UIC CODE 608

3rd edition, April 2003

Translation

OR

Conditions to be complied with for the pantographs of tractive units used in international services

Conditions à respecter pour les pantographes des engins moteurs utilisés en service international
Bedingungen für die Stromabnehmer der Triebfahrzeuge im internationalen Verkehr

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

Leaflet to be classified in Volumes :

V - Rolling Stock

VI - Traction
VII - Way and Works

Application :

With effect from 1 July 1989, except for:
- point 5.1.4 (01.07.95)
All members of the International Union of Railways

Record of updates

2nd edition, July 1989	First issue with Amendment No. 1 of 1.7.92.
3rd edition, April 2003	Retyped in FrameMaker. Important: the articles (points) in 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, and so on). 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

This leaflet sets out the general characteristics of the pantographs of the various railways, which apply to lines carrying or suitable for carrying international traffic up to speeds of 200 km/h. For higher speeds, agreements should be reached by the railways concerned.

However, this leaflet also covers motive power units that may be worked on 25 kV high-speed new lines.

1 - General - Field of application

1.1 - The essential regulations to be observed in the construction of tractive units to enable them to run on international services are laid down in *UIC Leaflet 611* (see Bibliography - page 20).

Nevertheless, the question of current collection requires special attention in view of the diversity of the contact lines on each railway or each traction system.

1.2 - This leaflet sets out the general characteristics of the pantographs of the various railways, which apply to lines carrying or suitable for carrying international traffic up to speeds of 200 km/h. For higher speeds, agreements should be reached by the railways concerned.

1.3 - However, this leaflet also covers motive power units that may be worked on 25 kV high-speed new lines (see point 5.1.4 - page 7).

2 - General design

The general design of pantographs (articulation, bow suspension, operating mechanism, etc.) must be in line with the recommendations of ERRI Specialists' Committees (A 69: Wear of contact strips and contact wires when using contact strips made of metal or composite materials and A 129: Current collection at high speed).

3 - Compliance of lowered pantographs with the gauge

In the vertical position, the lowered pantograph must comply with the gauge defined in *UIC Leaflet 505-1* (see Bibliography - page 20). As railways operating a more restrictive gauge are unable to comply with all regulations in this leaflet, an agreement between them is essential for international services.

o 4 - Vertical range of movement of pantographs

Any actual increase in the vertical range of movement of the pantograph, taking into account vertical oscillations, depression of the suspension due to overloads, wear of the tyres, etc., must be specified with a view to guaranteeing current collection with minimum and maximum contact wire heights as shown in Appendix A - page 13.

For running on the NS system, the vertical range of the pantograph must, however, be limited to 5 860 mm above rail level.

5 - Bow

5.1 - Bow profile

For bow widths[1], Appendix A - page 13 specifies:

- profiles normally used by each railway, and
- profiles which can be accepted by these railways.

The following overall profiles, with contact strips in new condition, shall be accepted by the various railways under the conditions shown and subject to the coefficient of roll flexibility of the vehicle, as defined in *UIC Leaflet 505-5* (see Bibliography - page 20), being $\leq 0{,}225$.

NB : coefficient of roll flexibility: when a vehicle, empty or loaded, is placed stationary on a track with cant D, where the running surface of the rail makes an angle δ with the horizontal, its body inclines on the springs and makes an angle η with the perpendicular to the running surface of the rail. The ratio η/δ, designated by S, is known as the coefficient of roll flexibility and is calculated, or measured, after eliminating the influence of any dissymmetry and that of the friction of springs and shock absorbers.

5.1.1 - 1 450 mm bow

The profile defined in Appendix B - page 16 is acceptable:

- on the SBB network with horns of insulating material,
- on the FS network with metal horns only[2],
- on the entire SNCF 25 kV with horns of insulating material,
- on the entire CFL 25 kV network with horns of insulating material.

5.1.2 - 1 600 mm bow

The profile defined in Appendix C - page 17 is acceptable:

- on the british network with horns of insulating material and a maximum design length of 150 mm,
- on the entire SNCF 25 kV network with horns of insulating material with a design length of 265 mm,
- on most of the SNCF 1,5 kV network with or without horns of insulating material.

1. Dimension of the bow perpendicular to the centre line of the track.
2. For the multi-current former-TEE sets of the SBB, insulating horns are acceptable, as an exception, on the Chiasso-Milan and Milan-Domodossola lines.

