

7th edition, October 2010

Translation

OR

Brakes - Disc brakes and their application - General conditions for the approval of brake pads

*Freins - Freins à disques et leur utilisation - Conditions générales pour l'admission de garnitures de frein
Bremse - Scheibenbremse und ihre Anwendung - Allgemeine Bedingungen für die Zulassung von
Bremsbelägen*



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Summary

This Leaflet contains the general conditions for disc brakes and their indicating equipment. The properties required for brake pads are specified as well as their frictional and geometrical requirements and the mechanical, physical and chemical features of both organic brake pads and sintered brake pads for different categories of vehicles.

The approval procedure for brake pads including the test programmes to be used for each type is described. The instantaneous and the average coefficients of friction to be achieved are shown in diagrammatic form. The validity of the approval expires after a certain time.

The internationally approved brake pads are listed by different applications in tables and the same is true for the internationally approved brake test benches.

The Leaflet is completed by a glossary of terms, the test methods and measurements to be made.

1 - Disc brakes

o 1.1 - Application of disc brakes

Vehicles fitted with disc brakes (as well as those combined with additional block brakes) may be used in international traffic.

o 1.2 - Use of brake pads

The brake pads to be used shall be approved as specified in point 2.2 - page 8. The Table of point 2.2.2.1 - page 8 gives their fields of application, classified according to vehicle category. Category 4, Passenger coaches, is correct for the brake pads approved up to the 4th issue of the Leaflet. Pads of the types 4.1 to 4.3 meet the requirements for RIC vehicles. The pad type 4.4 is reserved for those RUs which have to operate under difficult winter conditions. If these pads are to be used on vehicles that cross frontiers this needs to be approved bilaterally depending on the application. These pads are specially marked as specified in point 2.1.5 - page 7. The other fields of application apply for the use in international traffic and produce approval conditions for the TSI-requirements as well.

o 1.3 - Fitness for service

In order to check that the brakes are operating properly, a "brake on/brake off" indicator must be fitted in a clearly visible position on each side of the vehicle. The "brake on" state must be indicated by a red indicator and the "brake off" state by a green indicator.

On vehicles fitted with several distributors, there must be a separate indicator for each distributor.

The area of a display field shall be about 2 400 mm². In the centre of the red display field, there is a dark field 15 mm in diameter or a continuous black line 10 mm wide.

1.4 - Indicating equipment

- o 1.4.1 - When pressure is applied to the brakes, the "brake on/brake off" indicators must make it possible to check with precision whether the compressed-air brakes of the vehicle are on or off and whether the hand brakes are off. When the indicators show a green field (brake off), this must ensure that both brakes - compressed-air and handbrake - really are off. The indicators showing the position of the handbrake must be marked with the "handbrake" symbol .

NB : The "handbrake" symbol  is not obligatory for existing vehicles if the indicator for the handbrake is adjacent to the handbraked bogie.

- R 1.4.2 - It is recommended that the handbrakes on wagons be checked by means of indicators.
- R 1.4.3 - The indicator units may have an extra device consisting of a diagonal black cross on a white background to indicate that the indicator unit is temporarily non-operational.
- R 1.4.4 - It is recommended that the indicator unit "brake applied - brake released" should be located in the vicinity of the operating equipment for the brake gear.

o 1.5 - Braked weights

The braked weights of vehicles fitted with disc brakes shall be determined in accordance with the method defined in *UIC Leaflet 544-1* (see Bibliography - page 79).

o 1.6 - Vehicle inscription

Vehicles with disc brakes (and those fitted with the additional block brakes) shall be identified with the mark (D) in accordance with *UIC Leaflet 545, Appendix G* (see Bibliography - page 79).

This mark shall be applied behind the abbreviated brake designation.

2 - Brake pads for vehicles equipped with disc brakes

2.1 - Characteristics of the brake pads

2.1.1 - General

- **2.1.1.1** - This specification defines the characteristics required of brake pads made of organic and sintered materials for the categories of vehicles listed in the table in point **2.2.2.1 - page 8**.

