UIC CODE 540

5th edition, November 2006

Translation

O

Brakes - Air brakes for freight trains and passenger trains

Freins - Freins à air comprimé pour trains de marchandises et trains de voyageurs
Bremsen - Druckluftbremsen für Güter- und Personenzüge

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

Leaflet to be classified in Volume:

V - Rolling stock

Application:

With effect from 1 November 2006
All members of the International Union of Railways

Record of updates

1st edition, August 1954	First issue
3rd edition, January 1982	
4th edition, June 2002	Retyped in FrameMaker. Incorporation of previous amendments (letter dated 28.7.2000 sent by Chairman of Sub-Commission 5T). Titles added to points 1.10, 1.12, 1.13, 1.19. Change to title of point 2. Point 3.4 added. Titles changed in Appendix A. Knorr braking system added to the two tables in Appendix A. SAB-Wabco braking system added to the table in Appendix C.
5th edition, November 2006	Publication of Appendix A on the UIC website and transfor of Appendix C to UIC Leaflet 543 (Appendix E, also published on the UIC website)

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

Contents

Summary

General provisions governing the approval of air brakes in international traffic.

Any RU, wishing to have a new continuous braking system for freight trains or for passenger trains approved for use in international traffic, must submit it beforehand for examination to the UIC Study Group 5 "Braking" which will ascertain that it complies with the conditions set out in this leaflet.

Any operating modification contemplated on the brakes previously approved in international traffic must, beforehand, be brought to the notice of the SG5 "Braking", which will lay down the requisite conditions for approval.

1 - Conditions with which air brakes for freight trains and passenger trains must comply to be approved in international traffic

1.1 - The brake must be automatic; the use of compressed air must be sufficient for the working of the brake, and this only with one pipe system (brake pipe) with an inside diameter of 25 mm or 32 mm.

The brake must also comply with all the conditions set out below, even if the auxiliary reservoir is filled permanently from the main air supply pipe.

The use of electricity for the control of the brake is allowed, provided that the latter may also be worked by means of compressed air alone without it being necessary to perform any manipulation on the vehicle, and that it complies with all the conditions below and with those in *UIC Leaflet 541-5* (see Bibliography - page 23).

1.2 - The new air brakes must be capable of working without difficulty together with those previously approved.

1.3 - The normal working pressure is 5 bar, although a decrease or an increase in this working pressure of less than 1 bar must not disrupt the operation of the brake.

1.4 - The brake must comply with all the conditions when it is operated by means of a driver's brake valve which conforms to the conditions in *UIC Leaflet 541-03* (see Bibliography - page 23).

The operation of the brake by means of older driver's brake-valve designs not complying with the above-mentioned conditions must be possible.

1.5 - The brake must be ready-for-use and released when the working pressure is applied.

The application must be obtained by a pressure decrease in the brake pipe, and the release by pressure increase thus obtained. It is permitted for the brake to be completely released before pressure in the main brake pipe has attained the normal value.

The brake must not come back to the ready-for-use position as long as the pressure at the brake cylinder is more than or equal to 0,3 bar[1]. On the other hand, the brake must have come back to the ready-for-use position, at the latest, when the pressure at the brake pipe has attained a value 0,15 bar lower than the normal value, it being understood that the brake must then be completely released.

1.6 - The brake must permit emergency application by a sudden and considerable exhaust of the air contained in the pipe, as well as ordinary progressive application till full application, and non-progressive full application by slow exhaust of the air from the brake pipe.

At the time of release, it must be possible to obtain graduated release by interrupting the re-filling of the brake pipe (adjustability on release).

1.7 - In order to obtain full application as from the normal working pressure, the pressure in the brake pipe must be reduced by 1,5 ± 0,1 bar.

1. In the case of brakes with pneumatically-controlled devices for the variation of the braking power, the pressure of 0,3 bar corresponds to the pressure existing at the pneumatic relay (pilot pressure).

The maximum pressure obtained at the brake cylinder must be 3,8 ± 0,1 bar without being related to the stroke of the piston in the cylinder. If the brake equipment includes a relay device allowing fixed or variable pressure ratios, this provision shall apply to the control pressure of this device.

1.8 - The filling time of the brake equipment of a vehicle must be such that the filling of auxiliary reservoirs and the release of the brakes on the rear vehicles, even on long rafts of vehicles, are not impeded and that there do not appear, in the brake pipe, sudden large variations in pressure, likely to bring about an inopportune application of the brakes on the neighbouring vehicles.

1.9 - The operation of the brake on a raft of vehicles must be ensured when, on a maximum of 50% of the vehicles, the complete brake equipment is working, whereas, on the other vehicles, only the brake pipe is in operation.

The vehicles on which the brake has been isolated may form one or several coherent groups within the raft; the length of each of them must not exceed 80 m approximately.

1.10 - Sensitivity/Insensitivity

1.10.1 - The insensitivity of the brake to slow decreases in pressure in the brake pipe must be such that the brake is not activated if the normal working pressure drops by 0,3 bar in one minute.

1.10.2 - The sensitivity of the brake to decrease in brake-pipe pressure must be such that the brake is activated within 1,2 second if the normal working pressure drops by 0,6 bar in 6 seconds.

1.11 - The brake must be designed to allow vehicles to be fitted with a device capable of varying the braking power (load-proportional braking in two or more stages or automatic load-proportional braking, graduated braking).

1.12 - Brake Inexhaustibility

1.12.1 - Brakes must allow the train to run down all gradients on the main railway lines, with perfect safety and variations of the speed prescribed as reduced as possible.

1.12.2 - Brakes must be inexhaustible, that is to say it must always be possible, by emergency application on a given train when stationary, and after any manipulation of the driver's brake valve, to obtain on the brake cylinders of the vehicles a final weighted pressure at least equal to 85% of the pressure obtained, on the same train, by emergency application as from the normal working pressure.

However, these manipulations will not include the prolonged use of the driver’s brake valve in a position interrupting the brake-pipe supply and must not give rise, at any time, to a pressure under 0,3 bar in the brake cylinders.

1.13 - Cylinder pressure

1.13.1 - The brake must be such that the pressure at the cylinder is always in keeping with the variations in the brake pipe. A pressure variation of 0,1 bar in the brake pipe must give rise, from the distributor, to a corresponding variation in the cylinder, after the brake starts working.

For one and the same pressure in the brake pipe, the pressure at the brake cylinder must not vary by more than 0,1 bar during applications and releases.

