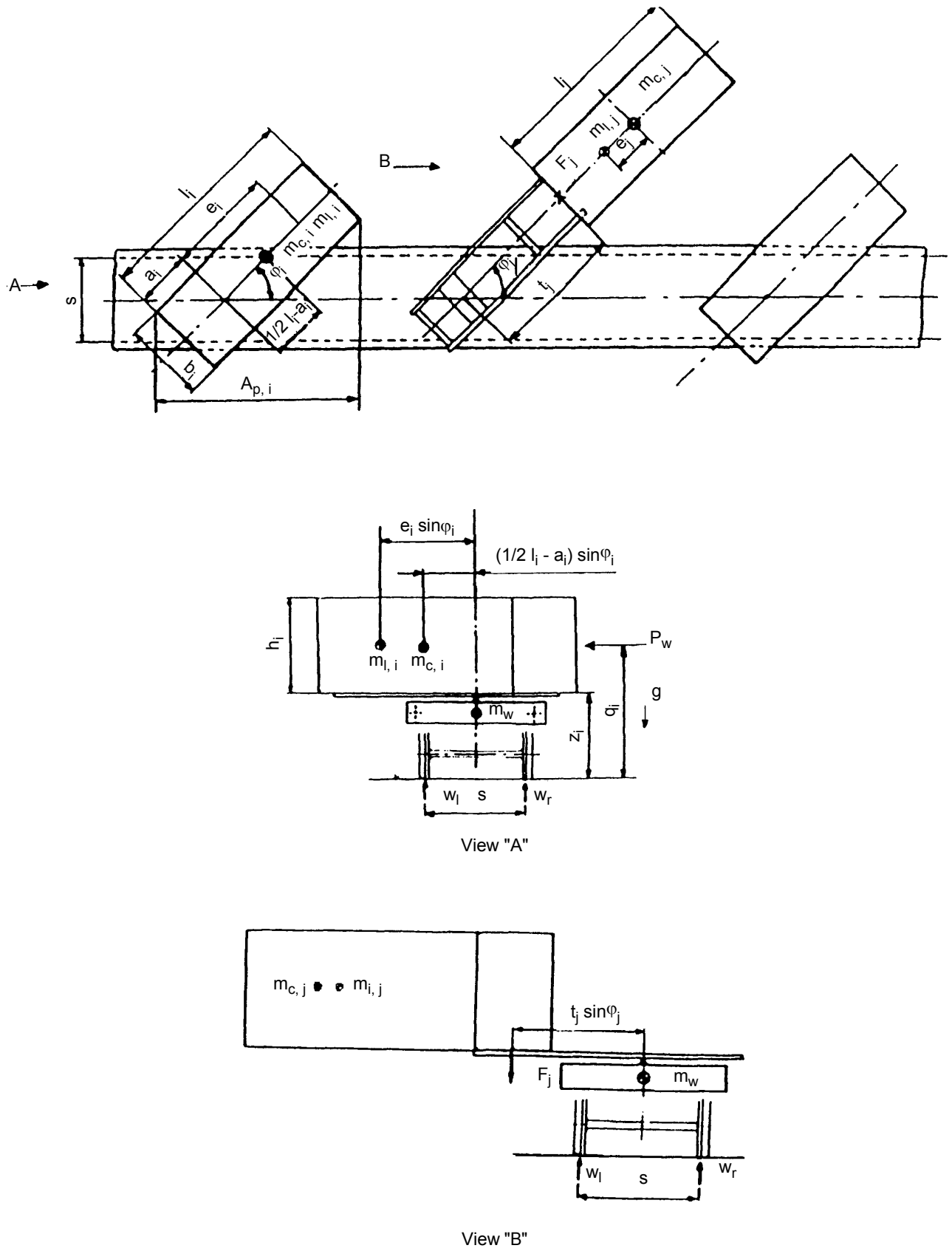
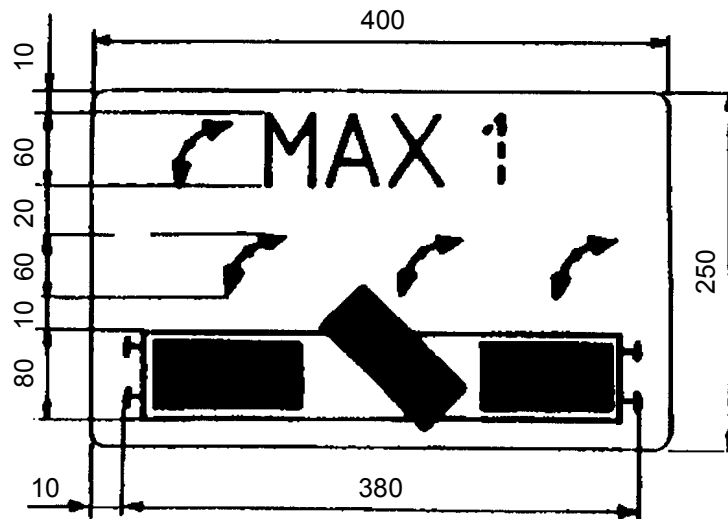