5.1.3 - 1 950 mm bow

The profiles defined in points D.1 - page 18 and D.2 - page 19 are accepted by the following railways:

CFL (3 kV-)
ČD + ŽSR
DB
DSB
MÁV
NS
ÖBB (profile only as per point D.2)
PKP
SNCB
SNCF (1,5 kV-)
VR

However, with regard to the DB, the type 2 envelope in point D.2 is only acceptable in exceptional cases. Its use should however be covered by bilateral agreements.

To take account of the provisions of *UIC Leaflet 505-1*, bows should be fitted with isolating horns (design length: 200 mm([1])) when they remain energised in the lowered position.

5.1.4 - The motive power units that are liable to operate on future 25 kV high-speed lines must be fitted with a 1 450 mm or 1 600 mm bow.

5.2 - Maximum travel of the bow

Bows with contact strips with independent suspensions must conform with an overall bow profile, which they would attain with a static contact force of 70 N applied at the middle of the bow.

The elastic movement of contact strips (value fws of *UIC Leaflet 606-1, Appendix 5*) must not exceed 60 mm([2]), even when an eccentric force is applied, over the minimum useful length of the contact strip, as defined in Appendix A - page 13.

1. The 250 mm dimension is accepted, as an exception, for the multi-current former-TEE sets of the SBB. 150 mm may be accepted over the whole network in Great Britain.
2. General application of this value is not permissible on the DB network; if necessary, bilateral agreements will be required.

6 - Static contact force

NB : mean value of the static forces for upward and downward movement.

6.1 - Adjustment range

The following static force ranges are recommended:

60 to 80 N	for 15 and 25 kV
80 to 120 N	for 3 kV
80 to 90 N	for 1,5 kV
85 to 140 N	for 1,5 kV for pantographs with contact strips of metallised carbon

o 6.2 - Minimum values

These must not fall below the lower limit of each range indicated in point 6.1.

7 - Aerodynamic force

NB : the aerodynamic force is the mean vertical force measured at the bow, when the latter is not touching the contact wire. Its value is equivalent to the static contact force plus the force resulting from the airstream at the corresponding speed. Wind influence is not included.

The pantographs should be designed and their position on the roof defined so that the values of the aerodynamic forces do not exceed the limiting values given in Appendix A - page 13, irrespective of the direction of running.

8 - Transverse flexibility

Under a lateral force of 300 N (see *UIC Leaflet 505-1*) exerted on the bow, when raised to 6 500 mm above the rail, the movement of the bow should not exceed 30 mm[1].

1. If this dimension is, as an exception, exceeded, bilateral agreements should be reached.

9 - Nature of the contact strips

It is recommended that contact strips of similar type to those normally used by the railways, and shown in Appendix A - page 13, be employed.

The wear limit of the contact strips should be fixed by agreement between the railways concerned.

With direct current, particularly 1,5 kV, the number and the nature of the contact strips are to be defined in relation to the intensity of current to be collected.

10 - Control mechanism

NB : some railways make use of an arrangement, which in the event of the pantograph becoming defective (excessive wear of the friction pieces, bow fracture, etc.), causes it to be lowered automatically.

The mechanism and its supply device should be designed to permit smooth raising and very rapid lowering operations, both at standstill and at maximum speed (disengagement of the contact wire and achievement of minimum electrical clearance in no more than 3 seconds).

In addition, the force required for maintaining the pantograph in the lowered position should be sufficiently high to prevent the pantograph from rising on its own accord under the action of the dynamic and aerodynamic forces, even at high speeds.

Appendix A - Composition of the contact strips

NB : for the exact composition of the contact strips and their form, the railways concerned should be consulted.

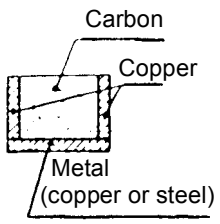
A.1 - Nature of the contact strips normally used or accepted by various railways

Steel: Silico-manganese steel with the following characteristics:
C = 0,45 to 0,55 % - Si = 1,5 to 2 %
Mn = 0,5 to 0,8 % and in normalised condition
R = 8 000 bars - A = 15 %.
For this purpose 51 S7 steel as in *UIC Leaflet 820* (see Bibliography - page 20) may be used.

Copper: (outside of the bow)
The following may apply:
- either: Cu 99,7 % - R = 3 500 bars
Brinell hardness = 80 to 84
10 mm ball under 10 000 N (used by the FS)
- or: Cu + Ag ≥ 99,9 %, copper refined electrolytically -
R = 2 300 bars - A = 20 % (used by the SNCF, this cooper corresponds to the copper in Cu/a1 condition x 601 of the French standard A53-301).