NB : As regards brakings achieved with pneumatically-controlled devices for braking-power variation, the pressure of 0,1 bar corresponds to the pressure existing at the pneumatic relay (pilot pressure).

1.13.2 - As regards the pressure at the cylinder, the brake shall be such as to maintain the pressure in the course of all ordinary applications, full and emergency applications, i.e. the leakages in the cylinder and its pipes shall be automatically compensated as long as the pressure in the auxiliary reservoir so permits.

1.14 - At the time of a normal operation of the brake and, in particular, at the time of an emergency application on a train in which the braking operation is already under way, no harmful longitudinal recoils must occur.

1.15 - The brake must be such as to be capable of being utilised either as "Freight" brake, passenger brake, or "Freight-Passenger" brake; in the latter case, a changeover device must be provided to permit its utilisation in passenger trains as well as in "freight" trains.

1.16 - The transmission speed[1] of brake action must be, for emergency applications effected as from the normal working pressure, at least 250 metres per second, whatever the composition of the raft.

This applies to trains with a length equal to or exceeding 500 m, at least 50% of the hauled vehicles being braked.

1.17 - The ordinary applications must be transmitted to the last vehicle of the train, under any braking system, as soon as the pressure in the brake pipe at the front of the train has been reduced by a maximum of 0,3 bar, irrespective of the length and consist of the train, it being understood that the first reduction in pressure achieved in the brake pipe of the rear vehicle by the distributor accelerators must not exceed 0,4 bar.

1.18 - When activating the brake of one separate vehicle, either by emergency application or by ordinary application, effected as from the normal working pressure, the pressure at the brake cylinder:

- in "G" (freight) position, irrespective of the load, must rapidly be obtained and be sufficient to permit the application of the brake-shoes on the wheels. The pressure on the shoes[2] thus obtained must be approximately 10 % of the maximum pressure which may be obtained at the end of the application.

  Following this, the pressure increase to its maximum value must be progressive; the filling time of the brake cylinder, measured between the moment when the air begins to enter the cylinder and that when the pressure in the cylinder reaches 95 % of its maximum, must be between 18 and 30 seconds (subject to Technical Unity's approval), whether or not there is a system for braking the load and whatever its type,

- in the "P" (passenger) position, must increase continuously up to its maximum value, whatever the load braking system considered.

  In emergency application, the filling time of the brake cylinder, measured from the moment when the air begins to enter the cylinder and that when the pressure attains 95 % of its maximum value, must be between 3 and 5 seconds, except in the case of the load-braking system for which a period of 3 to 6 seconds is allowed.

1.19 - Release procedures for individual wagons/vehicles

1. The transmission speed is the quotient of the length of the brake pipe, determined without taking the branch pipes into consideration, from the driver's brake valve to the rear stop cock, by the time elapsing between the moment when the driver places his valve in the application position and that when the air begins to enter the brake cylinder of the last vehicle (transmission time).
2. "The pressure on the shoes" is the actual pressure of the shoes on the wheels, measured when stationary.

1.19.1 - At the time of a full continuous release of the brake on one separate vehicle, following a full application, the pressure at the brake cylinders must fall progressively.

The draining time of the brake cylinder, measured by the time between the moment when the air begins to escape from the brake cylinder and that when the pressure attains 0,4 bar, the driver's valve being placed in the application position, must be[1]:

- between 45 and 60 seconds, in the "G" position,

- between 15 and 20 seconds in the "P" position (for a wagon with a mass on rails equal to or exceeding 70 t, a time between 15 and 25 seconds is permissible).

1.19.2 - On a separate vehicle, it must be possible, after a full application, to make an uneven release at a pressure of at least 6 bar, maintained in the brake pipe during:

- at least 40 seconds, on "Freight" system,

- at least 10 seconds, on passenger system,

with no overload occurring in the various brake capacities, which would be likely to impede the subsequent operating of the brake.

1.20 - When a brake release is effected on a complete train following a full application, and without any overload occurring that might impede the subsequent operation of the brakes, the time which elapses between the beginning of the release operation on the valve and the moment when the pressure in the brake cylinder of the last vehicle has fallen to 0,4 bar, must not exceed[1]:

- in the "G" position, 70 seconds for a train 750 m in length, with a brake-pipe inside diameter of 32 mm, made up at least, of 50 vehicles, all braked,

- in the "P" position, 25 seconds for a train 400 m in length, either made up of 15 bogie-vehicles (coaches) with a brake pipe inside diameter of 25 mm, or of 20 wagons (with 2 axles and/or bogies) with a brake-pipe inside diameter of 32 mm.

These times must be obtained even when the full application is preceded by some partial application and release operations, achieving in the brake cylinders a pressure reaching approximately the third of the pressure obtained by a full application.

1.21 - When releasing the brake, it must be possible to effect a high pressure overcharge for 2 seconds at a pressure of 6 bar without the brakes being activated once the overcharge has been cancelled, bringing the pressure down from 6,0 bar to 5,2 bar in 1 second and followed by a return to normal working pressure.

No activation of the brakes must occur on the train for a period of 30 seconds after the said cancellation.

1.22 - The brake must have a device allowing manual release.

1. On vehicles fitted with a pneumatically-controlled device for the variation of the braking power, the release time is the time which must elapse before obtaining a pressure of 0,4 bar at the relay control chamber (pilot pressure).

2 - Conditions governing air brakes approved in international traffic prior to 1.1.1982

2.1 - In view of the present state of technology, air brakes for freight trains and passenger trains, approved in international traffic before the date of implementation of the present leaflet, may possibly not comply with all the conditions in point 1 - page 2 of this leaflet.

2.2 - Air brakes for freight trains approved in international traffic before the date of implementation of this leaflet are listed in Appendix A - page 8.

2.3 - Air brakes for passenger trains approved in international traffic before the date of implementation of this leaflet are listed in Appendix A - page 8.

2.4 - Any RU wishing to modify the operating method of an air brake previously approved in international traffic must submit an accurate description of the modification and of the new operating method contemplated, in French and German. After examination of these documents, the UIC SG5 "Braking" will either lay down the procedure to be followed for approval, or refuse approval for this modification of the operating method of the brake in international traffic.

2.5 - The conditions regarding air brakes approved in international traffic before the date of implementation of this leaflet are shown in Appendix D - page 12 .