The tolerance ranges for the instantaneous coefficient of friction (μ_a) and the average coefficient of friction (μ_m) are given for the corresponding test programme - see the table under point **2.2.2.1**.

The design of the vehicle brake equipment shall be based on the nominal value of the μ_m curve (in which the appropriate coefficient of friction diagrams are shown).

- **2.1.1.2** - Brake pads of organic and sintered materials work on the brake discs made of cast steel, forged steel or cast iron attached to the wheels or axles.

Small brake pads with 140 cm² rubbing surface may act directly on the side surfaces of the wheels.

- **2.1.1.3** - The composition of the material and the method of manufacture of the brake pads in current production must agree with that of the pad that was approved.

- **2.1.1.4** - The use of asbestos is forbidden.

- R **2.1.1.5** - The use of the metals lead or zinc, even in the form of compounds, is not recommended; this also applies to any other materials which, when the pads are in use, may produce dust, particles or gas likely to be a health risk or unpleasant for passengers.

- **2.1.1.6** - The composition of the material from which the brake pads are made shall be so chosen, that the best compromise is obtained between:

- the frictional properties,
- the wear and the life of the pads and
- the aggressivity against the brake disc.

- **2.1.1.7** - The characteristics laid down in this leaflet must be complied with over the full thickness of the brake pads.

2.1.2 - Frictional requirements

2.1.2.1 - As far as possible the coefficient of friction shall be independent of the extent to which the pads are bedded-in, the specific pressure, the temperature and the weather effects. The frictional requirements for various applications of the brake pads are described in the test programmes No. 1 to 6. The permissible coefficients of friction for universal use in RIC traffic are described in Appendix C (points C.1 - page 21 to C.6 - page 34) and for special applications in Appendices B - page 16 and D - page 36 to G - page 57.

- **2.1.2.2** - The tolerance ranges for the instantaneous and average coefficients of friction (for definitions, see Appendix J - page 75) on a dry disc are given for the respective applications in the diagrams of the corresponding Appendices and in the table of point 2.2.2.1 - page 8. The instantaneous and the average coefficients of friction measured in the test bed tests shall be documented in the appropriate tolerance diagrams. For the highest contact pressures of the test programme the average coefficients of friction are summarised in a separate tolerance diagram and documented in tabular form. These average coefficients of friction at the highest contact force shall, if possible, not vary either upwards or downwards from the nominal coefficient of friction given in the tolerance diagram of the respective test programme in the area of the initial speed at which the brake application was made ≥ 100 km/h.

During the bedding-in period, these coefficients of friction may not vary by more than $\pm 15\%$ from the values obtained under the same conditions when the bedding-in process is complete.

- **2.1.2.3** - In wet conditions or when there is snow, the coefficient of friction at any given moment should vary only slightly compared to the coefficient of friction under dry conditions. The capacity for the elimination of ice should be as high as possible. The coefficient of friction must immediately return to its value under dry conditions once these disruptive influences have ceased.

In wet conditions, with the highest contact pressure of test programme 3A (Appendix C, point C.4 - page 30, simulation of wet conditions) the average coefficient of friction must not vary - all other things being equal - by more than $\pm 15\%$ compared with the average coefficient of friction obtained during braking under dry conditions. The average coefficients of friction of the other brake applications to a stand of this test programme may not under-run the absolute value of $\mu_m = 0,25$ under otherwise similar conditions.

The average coefficients of friction of wet brake applications with the highest pressure in the test programme 3B (simulation of severe winter conditions) may not be less than the value $\mu_m = 0,15$ under otherwise similar conditions. For the remaining brake applications the absolute value shall not be less than $\mu_m = 0,1$.