Metallised carbon: Chemical composition:
C = 75 to 77 % - Cu = 12 to 15 %
Pb = 7 to 10 % - Sb = 1 to 2 %

Coated carbon: Strip of carbon with inclusion of graphite, coated on both side faces and below with metal, the two side faces of which should be of electrolytic copper 1,5 to 3 mm in thickness.



A.2 - Copper-steel strips should be greased

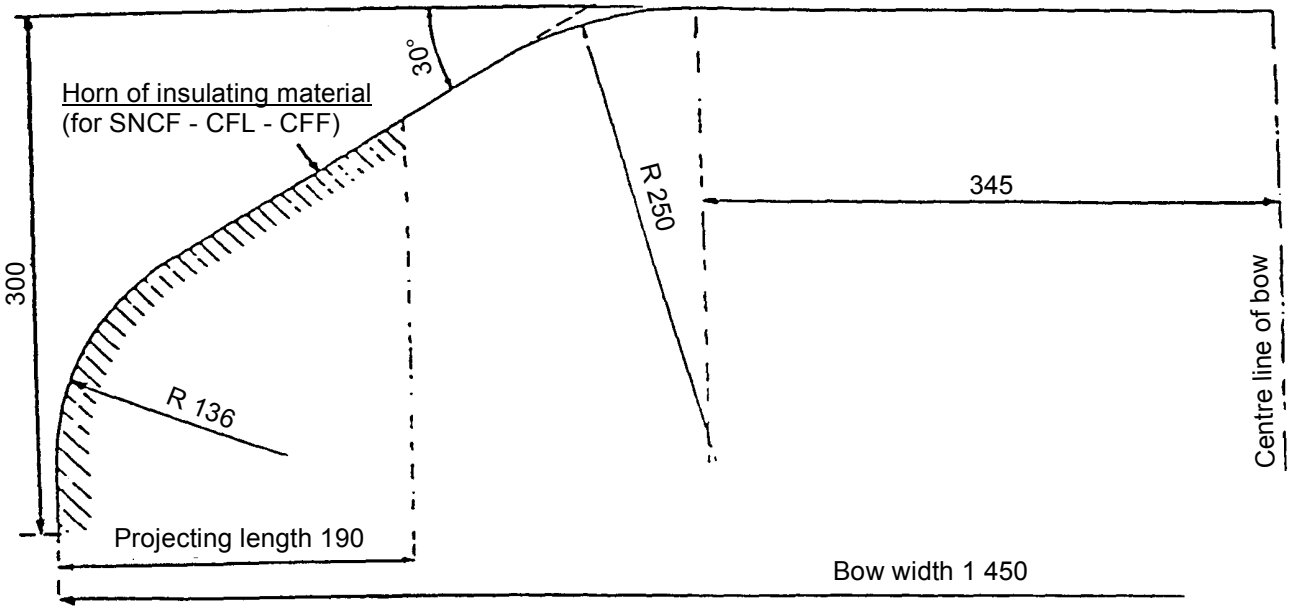
The following mixtures can be used:

Quality A	Graphite grease 80 % plombagin 20 %
Quality B	Mineral grease

Railway	Voltage (kV)	Contact wire height (max. norm. min.) (mm)	Width of bow used (permitted) (mm)	Min. actual length of contact strip (mm)	Static force Fs (N)	Max. aerodyn. force permitted Fa (N)	Max. permit-ted speed (km/h)	Type of contact strip
Net Rail Ltd	25 kVac	5 940 4 700 4 165	1 600	915	90	120	200	Copper impregnated carbon
CFF	15 kVac	6 000 5 500 4 800	1 450	670	60-70 (1)	90-100 (1)	160	Copper coated electrocarbon
(1) For international single traction running, higher values can be permitted.								
ČD + ŽSR	3 kVdc	6 300 5 500 5 100	1 920 (1 950)	900	100 ± 15	160	160	Copper Electrocarbon Electrical carbon ceramic
	25 kVac	6 300 5 500 5 200	1 920 (1 950)	900	65 ± 15	120	160	Electrocarbon Metallic carbon ceramic
CFL	25 kVac	6 200 5 750 4 940	1 600	750	60 ± 70	120	140	Steel Copper Electrocarbon
	3 kVdc	6 200 5 100 4 800	1 950	1000	90 ± 120	180	140	Electrocarbon Metallic carbon ceramic Copper-steel
DSB	25 kVac	6 000 5 500 4 900	1 950	1 030	70 + 80	120	200	Electrocarbon
FS	3 kVdc	6 200 5 000 4 700	1 450	700	85	350 150	à 250 à 160	Copper-steel
SNCB	3 kVdc	6 250 5 300 4 800	1 760 (1 950)	1 000	70 + 100	180	140	Electrocarbon Coated electro-carbon Copper-steel
MÁV	25 kVac	6 150 6 000 4 900	2 060 (1 950)	1 126	80 ± 5	120	160	Electrocarbon
Max. lateral displacement 500 mm.								
DB	15 kVac	6 500 5 500 4 950	1 950	1 030	60 + 80	120 (1)	200	Carbon
(1) As defined in point 7 - page 9.								
NS	1,5 kVdc	5 750 5 500 4 800	1 900 (1 950)	950	85 + 140	180	140	Metallic electrocarbon
As defined in point 4 - page 5..								