3 - Procedure to be followed for the approval of air brakes in international traffic

3.1 - Any RU wishing to obtain the approval of a new system of continuous brake for freight trains or passenger trains in international traffic must submit, beforehand, the relevant request to the UIC SG5, together with a detailed description in French and German of the operating method of this brake and a report on the tests carried out on a separate vehicle and on a raft of vehicles, while stationary. The said Study Group shall determine the additional tests to be carried out by the requesting railway in accordance with *UIC Leaflet 547*. The results of the latter tests will then have to be submitted, in both languages, as a test report.

3.2 - On the basis of test results thus submitted to it, the UIC SG5 will, at first, examine whether the conditions in point 1 - page 2 are actually fulfilled.

It will then determine the date of the acceptance tests and the required programme of tests.

3.3 - The new air brake systems for freight trains and passenger trains approved in international traffic will be shown in Appendix C - page 11 to the present leaflet.

3.4 - The fitting of new or existing vehicles with approved air brakes shall be governed by the provisions laid down in *UIC Leaflet 543* (see Bibliography - page 23).

Appendix A - Air brakes for freight trains and passenger trains approved before 1.1.1982 in international traffic

A.1 - Air brakes for freight trains approved before 1.1.1982

This table now serves only as a source of information about older types of air brake still in use on existing vehicles. It no longer applies to either new or renovated wagons.

This table can be found on the UIC website:
http://www.uic.asso.fr/ Activities/Technology&Research/Products.

A.2 - Air brakes for passenger trains approved before 1.1.1982

This table now serves only as a source of information about older types of air brake still in use on existing vehicles. It no longer applies to either new or renovated wagons.

This table can be found on the UIC website:
http://www.uic.asso.fr/ Activities/Technology&Research/Products.

Appendix B - Table of conditions

No.	Characteristics		Refer-ence	Values required	Test method UIC Leaflet 547	Checking
1	Filling time of reservoirs from 0 to 4,8 bar in seconds	Control reservoir	Point 1.8 - page 3	–	3.1.1	Separate vehicle when stationary
		Auxiliary reservoir		–	3.2.1	Stationary trains
		Supplementary reservoir		–		
2	First stroke in % of the maximum brake shoe pressure	"Freight" brake	Point 1.18 - page 4	about 10%	3.1.4	Separate vehicle, when stationary
		passenger brake		–		
3	Maximum pressure in the brake cylinder		Point 1.7 - page 2	3,8 ± 0,1 bar	3.1.3	Separate vehicle, when stationary
4	Filling time up to 95% of the maximum pressure at the brake cylinder	"Freight" brake	Point 1.18 - page 4	18 - 30 s	3.1.4	Separate vehicle, when stationary
		passenger brake		3 - 5 (÷ 6) s		
5	Release time to a pressure of 0,4 bar in the brake cylinder	"Freight" brake	Point 1.19.1 - page 5	45 - 60 s	3.1.4	Separate vehicle, when stationary
		passenger brake		15 - 20 (÷ 25) s		
6	Reduction in pressure required to obtain full application		Point 1.7 - page 2	1,5 ± 0,1 bar	3.1.3	Separate vehicle, when stationary
7	Adjustability on application and release. Variations in pressure		Point 1.13.1 - page 3	≤ 0,1 bar	3.1.2	Separate vehicle, when stationary
8	Pressure corresponding to return to the filling position at the time of brake release	Brake pipe	Point 1.5 - page 2	≤ 4,85 bar	3.1.6	Separate vehicle, when stationary
		Brake cylinder		< 0,3 bar		
9	Uneven filling after full application	"Freight" brake	Point 1.19.2 - page 5	≥ 6 bar during ≥ 40 s[a]	3.1.7	Separate vehicle, when stationary
		passenger brake		≥ 6 bar during ≥ 10 s[a]		
10	Transmission speed in the case of emergency braking		Point 1.16 - page 4	≥ 250 m/s	3.2.3	Stationary trains
11	Sensitivity. The brake must operate following a pressure decrease in the brake pipe of:	Vehicle taken separately	Point 1.10.2 - page 3	0,6 bar in 6 s before 1,2 s	3.1.5	Separate vehicle, when stationary
		Train	Point 1.17 - page 4	≤ 0,3 bar	3.2.4	Stationary trains
	the pressure decreasing in the brake pipe:	On the last vehicle		≤ 0,4 bar		
12	Insensitiveness. The brake must not operate following a pressure decrease in the brake pipe of:	Vehicle taken separately	Point 1.10.1 - page 3	0,3 bar in 60 s	3.1.5	Separate vehicle, when stationary
		Train			3.2.6	Stationary trains
13	Release time of a train after a full application	"Freight" brake	Point 1.20 - page 5	≤ 70 s	3.2.5	Stationary trains
		passenger brake		≤ 25 s		

No.	Characteristics	Refer-ence	Values required	Test method UIC Leaflet 547	Checking
14	Uneven filling, the brake being released	Point 1.21 - page 5	6 bar for a period of 2 s (minimum)[a]	3.1.8	Separate vehicle, when stationary
			Return from 6 bar to 5,2 bar in 1 s[a]	3.2.11	Stationary trains
15	Inexhaustibility. Percentage of reduction in the average pressure in the brake cylinder	Point 1.12.2 - page 3	maximum 15	3.2.8	Trains at a standstill and down hill
16	Automatic operation of the brake	Point 1.1 - page 2	–		Stationary trains
17	Control by means of a single pipe	Point 1.1 - page 2	–	3.1 App. 1	
18	Operation also at permanent filling of the auxiliary reservoir from the main supply pipe	Point 1.1 - page 2	–	3.1 App. 1	Separate vehicle, when stationary
19	Operation in combination with previously-approved brakes	Point 1.2 - page 2	–	4.0	
20	Reliability of operation of the brake for the working pressures of 4 and 6 bar	Point 1.3 - page 2	–	3.1 App. 1 3.2.7	Separate vehicle, when stationary Stationary trains
21	Operation by means of various types of driver's brake valve (old types included)	Point 1.4 - page 2	–		Separate vehicle and trains, when stationary
22	Emergency application, full application, gradual application, adjustability on release	Point 1.6 - page 2	–	3.1.2 3.2.9	Separate vehicle, when stationary Stationary trains
23	Operation of the brake on a train including coherent groups of through-pipe vehicles	Point 1.9 - page 3	–	3.2.9	Trains at a standstill and run on a level track
24	Load-proportional braking	Point 1.11 - page 3	–	3.1 App. 1	
25	Automatic compensation for leakages at the brake cylinders	Point 1.13.2 - page 4	–	3.1.9	Separate vehicle, when stationary
26	Longitudinal recoils on a train on which the braking operation has already started	Point 1.14 - page 4	–	4.1.3	Trains on a level track
27	Use as "Freight" brake and passenger brake	Point 1.15 - page 4	–	3.1 App. 1 4.1.3 App. 3	
28	Controllability of the brake on downhill sections	Point 1.12.1 - page 3	–	4.2.2	Trains, downhill
29	Manual release of the brake	Point 1.22 - page 5	–	3.1.10	Separate vehicle, when stationary

a. The brake must not operate.