Fig. 27 - Wagon for conveyance of Type 1 horizontally-transferred roller units

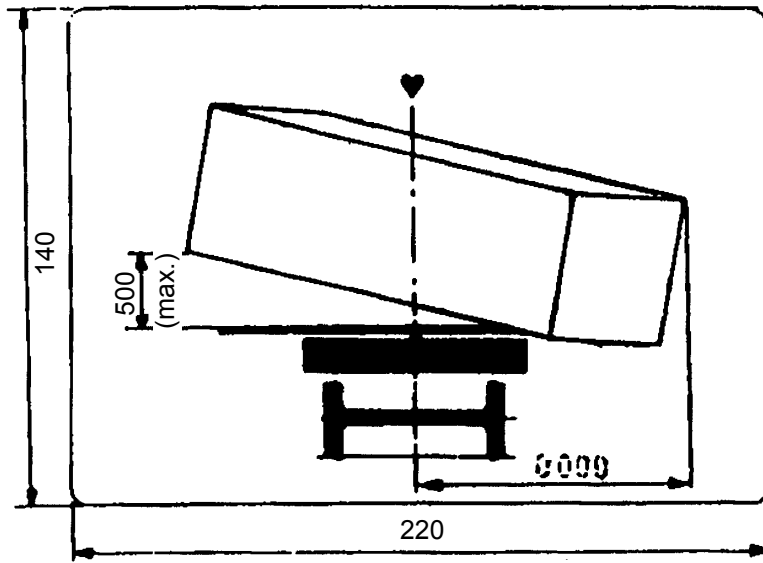
Appendix Q - Wagons for conveyance of horizontally-transferred roller units - Pictogram

Q.1 - Pictogram "Number of pivoted frames swung out which do not affect the safety against overturning"



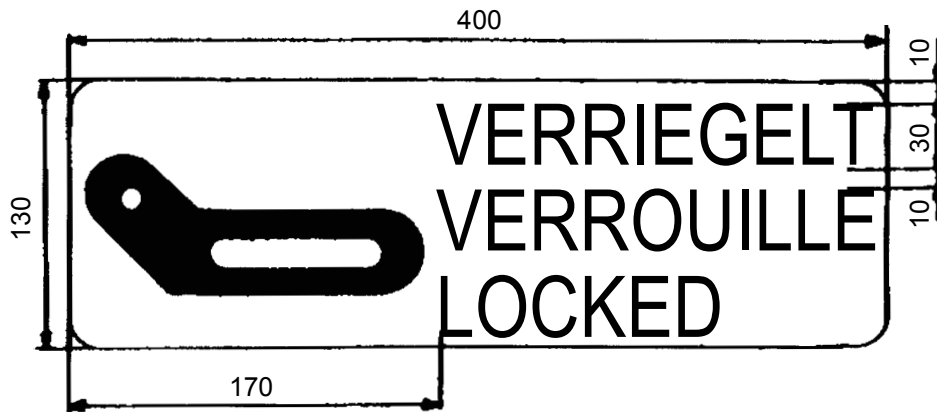
Background	White
Text and	Red
	Black

Q.2 - Pictogram "Overhang of pivoted roller unit"



Background	White
Text	Red
	Black

Q.3 - Pictogram "Position of locking lever during transit"



Text	Black
Background	Yellow

Appendix R - Light weight bogie wagon - Propelling tests - Composition of the test train