Railway	Voltage (kV)	Contact wire height (max. norm. min.) (mm)	Width of bow used (permitted) (mm)	Min. actual length of contact strip (mm)	Static force Fs (N)	Max. aerodyn. force permitted Fa (N)	Max. permit-ted speed (km/h)	Type of contact strip
PKP	3 kVdc	6 100	1 950	1 230	90 ± 5	150	160	Copper
BLS	15 kVac	6 500 5 600 4 800	1 450	500	60	100	160	Copper-coated carbon
Contact wire stagger ± 250 mm.								
VR	25 kVac	6 500 6 150 5 600	1 950	1 300	60 + 80	120	160	Electrocarbon
SNCF	1,5 kVdc	6 500 5 500 4 600	1 950 (1 600) (1)	1000	90	200	200	Copper-steel
	25 kVac	6 500 5 500 4 600	1 450 (1 600)	800	70	150	200	Steel Coated electro-carbon Non-coated electrocarbon
(1) See points 5.1.1 and 5.1.2 - page 6.								
ÖBB	15 kVac	6 000 5 750 4 950	1 950	1 000	60 + 70	120	160	Hard carbon
Lateral movement as per *UIC Leaflet 505-1*.								
JŽ +HŽ +MŽ +ŽBIH +ŽRS	25 kVac	6 200 5 500 5 000	1 600	800	60 + 90	70	160	Electrocarbon
HŽ+SŽ	3kVdc	6 000 5 350 4 950	1 450	900	80		120	Copper

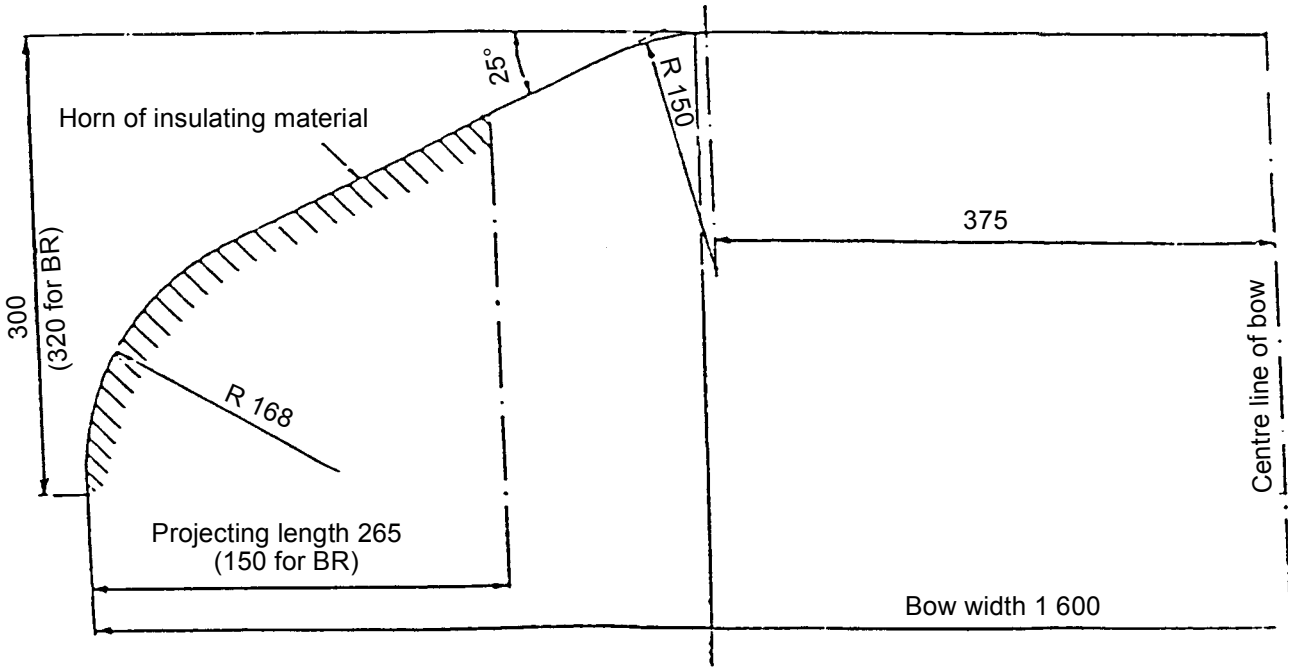
Appendix B - 1 450 mm bow (envelope)