Appendix C - Air brakes for freight and passenger trains approved in international traffic after 1.1.1982

These air brakes are documented in *UIC Leaflet 543, Appendix E* and can be consulted on the UIC website: http://www.uic.asso.fr/ Activities/Technology&Research/Products.

Appendix D - Conditions for air brakes approved in international traffic before the date of implementation of this leaflet

D.1 - Special conditions for brake systems approved in international traffic after 1 January 1953

D.1.1 - The brake must be automatic; the use of compressed air must be sufficient for the working of the brake, and this only with one pipe system.

However, another source of energy than compressed air may be used for the brake control (electricity for instance), provided that the latter may also be worked by means of compressed air without it being necessary to perform any manipulation on the vehicle, and that it complies with all the conditions below.

D.1.2 - The new air brakes must be capable of working without difficulty together with those already approved.

D.1.3 - The normal working pressure is 5 bar in the brake pipe, although a decrease or increase in this working pressure of less than 1 bar must not disrupt the operation of the brake.

D.1.4 - It must be possible for the brake to be activated by means of any of the driver's brake valves (for example, Westinghouse type) now used on the european railways.

D.1.5 - The brake must be ready-for-use and released when the working pressure is applied.

The application must be obtained by decrease of the brake-pipe pressure, and the release by the pressure increase thus obtained. It is permitted for the brake to be released completely before pressure in the brake pipe has attained the normal value.

The brake must not come back to the ready-for-use position as long as the pressure at the brake cylinder is more than or equal to 0,300 bar. On the other hand, the brake must have come back to its ready-for-use position at the latest when the pressure at the brake pipe has attained a value equal to 4,850 bar.

D.1.6 - The brake must permit emergency application by a sudden rather considerable exhaust of the air contained in the pipe, as well as ordinary progressive application till full application, and non-progressive full application by slow exhaust of the air from the pipe.

At the time of release, it must be possible to obtain gradations by interrupting the re-filling of the pipe.

D.1.7 - In order to obtain a full application as from the normal working pressure, the pressure in the pipe must be reduced by 1,3 and 1,6. bar.

The maximum pressure thus obtained must be between 3,7 and 3,9 bar. If the brake equipment includes a device giving several braking powers by variation of the pressure in the brake cylinder, this regulation is applicable to the pressure obtained under the system which gives the highest braking power.

D.1.8 - The filling time of the brake equipment of a vehicle must be such that the filling of auxiliary reservoirs and the release of the brakes on the rear vehicle, even on long trains, are not impeded, and that there do not appear, in the pipe, sudden large variations of pressure capable of causing an untimely application of the brake on the neighbouring vehicles.

D.1.9 - The brake must be such as to allow part of the vehicles to be fitted with the complete brake components (braked vehicles), the other vehicles being only fitted with the brake pipe (through-pipe vehicles).

It must be possible to place the braked vehicles and through-pipe vehicles as irregularly as they may normally be placed in service; in particular, it must be possible to incorporate, in any part of the train, groups of through-pipe vehicles, up to 15 each, in trains with small braking percentages, according to the conditions laid down in the standard programme.

D.1.10 - The brake must work without any other component (accelerator or other) being fitted on vehicles with a through pipe.

D.1.11 - The brake must be such as to allow vehicles to be fitted with a device capable of braking them more strongly when they are loaded (one or several systems for braking the load, or automatic load-proportional brake) than when they are empty (braking the tare).

If this device acts through variation of the pressure at the cylinder, the pressure on the shoes, when the load is braked, must remain, throughout the duration of a full application, practically proportional to the one obtained when the tare alone is braked, the time necessary to attain the maximum braking being practically the same.

D.1.12 - Brakes must be inexhaustible, that is to say it must always be possible, by emergency application on a given train when stationary, and after operation of the driver's brake valve, to obtain on the brake cylinders of the vehicles a total pressure at least equal to 85% of the total pressure obtained on the same train by emergency application as from the normal working pressure. These manipulations will not include, however, the prolonged use of a position interrupting the supply to the brake pipe and must not give rise at any time to a pressure less than 0,3 bar in the brake cylinders.

Brakes must allow the train to run down the longest and steepest gradients on main railway lines with perfect safety and variations of the speed prescribed as reduced as possible.

D.1.13 - The working of the brake must be ensured, in all cases, without dangerous longitudinal shocks for the passengers, staff, load and vehicles:

- in the "G" position, as long as the distance between the buffer plates does not exceed 10 centimetres, this distance averaging 35 millimetres on the whole of the train. In particular the applications have to be effected without abnormal longitudinal shocks when all the vehicles of a fully loaded train of 1500 tonnes and approximately 100 axles, or of a partly loaded or empty train up to 150 axles, are braked, and also when 75% of the axles of an empty train of 200 axles are braked.

- in the "P" position, assuming that the vehicles are coupled in such a manner that the springs of each buffer have a load of approximately 1 to 2 tonnes; in particular, the applications and releases have to be effected without abnormal longitudinal shocks on a train of 40 two-axle vehicles, even when this train includes a group of 6 through-pipe vehicles.

D.1.14 - There must be no harmful longitudinal shocks if, after a strong ordinary braking, an emergency braking occurs or if the brakes are released during running.

D.1.15 - The brake must be such as to be capable of being utilised either as "Freight" brake, passenger brake, or "Passenger-Freight" brake; in the latter case, a changeover device must be provided to allow its utilisation in the "P" position or "G" position and the braking of the tare only is required.

D.1.16 - The transmission speed[1] of brake action must be, for emergency applications, effected as from the normal working pressure, at least 250 metres per second, whatever the consist of the train:

- in the "G" position, up to a limit of 200 axles, with at least 1/4 of the axles braked;

- in the "P" position, up to a limit of 80 axles, with at least 1/3 of the axles braked.

D.1.17 - In ordinary braking, the action of the brake must be transmitted as far as the last vehicle, once the pressure in the main brake pipe has dropped to a maximum of 0,3 bar, whatever the composition of the train:

- in the "G" position, up to a limit of 200 axles;

- in the "P" position, up to a limit of 80 axles (two-axle vehicles).