- **2.1.2.4** -

1. For brake applications to a stand, which are done from a high initial temperature ($\geq 140^\circ\text{C}$), the average coefficient of friction under otherwise similar conditions may not vary by more than $\pm 15\%$ from the average of brake applications initiated from the cold ($\leq 60^\circ\text{C}$) and dry condition.
2. For continuous braking (when running down inclines) with a maximum power of 43 kW per brake disc, the instantaneous coefficient of friction shall meet the following conditions:
 - after 2 minutes braking: $\mu_{\min} = 0,25$ and $\mu_{\max} = 0,40$
 - during the whole of the braking period: $\mu_{\min} = 0,25$, $\mu_{\max} = 0,50$ and $\Delta\mu_a \leq 0,15$

Moreover the coefficient of friction must not experience any sudden variations and so disturb the operation and the controllability of the brake. During a minute, the instantaneous coefficient of friction shall not increase or drop by more than 0,05 ($|\Delta\mu_a| \leq 0,05$).

o 2.1.3 - Geometrical features of the brake pads

2.1.3.1 - Organic brake pads (two part or monobloc) are used with thicknesses of 24 or 35 mm; the dimensions are specified with the tolerances in Appendix A - page 11.

Appendix A, point A.1 - page 11 shows a brake pad half with a rubbing area of 200 cm². This pad can be used on internally ventilated axle brake discs from 610 mm up to 640 mm external diameter.

Brake pads with a rubbing area of 175 cm² as shown in Appendix A, point A.2 - page 12 can be used in internally ventilated axle brake discs from 510 mm up to 610 mm external diameter.

Brake pads with a rubbing surface of 140 cm² have a geometrical shape as shown in Appendix A, point A.5 - page 15. These pads are arranged horizontally over the axle and can be used for brake ring surfaces from 330 mm to 440 mm external diameter.

2.1.3.2 - The maximum pad thickness of sintered brake pads shall be 35 mm. The shape, number and arrangement of the rubbing parts on the carrier plate shall be designed to achieve a uniform temperature distribution in the brake disc. Its shape shall:

- either correspond to the requirements of the RUs (e.g. Appendix A, point A.3 - page 13),
- or appear like that for organic pads.

2.1.3.3 - The design of the brake pads must enable them to wear uniformly to a frictional material thickness of 5 mm, without the reinforcement, if fitted, coming into contact with the brake disc.

2.1.3.4 - The brake pads shall be affixed to the vehicle by pushing them into a dovetail shaped cut out in the brake pad holder and locking them in.

The design of the dovetail section is shown in Appendix A, points A.1 - A.4 - page 14.

The pads with 140 cm² rubbing surface have a different fixing system.

2.1.3.5 - The pads shall not deform under the effect of heat or humidity so that they can no longer be fitted or removed.

2.1.3.6 - In no case may the arrangement of the rubbing parts cause the pad to overlap the outer or inner diameter of the rubbing ring when the vehicle has average spring deflection.

o 2.1.4 - Mechanical, physical and chemical characteristics

2.1.4.1 - Manufacturer's data sheet

The manufacturer of sintered brake pads or organic brake pads shall submit a data sheet, on which sufficient mechanical, physical and chemical characteristics are given, so that by quality testing or subsequent inspections it is possible to check that these characteristics have not changed and the brake pad actually conforms to the approved brake pad.

2.1.4.2 - Mechanical requirements

1. When delivered and up to the assembly on the vehicle (after holding in stores) the frictional material must be sufficiently homogeneous that its assembly, as well as its use up to the wear limit, is neither affected by defects (craters, bubbles, cracks, etc.), which could cause brittleness, nor by any deformation or cracking. Consequently a loss of rubbing elements or parts of the rubbing material on the track should be prevented.
2. The method of bonding the frictional material to the carrier plate is left to the manufacturer. This shall be done in such a way that the operating loads that occur can be withstood.

2.1.4.3 - Thermal requirements

1. The frictional material shall not cause any thermal damage on the brake disc (burn marks and thermally initiated cracks, which can lead to fracture of the disc). Also the adjacent rubbing surface shall not be attacked nor should it tend to form metallic inclusions.
2. The brake pad shall withstand the thermal loading within the limits of the approval programme without burning, melting, or forming large deposits on the brake disc or wearing unusually quickly.