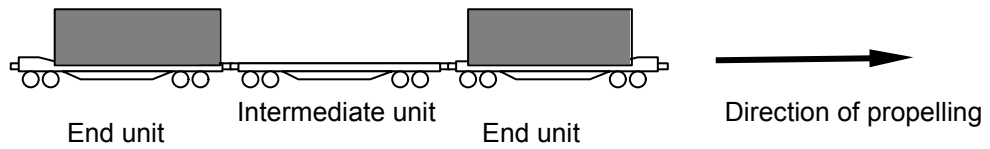


Fig. 28 - Testing the intermediate units

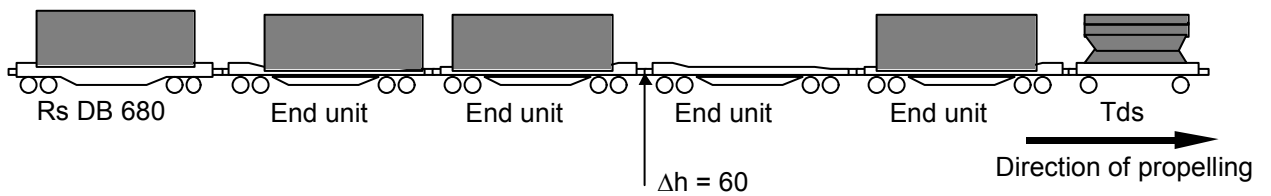


Fig. 29 - Testing the end units in a homogeneous train

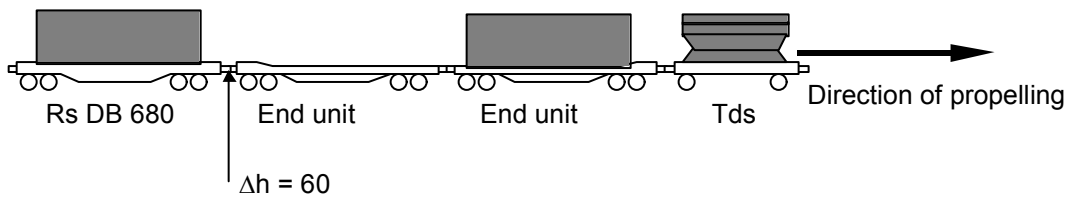


Fig. 30 - Testing the end units in a conventional train

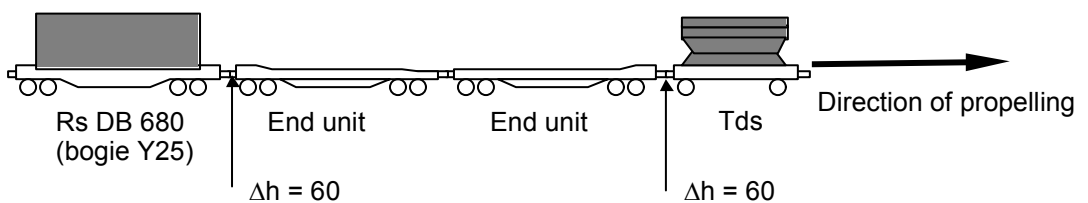


Fig. 31 - Testing the end units in a combined traffic train

Bibliography

1. UIC leaflets

International Union of Railways (UIC)

UIC Leaflet 430-1: Conditions with which wagons must comply in order to be accepted for transit between France and Spain with axle-changeover at transfer point, 2nd edition of 1.7.81 - Reprint dated 1.7.97

UIC Leaflet 430-2: Conditions to be observed by coaches in order to be accepted for transfer between France and Spain with changing of bogies at the transit point, 1st edition of 1.1.75

UIC Leaflet 432: Wagons - Running speeds - Technical conditions to be observed, 9th edition, January 2002

UIC Leaflet 438-2: Identification marking for freight rolling stock, 7th edition, May 2004

UIC Leaflet 500: Standardisation of transport stock and components - Principles, procedures, results, 2nd edition, December 2000 (reissue)

UIC Leaflet 503: Continental wagons running in Great Britain - General conditions (Reference profile, axle-load, etc.) for the acceptance, in international traffic with Great-Britain, of 2-axle and bogies wagons registered with other UIC Railways, 5th edition of 1.1.94 and 1 Amendment (6th edition under preparation)