D.1.18 - When an emergency or ordinary application is effected as from the normal working pressure on the brake of one separate vehicle, the pressure of the brake cylinder:

- in the "G" position, must become rapidly sufficient to permit application of the shoes on the wheels.

  The pressure on the shoes[2] thus obtained must be approximately 10% of the maximum pressure which may be obtained at the end of the application.

  Following this, the increase in pressure to the maximum value must be progressive; the filling time of the brake cylinder, measured between the moment when the air begins to enter the cylinder and that when the pressure in the cylinder reaches 95% of its maximum value, must be between 18 and 30 seconds, whether or not there exists an "empty-loaded" changeover device and whatever its type.

- in the "P" position, must increase continuously up to its maximum value whatever the braking system considered (tare or load).

  In emergency application, the filling time of the brake cylinder, measured from the moment when the air begins to enter the cylinder and that when the pressure attains 95 % of its maximum value, must be between 3 and 5 seconds, except in the case of the "empty-loaded" device for which a filling time of 3 to 6 seconds is allowed.

D.1.19 - At the time of full and continuous release of the brake of one separate vehicle, following full application, the pressure at the brake cylinder must fall progressively.

Regardless of whatever there is an "empty-loaded" device and irrespective of the design, the draining time of the brake cylinder, measured by the time between the moment when the air begins to escape

1. The transmission speed is the quotient of the length of the brake pipe, determined, without taking the branch pipes into consideration, from the driver's brake valve to the rear stop cock, by the time elapsing between the moment when the driver places his valve in the application position, and that when the air begins to enter the brake cylinder of the last vehicle (transmission time).
2. The pressure on the shoes is the actual pressure of the shoes on the wheels, measured when stationary.

from the brake cylinder and that when the pressure attains 0,3 bar, the driver's valve being placed in the application position, must be:

- between 45 and 60 seconds, in the "G" position,

- between 15 and 20 seconds, in the "P" position.

D.1.20 - When a brake release is effected on a complete train following full application, and without any overload occurring that might impede the subsequent operation of the brakes, the time which elapses between the beginning of the release operation and the moment when the pressure in the brake cylinder of the last vehicle has fallen to 0,4 bar:

- in the "G" position, must not be more than 70 seconds for a train of 150 axles, 3 vehicles out of 4 being braked;

- in the "P" position, must not be more than 25 seconds, for a train of 15 four-axle vehicles or for a train of 30 two-axle vehicles.

D.2 - Special conditions for brake systems approved in international traffic prior to 1 January 1953

D.2.1 - Required reduction in brake-pipe pressure

For both the "G" and "P" positions.

At the time of full application with the brake operating at normal working pressure, the required reduction in pressure to achieve the maximum pressure in the brake cylinder must not be less than 1 bar.

If the vehicle is not fitted with an automatic slack adjuster, it must not exceed 1,5 bar when the tare alone is braked and 1,7 bar when the load is braked, whatever the stroke of the piston.

If the vehicle is fitted with an automatic slack adjuster, it must be between 1,3 bar and 1,6 bar.

D.2.2 - Transmission speed

In emergency braking, effected as from the normal working pressure, the transmission speed must be, whatever the consist of the train:

- in the "G" position, at least 100 metres per second up to a limit of 200 axles;

- in the "P" position", at least 150 metres per second, up to a limit of 80 axles.

D.2.3 - Sensitivity

In ordinary braking, effected as from the normal working pressure, the action of the brake must be transmitted as far as the last vehicle if the pressure in the main brake pipe drops by a maximum of 0,5 bar, whatever the consist of the train:

- in the "G" position, up to a limit of 200 axles,

- in the "P" position, up to a limit of 80 axles (2-axle vehicles).

D.2.4 - Application time

D.2.4.1 - Vehicles not fitted with an automatic slack adjuster

D.2.4.1.1 - In the "G" position

At the time of brake activation (by emergency application or ordinary application), the pressure at the cylinder must become rapidly sufficient to permit the application of the shoes on the wheels. The pressure on the shoes thus obtained must not exceed 20% of the maximum pressure which may be obtained during this application.

Following this, the pressure increase up to its maximum value must be progressive and such that in the full application, 95% of the maximum pressure on the shoes is obtained, for the minimum stroke of the piston after 28 seconds at the earliest, and for the maximum stroke of the piston, after 60 seconds at the latest, based on the beginning of the pressure increase in the brake cylinder.

D.2.4.1.2 - In the "P" position

At the time of the bringing into action of the brake of one separate vehicle by emergency application, the pressure at the cylinder must increase continuously up to its maximum value, whatever the braking system considered (tare or load).

If the emergency application is effected as from the normal working pressure, the filling time of the brake cylinder, measured by the length of time which elapses between the moment when the air begins to enter the cylinder and that when the pressure attains 95% of its final value, must be, for the average stroke of the piston, within the following limits:

- bogie coaches and vans: 3 - 5 seconds;

- all other vehicles: 4 - 8 seconds.

In the case of vehicles fitted with load-proportional braking, the limits indicated refer to the braking system giving the shortest times (in general braking of the tare); as regards the other braking systems, the higher limits must not be exceeded by more than 20%.

D.2.4.2 - Vehicles fitted with an automatic slack adjuster

D.2.4.2.1 - In the "G" position

At the time of brake activation (by emergency application or ordinary application) the pressure at the cylinder must become rapidly sufficient to permit the application of the shoes on the wheels. The pressure on the shoes thus obtained must not exceed 20% of the maximum pressure which may be obtained during this application.

Following this, the pressure increase up to its maximum value must be progressive and such that, in the full application, 95% of the maximum pressure on the shoes is obtained.

- Vehicles fitted with a mechanical "empty-loaded" changeover device, acting by modification of the multiplication of the rigging.

  The brake cylinder filling must be:

  • between 28 and 42 seconds in the "empty" position;

- between 28 and 50 seconds in the "loaded" position.

- Vehicles fitted with any other changeover device.

  The application times will have to be between 35 and 45 seconds.

D.2.4.2.2 - In the "P" position

The provisions of point D.2.4.1.2 - page 16, relative to this system, are to be applied.