The frictional material shall be able to withstand without worsening of its properties the following temperatures, measured on the rubbing surfaces of the brake discs:

- for organic brake pads: 400°C,
- for sintered brake pads: 550°C.

o 2.1.5 - Marking of approved brake pads

On the back of each part of an approved brake pad, there shall be the following marks:

- name or abbreviation of the manufacturer,
- date of manufacture (week and year),
- pad-abbreviation (material),
- type designation of the pad: "UIC-xx" (e.g. "UIC-42" for a type 4.2 pad; the type specified in the table of point [2.2.2.1 - page 8](#)).

These marks shall preferably be stamped, engraved or punched and shall be so applied, that each pad can still be identified even after it has worn to its scrapping size.

2.2 - Approval of brake pads

2.2.1 - Approval procedure

- **2.2.1.1** - Each RU which puts forward an application for approval for the use of a new brake pad in international traffic, shall establish by carrying out tests on the test bench in accordance with the method given in Appendix **H - page 65** (with brake discs of diameters 590, 610 or 640 mm and suitable pads), whether its features correspond to those given in the approval conditions defined in points **2.1 - page 4** and **2.2.2**.

- **2.2.1.2** - The RU, which submits a brake pad shall check that it is satisfactory and, among other things, that it is not too aggressive on the brake discs by tests in service. This investigation shall be carried out on several trains under different weather conditions without interruption for at least a year. These service tests must produce evidence that the brake pad corresponds to the application conditions given in the approval application.

A detail report shall be prepared on this service testing.

- R **2.2.1.3** - If the RU that makes the application does not have the necessary equipment, the tests can be carried out by another RU.

- **2.2.1.4** - The application for approval shall be submitted with the various test reports (25 copies in two of the three UIC languages) to the UIC Study Group "Braking and running gear", who shall decide whether to approve it. The SET7 retains the right to withdraw an approval if there are justifiable reasons by granting a transition period.

For a list of the approved brake pads see Appendix **I - page 74**.

○ **2.2.2 - Conditions for approval tests on the test bench**

2.2.2.1 - The tests should preferably be carried out with a brake disc as per Appendix **H** (with the exception of the test programmes 2C, 6C, 7A, 7B as well as 4C and 4D) with the programmes given in the following Table. The RU that applied for the approval shall specify, bearing in mind the proposed application of the pad, the vehicle categories, and the type. The Table then gives the test programme to be used and tolerance ranges for the permitted coefficient of friction.

The use of programme 3B for special and extreme winter conditions is not obligatory for the general approval of pads for use in international traffic. It is carried out in addition when such pads are to be tested and approved.

Vehicle category	Type	$v_{\max}$ [km/h]	Brake pad material	Test programme to be carried out	Test programme (see points)	Tolerances μ_a (see points)	Tolerances μ_m (see points)
Category 1 High-speed trains	1.1 a ^a	300	organic or sintered	and 1 3A	B.1 C.4	B.2 C.6	B.3 C.7
	1.1 b ^a	320	sintered				
	1.2	320	sintered	and 5A 3A	E.1 C.4	E.4 C.6	E.5 C.7
Category 2 Multiple unit trains with wheel brake discs	2.1	160	organic	2C	C.3	C.8	C.9
	2.2	330	sintered	5B	E.3	E.6	E.6
Category 3 Locomotives	3.1 a	200	organic	7A	G.1	G.3	G.4
	3.1 b	220	sintered	7B	G.2	G.3	G.4
Category 4 Passenger coaches	4.1	140	organic	2A1 and or 2A2 3A	C.1 C.4	C.6 C.6	C.7 C.7
	4.2	200	organic	2B1 and or 2B2 3A	C.2 C.4	C.6 C.6	C.7 C.7
	4.3	200	sintered	and 6A 6B	F.1 F.2		
Extreme winter conditions	4.4	200	organic	2B1 and or 2B2 and 3A 3B	C.2 C.4 C.5	C.6 C.6 -	C.7 C.7 0,15/0,10 ^b
Category 5 Wagons (reserved)	5.1 a	160	organic	4A	D.1	D.4	D.5
	5.1 b		sintered	4B	D.2	D.4	D.5
Low floor wagons (rolling road)	5.2 a	120	organic	4C	D.3	D.6	D.7
	5.2 b		sintered				

a. Type 1.1 a - organic or sintered pads-bench-tested to max. 13,8 MJ / 300 km/h.