UIC Leaflet 505-1: Railway transport stock - Rolling stock construction gauge, 9th edition, November 2003

UIC Leaflet 510-1: Wagons - Running gear - Normalisation, 9th edition of 1.1.78 and 14 Amendments

UIC Leaflet 510-2: Trailing stock - Conditions concerning the use of wheels of various diameters with running gear of different types, 4th edition, May 2004

UIC Leaflet 511: Trailing stock - Wheelbase, 7th edition of 1.7.87 and 1 Amendment

UIC 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

UIC Leaflet 517: Wagons - Suspension gear - Standardisation, 6th edition of 1.7.79 - Reprint dated 1.1.89 incorporating 10 Amendments

UIC Leaflet 520: Wagons, coaches and vans - Drawgear - Standardisation, 7th edition, December 2003 (reissue)

UIC Leaflet 526-1: Wagons - Buffers with a stroke of 105 mm, 2nd edition of 1.7.98

UIC Leaflet 526-2: Wagons - Buffers with a stroke of 75 mm, 1st edition of 1.1.81 and 2 Amendments

UIC Leaflet 526-3: Wagons - Buffers with a stroke of 130 mm and 150 mm, 2nd edition of 1.7.98 (doesn't exist in English)

UIC Leaflet 527-1: Coaches, vans and wagons - Dimensions of buffer heads - Track layout on S-curves, 2nd edition of 1.1.81 and 4 Amendments

UIC Leaflet 527-2: Coaches, vans and wagons - Dimensions of buffer heads - Rolling stock built before 1.1.65, 2nd edition of 1.1.60 and 3 Amendments

UIC Leaflet 529: Long-stroke hydrodynamic shock absorbers - Technical conditions - Wagons, 1st edition of 1.1.78

UIC Leaflet 530-1: Constructional conditions for wagons to be observed with a view to fitting the automatic coupler of the Member Railways of the UIC and OSJD respectively, 2nd edition of 1.4.82 and 3 Amendments

UIC Leaflet 530-2: Wagons - Running safety, 4th edition of 1.7.85 - Reprint dated 1.7.97 and set of diagrams (Appendices 1, 2 and 3) with 4 Amendments

UIC Leaflet 530-4: Permissible state of equipment on wagons in international traffic during the period of introduction of automatic couplers, 2nd edition of 1.7.82

UIC Leaflet 532: Trailing stock - Signal lamp brackets - Coaches - Fixed electric signal lamps, 9th edition of 1.1.79 - Reprint dated 1.1.91 and Amendment No. 2

UIC Leaflet 533: Protection by the earthing of metal parts of vehicles, 2nd edition of 1.1.77 and 4 Amendments

UIC Leaflet 535-1: Standardisation of steps and handrails on wagons, 5th edition of 1.1.72 and 2 Amendments

UIC Leaflet 535-2: Standardisation and positioning of steps, end platforms, gangways, handrails, tow hooks, automatic coupler and brake valve controls on wagons in connection with the fitting of the automatic coupler of the UIC Member Railways and OSJD Member Railways, 3rd edition of 1.1.78 - Reprint dated 1.1.97 (4th edition under preparation)

UIC Leaflet 535-3: Equipping of wagons with devices for passing from one to the other and with screw brakes, 1st edition of 1.1.76 - Reprint dated 1.7.95

UIC Leaflet 536: Coupling hooks for wagons, 3rd edition of 1.1.67 - Reprint dated 1.1.96

UIC Leaflet 540: Brakes - Air Brakes for freight trains and passenger trains, 4th edition, June 2002

UIC Leaflet 541-1: Brakes - Regulations concerning the design of brake components, 6th edition, November 2003

UIC Leaflet 541-2: Dimensions of hose connections (brake hoses) and electric cables; types of pneumatic and electric connections and their positioning on wagons and coaches equipped with automatic couplers of the UIC and OSJD Member Railways, 1st edition of 1.7.81 and 2 Amendments

UIC Leaflet 542: Brake parts - Interchangeability, 4th edition of 1.1.82 and 4 Amendments

UIC Leaflet 543: Brakes - Regulations governing the equipment of trailing stock, 12th edition, June 2003