D.2.5 - Release time

D.2.5.1 - Vehicles not fitted with an automatic slack adjuster

D.2.5.1.1 - In the "G" position

At the time of a full and continuous release of the brake of one separate vehicle after full application, the pressure on the shoes must fall progressively so that the shoes clear the wheels: at the earliest after "a" seconds, for the minimum stroke of the piston, and at the latest after "b" seconds, for the maximum stroke of the piston, as from the moment when the air begins to escape from the cylinder and that when the pressure attains the value of 0,3 bar, whatever the braking system considered (tare or load).

If the brake is not fitted with a "level-gradient" device, the above-mentioned limits shall be:

- a = 45 and b = 110 seconds.

If the brake is fitted with a special "level-gradient" device, the following values will have to be adopted:

- on a level track: a = 25 and b = 60 seconds,

- on a gradient: a = 45 and b = 110 seconds.

D.2.5.1.2 - In the "P" position

At the time of a full release of the brake of one separate vehicle, the pressure in the brake cylinder must fall continuously.

After an emergency application effected as from the normal working pressure, the draining time of the brake cylinder, measured by the time which elapses between the moment when the air begins to escape from the cylinder and that when the pressure attains the value of 0,4 bar must be between 10 and 20 seconds, whatever the stroke of the piston and the braking system considered (tare or load).

D.2.5.2 - Vehicles fitted with an automatic slack adjuster

D.2.5.2.1 - In the "G" position

At the time of a full and continuous release of the brake of one separate vehicle, after a full application, the pressure on the shoes must fall progressively, whatever the braking system adopted (tare or load): the release times will have to be within the following limits:

- Vehicles fitted with a mechanical "empty-loaded" changeover device acting by modification of the rigging ratio.

  a. Brakes not fitted with the "level-gradient" device:

  - in the "empty" position : 45-60 seconds;
  - in the "loaded" position : 45-70 seconds.

  b. Brakes fitted with the "level-gradient" device:

  - in the "level" position and "empty" position : 25-40 seconds;
  - in the "level" position and "loaded" position : 25-50 seconds;
  - in the "gradient" position and "empty" position : 45-60 seconds;
  - in the "gradient" position and "loaded" position : 45-70 seconds.

- Vehicles fitted with any other "empty-loaded" changeover device

  a. Brakes not fitted with the "level-gradient" device: 45-60 seconds.

  b. Brakes fitted with the "level-gradient" device:

  - in the "level" position : 25-40 seconds;
  - in the "gradient" position : 45-60 seconds.

D.2.5.2.2 - In the "P" position

At the time of a full release of the brake of one separate vehicle, the pressure in the brake cylinder must fall continuously.

After an emergency application effected as from the normal working pressure, the draining time of the brake cylinder, measured by the time which elapses between the moment when the air begins to escape from the cylinder and that when the pressure attains the value of 0,4 bar, must be between 10 and 20 seconds, whatever the stroke of the piston and braking system adopted (tare or load).

D.2.6 - Release time of a complete train

At the time of the release of a complete train, effected after a full application and in such conditions that no permanent overload of the brake capacities of the train is obtained, the piston stroke of the last vehicle having as its average value or that maintained by a slack adjuster:

- in the "G" position, the time which elapses between the beginning of the release operation and the moment when the pressure in the brake cylinder of the last vehicle has fallen to 0,3 bar must not exceed:

  • 120 seconds for a train of 150 axles, 3/4 of which are braked, the brake being adjustable or not at the time of the release operation;

- in the "P" position, the time which elapses between the beginning of the release operation and the moment when the pressure in the brake cylinder of the last vehicle has fallen to 0,4 bar must not exceed:

  • 35 seconds for a train of 15 four-axle vehicles or for a train of 30 two-axle vehicles, all axles being braked and the brake being adjustable or not at the time of the release operation.

D.3 - Application procedure for the conditions applicable to brakes introduced before 1st January 1953

NB : Formerly Appendix 4, Annex 1.

Condition No.	Brakes in use before 1-1-37	Brakes introduced after 1-1-37 and before 1-1-53	Observations
D.1.1	O	O	
D.1.2	O	O	
D.1.3	O	O	
D.1.4	O	O	
D.1.5	O	O	
D.1.6	O*	O*	* The second paragraph of this condition does not apply to brakes without gradual release.
D.1.7	- *	- *	* Follow the provisions of condition D.2.1 - page 15 (See application procedure hereafter).
D.1.8	O	O	
D.1.9	O	O	
D.1.10	O	O	
D.1.11	O	O	
D.1.12	O*	O	* As regards the Kunze-Knorr brake, this condition is only recommended as far as the first paragraph is concerned.
D.1.13	O	O	
D.1.14	O	O	
D.1.15	O	O	
D.1.16	- *	- *	* Apply provisions of condition D.2.2 - page 15 (See application procedure hereafter).
D.1.17	- *	- *	* Apply provisions of condition D.2.3 - page 15 (See application procedure hereafter).
D.1.18	- *	- *	* Apply provisions of condition D.2.4 - page 16 (See application procedure hereafter).
D.1.19	- *	- *	* Apply provisions of condition D.2.5 - page 17 (See application procedure hereafter).
D.1.20	- *	- *	* Apply provisions of condition D.2.6 - page 18 (See application procedure hereafter).
D.2.1	R	O	
D.2.2	R	O	
D.2.3	O	O	
D.2.4	R	O	
D.2.5	R	O	
D.2.6	R	O	
NB :	See the texts of conditions D.1.1 to D.1.20 in Appendix D to this leaflet. See the texts of conditions D.2.1 to D.2.6 in Appendix D to this leaflet.		

D.4 - Table of provisions applicable to brakes for freight trains

NB : Formerly, Appendix 4, Annex 2.