Type 1.1 b - sintered pads bench-tested to max. 17,8 MJ / 320 km/h.

b. See point 2.1.2.3.

In these tests brake applications shall be made to a stand from various starting speeds with various applied forces and temperatures in dry and wet conditions, as well as incline brake applications. The wear shall be determined by weighing.

The spraying equipment shown in Appendix H, point H.2 - page 69 shall be used to carry out the wet test

2.2.2.2 - Only brake pads of the original size may be used. Each test programme shall be carried out with new pads.

2.2.2.3 - The test benches used for the approval tests and the test runs shall be approved as specified in the conditions of Appendix H, point H.5 - page 72.

The abbreviations and formulae used in the text and the appendices are defined in Appendix J - page 75.

2.2.2.4 - No flames, bubbles, sweating of the bonding material, continuous squeaking, strong odours or other difficulties may occur on the brake pads during the tests.

o **2.3 - Validity of approval**

In general, pads for disc brakes are approved for a period of 10 years, provided that no serious modifications of the requirements in this Leaflet bring their suitability into question before the end of this time.

If an RU wants to renew the approval of a pad, a corresponding application must be made 1 year before the expiry of this approval to the SET7.

A test report as specified in point 2.2.1.1 - page 8 (pads from current manufacture) must be attached to the application for renewal of the approval.

The brake pad must meet the requirements of the leaflet that is current at the time when the application is made for the renewal of approval.

Moreover in the following cases a new approval certificate must be applied for:

- major changes in the manufacturing methods or materials used for the brake pads,
- changed requirements.

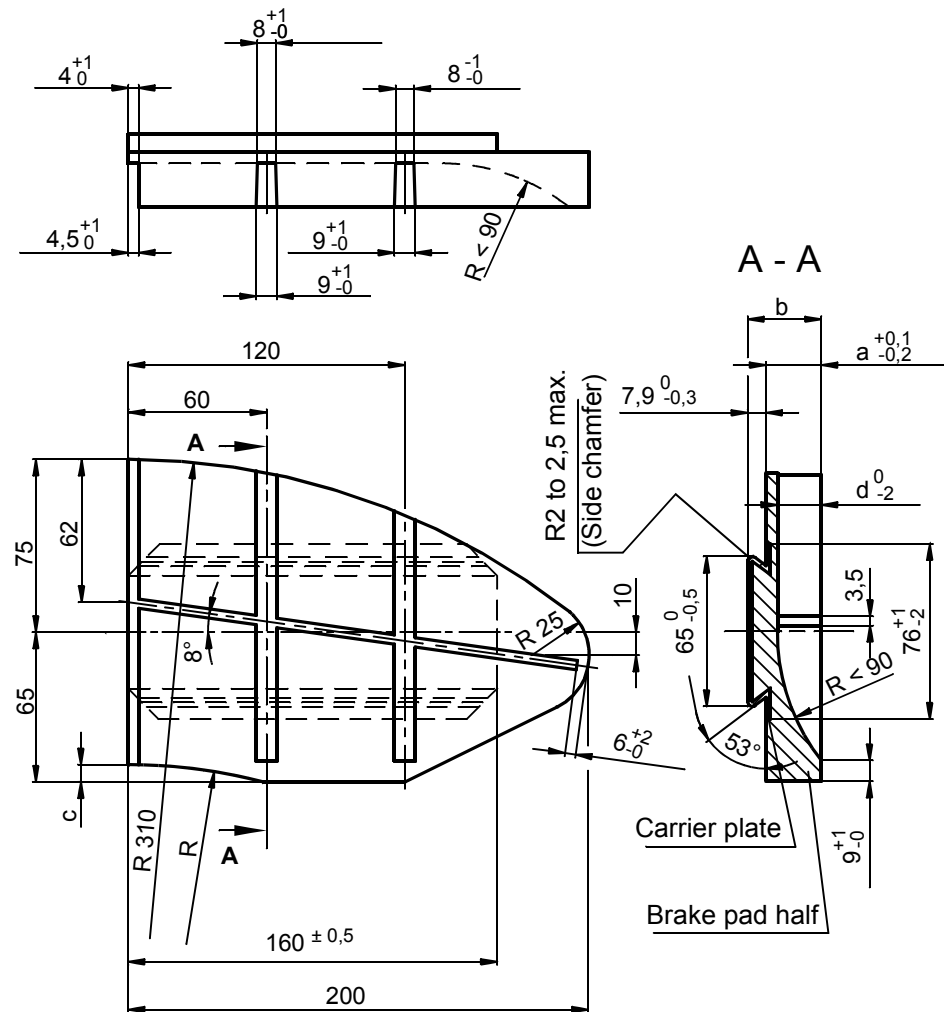
Another RU than the one that originally applied can ask to have the approval of the brake pad renewed.