This bow may be used on:

- SNCF and CFL (25 kV 1 ≈ 50)
- FS (3 kV-)
- SBB (15 kV 1 ≈ 16 2/3)
- all future 25 kV high-speed lines

Appendix C - 1 600 mm bow (envelope)

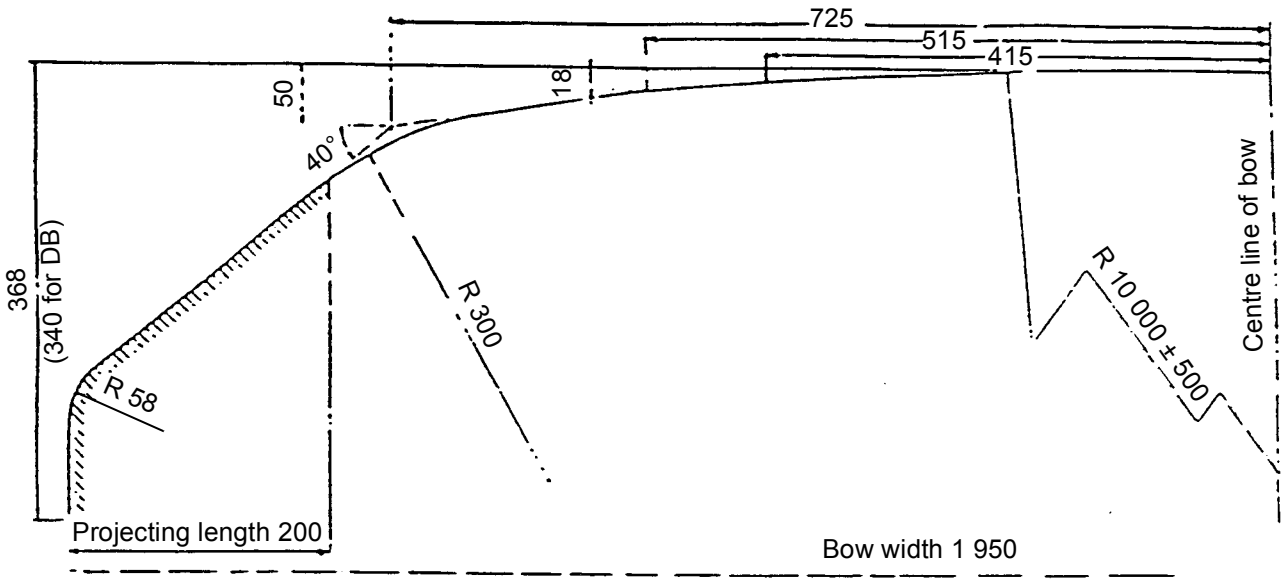


Thiw bow may be used on (25 kV 1 ≈ 50) railways:

- Net Rail Ltd
- CFL
- JŽ, HŽ, MŽ, ŽBIH, ŽRS
- SNCF (see points 5.1.1 and 5.1.2 - page 6)
- all future 25 kV high-speed lines