NATURE OF THE CHARACTERISTICS					REGULATION		REGULATION		REGULATION		REGULATION	
					Reference	Valid until 1.1.53	Reference	Valid until 1.1.56	Reference	Valid until 1.1.65	Reference	Valid until 31.12.81
Filling time of reservoirs from 0 to 4,8 bar in seconds (vehicle taken separately)		Control reservoir			a	–	–	–	–	–	–	–
		Auxiliary reservoir				–		–		–		–
		Supplementary reservoir				–		–		–		–
Filling time of the brake cylinder, to 0,95 of the maximum pressure (in seconds)	with slack adjuster	with mechanical device for braking the load		empty	Condition D.2.4[b]	28 - 42	Condition D.1.18[b]	30 - 40	Condition D.1.18[b]	20 - 28	Condition D.1.18[b]	18 - 30
				loaded		28 - 50						
		without or with other device for braking the load		empty		35 - 45						
				loaded								
	without slack adjuster	without or with other device for braking the load		empty		28 - 60						
				loaded								
Draining time of the brake cylinder to ..... bar of brake cylinder pressure (in seconds)	with slack adjuster	with mechanical device for braking the load	without "level-gradient" device	empty	Condition D.2.5[bc]	Up to 0,3 bar	45 - 60	Condition D.1.19[b]	Up to 0,4 bar 45 - 60	Condition D.1.19[b]	Up to 0,4 bar 45 - 60	Condition D.1.19[b]	Up to 0,4 bar 45 - 60
				loaded			45 - 70						
			with "level-gradient" device	"level" empty			25 - 40						
				"level" loaded			25 - 50						
				"gradient" empty			45 - 60						
				"gradient" loaded			45 - 70						
		with any other device for braking the load	without "level-gradient device"				45 - 60						
			with "level-gradient" device	"level"			25 - 40						
				"gradient"			45 - 60						
	without slack adjuster, whatever braking system considered (tare or load)	without "level-gradient" device					45 - 110						
		with "level-gradient" device		"level"			25 - 60						
				"gradient"			45 - 110						
Necessary reduction in pressure (in bar) to obtain full application	with slack adjuster				Condition D.2.1[b]	1,3 - 1,6	Condition D.1.7[b]	1,3 - 1,6	Condition D.1.7[b]	1,3 - 1,6	Condition D.1.7[b]	1,3 - 1,6
	without slack adjuster			empty		1,0 - 1,5						
				loaded		1,0 - 1,7						
1st stroke in % of the maximum brake shoe pressure					Condition D.2.4[b]	Maximum 20 %	Condition D.1.18[b]	approximately 10 %	Condition D.1.18[b]	approximately 10 %	Condition D.1.18[b]	approximately 10 %
Maximum pressure in the brake cylinder (in bar)				limited	a	–	–	–	Condition D.1.7[b]	3,7 - 3,9	Condition D.1.7[b]	3,7 - 3,9
				not limited	–	–		–				
Transmission speed in m/second in the case of emergency braking					Condition D.2.2[b]	Up to 200 axles 75% braked minimum 100	Condition D.1.16[b]	Up to 200 axles at least 25% braked minimum 250	Condition D.1.16[b]	150 axles 50% braked minimum 250	Condition D.1.16[b]	150 axles 50% braked minimum 250
Automatic compensation for the leakage of the brake cylinders					d	exists or does not exist	d	exists or does not exist	d	exists or does not exist	d	exists or does not exist
Sensitivity	The brake must not operate	at the time of a reduction in pressure at least equal to...		Separate vehicle	d	0,3 bar in 60 s	d	0,3 bar in 60 s	d	0,3 bar in 60 s	d	0,3 bar in 60 s
				Train	d	150 axles all braked 1 bar in 10 mn	d	150 axles all braked 1 bar in 10 mn	d	150 axles all braked 1 bar in 10 mn	d	150 axles all braked 1 bar in 10 mn
	The brake must operate	at the time of a reduction of pressure at the most equal to...		Separate vehicle	d	0,6 bar in 6 s. before 6 seconds	d	0,6 bar in 6 s. before 6 seconds	d	0,6 bar in 6 s. before 6 seconds	d	0,6 bar in 6 s. before 6 seconds
				Train	Condition D.2.3[b]	200 axles 75% braked 0,5 bar	Condition D.1.17[b]	200 axles 75% braked 0,3 bar	Condition D.1.17[b]	200 axles 75% braked 0,3 bar	Condition D.1.17[b]	200 axles 75% braked 0,3 bar
Uneven filling after full application - 6 bar pressure in the brake pipe during ... seconds (separate vehicle)					–	–	Condition D.1.8[b]	at least 25	Condition D.1.8[b]	at least 25	Condition D.1.8[b]	at least 25
Maximum release time of a 150 axle train, 75% braked, empty position, after full application (in seconds)					Condition D.2.6[b]	120	Condition D.1.20[b]	70	Condition D.1.20[b]	70	Condition D.1.20[b]	70
Inexhaustibility - Maximum percentage of reduction in braking power					–	–	Condition D.1.12[b]	15 %	Condition D.1.12[b]	15 %	Condition D.1.12[b]	15 %
Braking the load					–	–	Condition D.1.11[b]	must be possible	Condition D.1.11[b]	must be possible	Condition D.1.11[b]	must be possible
Uneven filling, the brake being released (150 axles, all braked) (in seconds)					–	–		2		2		2
Pressure corresponding to the return to the filling position (in bar)					–	–	Condition D.1.5[b]	maximum 4,85	Condition D.1.5[b]	maximum 4,85	Condition D.1.5[b]	maximum 4,85

a. The maximum pressures at the brake cylinder are not exceeded in the event of overloading.
b. 20 conditions for air brakes (Appendix D to this leaflet).
c. Determined with driver's valve in running position.
d. Normal test programme for air brakes (UIC Leaflet 547).

D.5 - Table of provisions applicable to brakes for passenger trains

NB : Formerly, Appendix 4, Annex 3.