UIC Leaflet 545: Brakes - Inscriptions, marks and signs, 7th edition, April 2002

UIC Leaflet 549: Equipment of hand brakes for wagons used on international services and accepted for running in Great Britain, 4th edition of 1.1.85 - Reprint dated 1.9.87

UIC Leaflet 554-1: Power supply to electrical equipment on stationary railway vehicles from a local mains system or another source of energy at 220 V or 380 V, 50 Hz, 3rd edition of 1.1.79

UIC Leaflet 554-2: Power supply to mechanically-refrigerated wagons running in rafts - Safety measures and electric installations, 1st edition of 1.1.78

UIC Leaflet 570: Wagons - Interchangeable parts, 6th edition of 1.1.81 - Reprint dated 1.1.95

UIC Leaflet 572: Wagons composed of permanently coupled units (multiple wagons) and articulated wagons, 1st edition of 1.1.90 and 4 Amendments

UIC Leaflet 574: Insulated, refrigerator and mechanically-refrigerated wagons and containers - Procedure to be followed for the determination of the thermic transmission coefficient of the body, 3rd edition of 1.7.71

UIC Leaflet 575: Wagons - Label holders (Interchangeability) and hazard identification panels, 4th edition of 1.1.95

UIC Leaflet 577: Wagon stresses, 3rd edition, May 2004 (reissue)

UIC Leaflet 578: Stanchions and bolsters - Standardisation, 5th edition of 1.1.95

UIC Leaflet 581: Wagons - Lifting - Rerailing, 1st edition of 1.1.83 and 1 Amendment

UIC Leaflet 582: Marks on unified and standard wagons, 3rd edition of 1.2.77

UIC Leaflet 591: Roller units for horizontal transshipment - Technical conditions governing their use in international traffic, 2nd edition of 1.1.98

UIC Leaflet 592-2: Large containers for transport on wagons - Technical conditions to be fulfilled by large containers accepted for use in international traffic, 5th edition of 1.7.96 (6th edition under preparation)

UIC Leaflet 596-5: Transport of road vehicles on wagons - Technical organisation - Method 1 - Conveyance of ordinary grab-handled semi-trailers on special wagons (1) (Standard recess wagons), 3rd edition of 1.7.85 - Reprint dated 1.1.96

UIC Leaflet 596-6: Conveyance of road vehicles on wagons - Technical organisation - Conditions for coding combined transport load units and combined transport lines, 3rd edition of 1.1.96

UIC Leaflet 597: Piggyback system - Semi-trailers on bogies - Characteristics", 1st edition of 1.1.91 - Reprint dated 1.7.93 incorporating 7 Amendments

UIC Leaflet 599: Equipment for loading and unloading containers or vehicles used in combined transport on/from wagons, 2nd edition of 1.1.86 and 2 Amendments

2. Minutes of meetings

International Union of Railways (UIC)

Joint sub-committee 25C - Combined transport (Question 45/C/FIC - Point 4.2 - Intermodal-traffic transfer techniques - Technical conditions for the international movement of roller units - Examination of propositions modifications to the text of leaflets), June 1997

3. ERRI reports

European Railway Research Institute (ERRI)

B12/RP54: Wagons - Reduction in the aerodynamic drag of wagons, 1. October 1992

B55/RP8: Prevention of derailment of goods wagons on distorted tracks - Conditions for negotiating track twists - Recommended values for the track twist and cant - Calculation and measurement of the relevant vehicle parameters - Vehicle testing (Final report), 1 April 1983

DG4: Drawings of standardized rolling stock with conditions governing their acquisition and use, 7th edition of July 1996

Warning

No part of this publication may be copied, reproduced or distributed by any means whatsoever, including electronic, except for private and individual use, without the express permission of the International Union of Railways (UIC). The same applies for translation, adaptation or transformation, arrangement or reproduction by any method or procedure whatsoever. The sole exceptions - noting the author's name and the source - are "analyses and brief quotations justified by the critical, argumentative, educational, scientific or informative nature of the publication into which they are incorporated".

(Articles L 122-4 and L122-5 of the French Intellectual Property Code).

© International Union of Railways (UIC) - Paris, 2004

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

ISBN 2-7461-0555-1 (French version)
ISBN 2-7461-0554-3 (German version)
ISBN 2-7461-0556-X (English version)