Appendix D - 1 950 mm bow

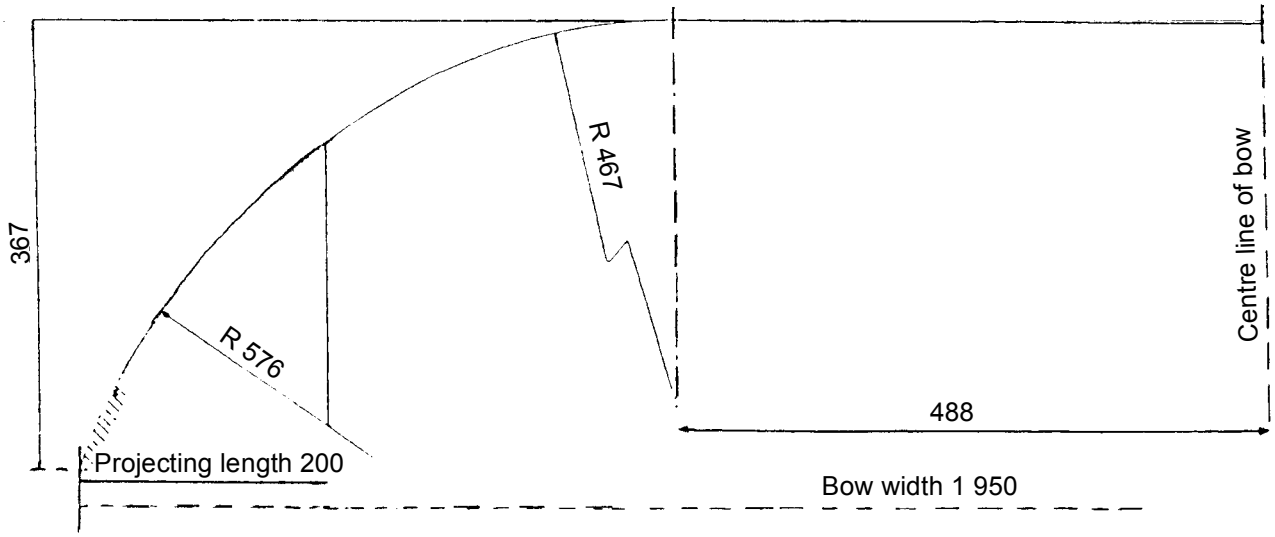
D.1 - Envelope - Type 1



This bow may be used on:

- DB - ÖBB	15 kV 1 ≈ 16 2/3
- ČD + ŽSR - DSB - MÁV - VR	25 kV 1 ≈ 50
- CFL - ČD + ŽSR - PKP - SNCB	3 kV-
- NS - SNCF	1,5 kV-

D.2 - Envelope - Type 2



This bow may be used on:

- DB[a]	15 kV 1 ≈ 16 2/3
- ČD + ŽSR - DSB - MÁV - VR	25 kV 1 ≈ 50
- CFL - ČD + ŽSR - PKP - SNCB	3 kV-
- NS - SNCF	1,5 kV-

a. exceptionally.

Bibliography

1. UIC leaflets

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

Leaflet 505-4: Effects of the application of the kinematic gauges defined in the 505 series of leaflets on the positioning of structures in relation to the tracks and of the tracks in relation to each other, 3rd edition of 1.1.77 and 2 Amendments

Leaflet 505-5: Basic conditions common to Leaflets 505-1 to 505-4 - Notes on the preparation and provisions of these leaflets, 2nd edition of 1.1.77 and 4 Amendments

Leaflet 506: Rules governing application of the enlarged GA, GB and GC gauges, 1st edition of 1.1.87 and 4 Amendments

Leaflet 600: Electric traction with aerial contact line, 3rd edition of 1.1.81 and 1 Amendment

Leaflet 606-1: Consequences of the application of the kinematic gauges defined by UIC leaflets in the 505 series on the design of the contact lines, 1st edition of 1.1.87 and 1 Amendment

Leaflet 606-2: Installation of 25 kV and 50 or 60 Hz overhead contact lines, 4th edition of 1.1.86

Leaflet 611: Regulations governing acceptance of electric locomotives, power cars and multiple-unit sets for running on international services, 6th edition, February 2001

Leaflet 820: Technical specification for the supply of spring steel flat bars for parallel leaf or volute springs, 5th edition of 1.7.77

2. Minutes of meetings

International Union of Railways
Sub-Committee 5/A "Motive power units" - Study Group 1 "Electric motive power units" (Conditions to be complied with for the pantographs of tractive units used in international services), September 1988

Sub-Committee 5/A "Motive power units" - Study Group 1 "Electric motive power units" (Conditions to be complied with for the pantographs of tractive units used in international services), March 1989

Sub-Committee 5/A "Motive power units" (Point 1.1.2 - Modifications to Leaflet 608), January 1992

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