NATURE OF THE CHARACTERISTICS				REGULATION		REGULATION	
				Reference	Valid until 1.1.53	Reference	Valid until 31.12.81
Filling time of reservoirs (separate vehicle) from 0 to 4,8 bar (in seconds)		Control reservoir		a	–	–	–
		Auxiliary reservoir			–	–	–
		Supplementary reservoir			–	–	–
Filling time of the brake cylinder, to 0,95 of the maximum pressure (in seconds)	with slack adjuster	with mechanical device for braking the load		Condition D.2.4[bc]	Bogie coaches and vans: 3-5; all other vehicles: 4-8. For the braking of the load, these limits apply to the braking system which gives the shortest time. For the other braking system, the greater limits must not be exceeded by more than 20%.	Condition D.1.18	3 - 5 In the case of the empty-loaded system, 3 - 6 will be admitted
		without or with other device for braking the load					
	without slack adjuster	without or with other device for braking the load					
Draining time of the brake cylinder to 0,4 bar of the cylinder pressure (in seconds)	with slack adjuster	with mechanical device for braking the load		Condition D.2.5[b]	10 - 20	Condition D.1.19[b]	15 - 20
		without or with other device for braking the load					
	without slack adjuster	without or with other device for braking the load, whatever braking system considered					
Necessary reduction in pressure in bar to obtain full application	with slack adjuster			Condition D.2.1[b]	1,3 - 1,6	Condition D.1.7[b]	1,3 - 1,6
	without slack adjuster		empty		1,0 - 1,5		
			loaded		1,0 - 1,7		
Maximum pressure at the brake cylinder (in bar)			limited	[d]	–	Condition D.1.7[b]	3,7 - 3,9
			not limited	–	–		
Transmission speed in m/sec., in the case of emergency braking, empty position				Condition D.2.2[b]	80 axles 75% braked / Minimum 150	Condition D.1.16[b]	80 axles all braked / Minimum 250
Automatic compensation for the leakages of the brake cylinders							exists or does not exist
Sensitivity	The brake must not operate	For a reduction in pressure, at least equal to...	separate vehicle		0,3 bar in 60 s.		0,3 bar in 60 s.
			train		80 axles / 0,1 bar in 60 s. maximum		80 axles all braked / 1 bar in 10 mn maximum
	The brake must operate	For a reduction in pressure, at the most equal to..	separate vehicle		0,6 bar in 6 s., before 6 seconds		0,6 bar in 6 s., before 6 seconds
			train	Condition D.2.3[b]	80 axles / 0,5 bar	Condition D.1.17[b]	80 axles all braked / 0,3 bar maximum
Uneven filling after full application - 6 bar pressure in the brake pipe during ... seconds (separate vehicle)				Condition D.1.8[b]	10	Condition D.1.8[b]	at least 10
Maximum release time of a 60-axle train, all braked, empty position, after a full application (in seconds)				Condition D.2.6[b]	35	Condition D.1.20[b]	25
Inexhaustibility - Maximum percentage of reduction in braking power				Condition D.1.12[b]	15%	Condition D.1.12[b]	15%
Braking the load				Condition D.1.11[b]	must be possible	Condition D.1.11[b]	must be possible
Uneven filling, the brake being released (80 axles, all braked) (in seconds)				–	–		2
Pressure corresponding to the return to the filling position (in bar)				–	–	Condition D.1.5[b]	maximum 4,85

a. Determined with driver's valve in running position.
b. 20 conditions for air brakes (Appendix D to this leaflet).
c. The time shown are valid for the average stroke of the piston. By average stroke of piston is meant the stroke determined by the automatic slack adjuster, when such apparatus is being used.
d. The maximum pressures of the brake cylinder indicated are not exceeded even in the event of overloading.

NB : The characteristics of brakes approved prior to 1 January 1948 are given under the responsibility of the RUs concerned.

Bibliography

1. UIC leaflets

International Union of Railways (UIC)
UIC Leaflet 541-03 : Brakes - Regulations concerning manufacture of the different brake parts - Driver's brake valve, 1st edition of 1.1.84

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

UIC Leaflet 541-3 : Brakes - Disc brakes and their application - General conditions for the approval of brake pads, 6th edition, November 2006

UIC Leaflet 541-4 : Brakes - Brakes with composition brake blocks, 2nd edition of 1.10.90 and 3 Amendments (3rd edition in preparation)

UIC Leaflet 541-5 : Brakes - Electropneumatic brake (ep brake) - Electropneumatic emergency brake override (EBO), 4th edition, May 2006

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, 13th edition, November 2006

UIC Leaflet 544-1 : Brakes - Braking power, 4th edition, October 2004

UIC Leaflet 544-2 : Conditions to be observed by the dynamic brake of locomotives and motor coaches so that the extra braking effort produced can be taken into account for the calculation of the braked-weight, 2nd edition of 1.1.83

UIC Leaflet 545 : Brakes - Inscriptions - Marks and signs, 7th edition, April 2002 (8th edition in preparation)

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

UIC Leaflet 547 : Brakes - Air brake - Standard programme of tests, 4th edition of 1.7.89

2. Minutes of meetings

International Union of Railways (UIC)
Traction and Rolling Stock Committee. - Question 5/T/FIC - Revision of and amendments to leaflets managed by the Sub-Commission for Braking, Paris, June 1981

Sub-Commission for Braking. - Question 5/T/36 - Conditions for the acceptance of brake equipment, Zurich, March 1988

Sub-Commission for Braking. - Question 5/T/FIC - Revision of UIC leaflets - Supplement to Appendix 2 of Leaflet 540, Paris, January 1989

Sub-Commission for Braking. - Question 5/T/36 - Conditions for the acceptance of brake equipment. a) ÖBB request for modification to the OERLIKON ESG distributor, Paris, January 1992

Sub-Commission for Braking. - Question 5/T/36 - Conditions for the acceptance of brake equipment. a) DB request for transformation of KEa 3,8 distributors into KEad distributors (exchange of HdB maximum-pressure limited for KEd version of KEd), Paris, January 1993

Sub-Committee for Braking. - Question 5/T/36 - Conditions for the acceptance of brake equipment. a) BR request for approval of the DMD3 version of the Davies & Metcalfe Est 3f distributor for passenger and freight trains (reproduction of the Oerlikon Est 3f distributor), Paris, January 1995

Sub-Committee for Braking - Study 5/T/FIC - Revision of UIC Leaflets. e) Amendments to Points 1.7 and 1.17 of Leaflet 540, Paris, January 1995

Sub-Committee for Braking - Study 5/T/36 - Conditions governing approval of brake components. Approval of the Fa. SAB-WABCO automatic brake valve designs SW 4, SW4C, SW 4/3 for freight and passenger trains, Saint Jean de Maurienne, November 1996

Sub-Committee for Braking - Study 5/T/36 - Application from JŽ for approval of the MZT-HEPOS brake valve designs MH3f for freight and passenger trains, Rotenburg (Wümme), October 1997

Sub-Committee for Braking - Study 5/T/36 - Approval of the Fa Knorr automatic brake valve designs KE 0d-483, KE 1d-483, KE 2d-483 for freight and passenger trains, Minden, May 1998

Sub-Committee for Braking - Study 5/T/FIC - Revision of UIC leaflets. Incorporation of the new Point 3.4 into Leaflet 540, Paris, January 1999

Sub-Commission for Braking - Study 5/T/FIC - Revision of UIC leaflets. Change of approval deadline to 1.1.2002 (see Point 3.4 of UIC Leaflet 543), Paris, June 1999

SG5 "Braking and Running gear" - Revision of UIC Leaflets, March 2006

Warning

Printed by the International Union of Railways (UIC)
16, rue Jean Rey 75015 Paris - France, November 2006
Dépôt Légal November 2006

ISBN 2-7461-1171-3 (French version)
ISBN 2-7461-1173-X (German version)
ISBN 2-7461-1172-1 (English version)