The duration of the validity of the approved pads is given in Appendix I - page 74.

Appendix A - Examples of drawings of brake pads

A.1 - Brake pad half 200 cm² made of organic materials

View B (right hand model)

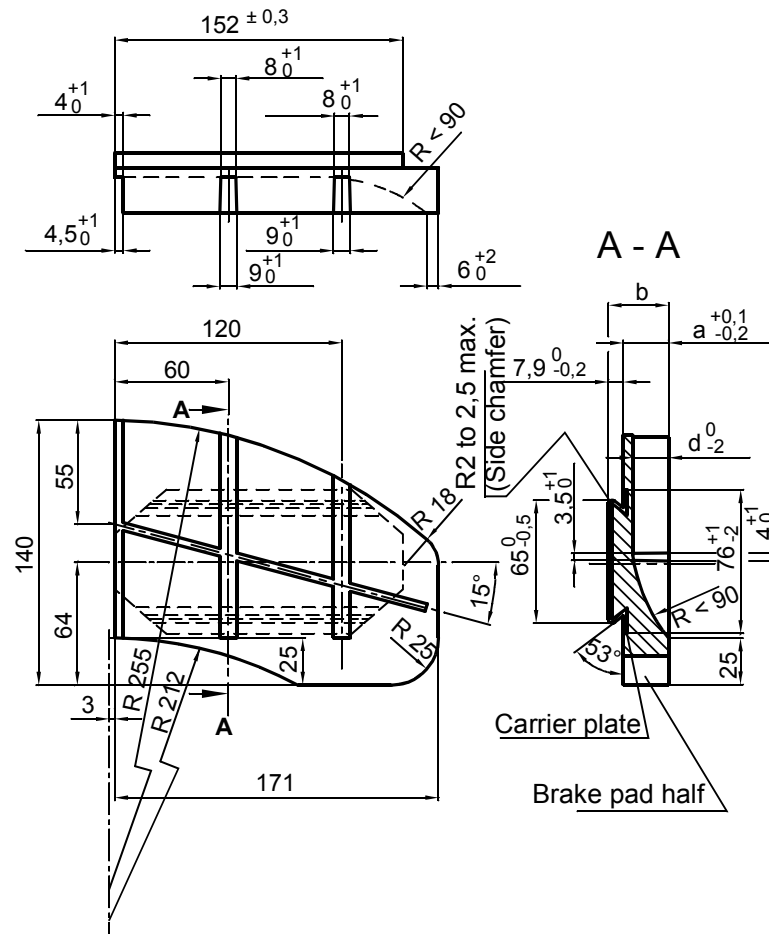


- Left hand model: same drawing but a mirror image.
- The pictorial display and the dimensions of the grooves are merely given as examples.
- For one piece pads (400 cm²), the two halves are joined together

a	b	d	c	R
24	31,9	19	7,5	232,5
35	42,9	30	7,5	232,5
24	31,9	19	15	240
35	42,9	30	15	240

A.2 - Brake pad half 175 cm² made of organic materials

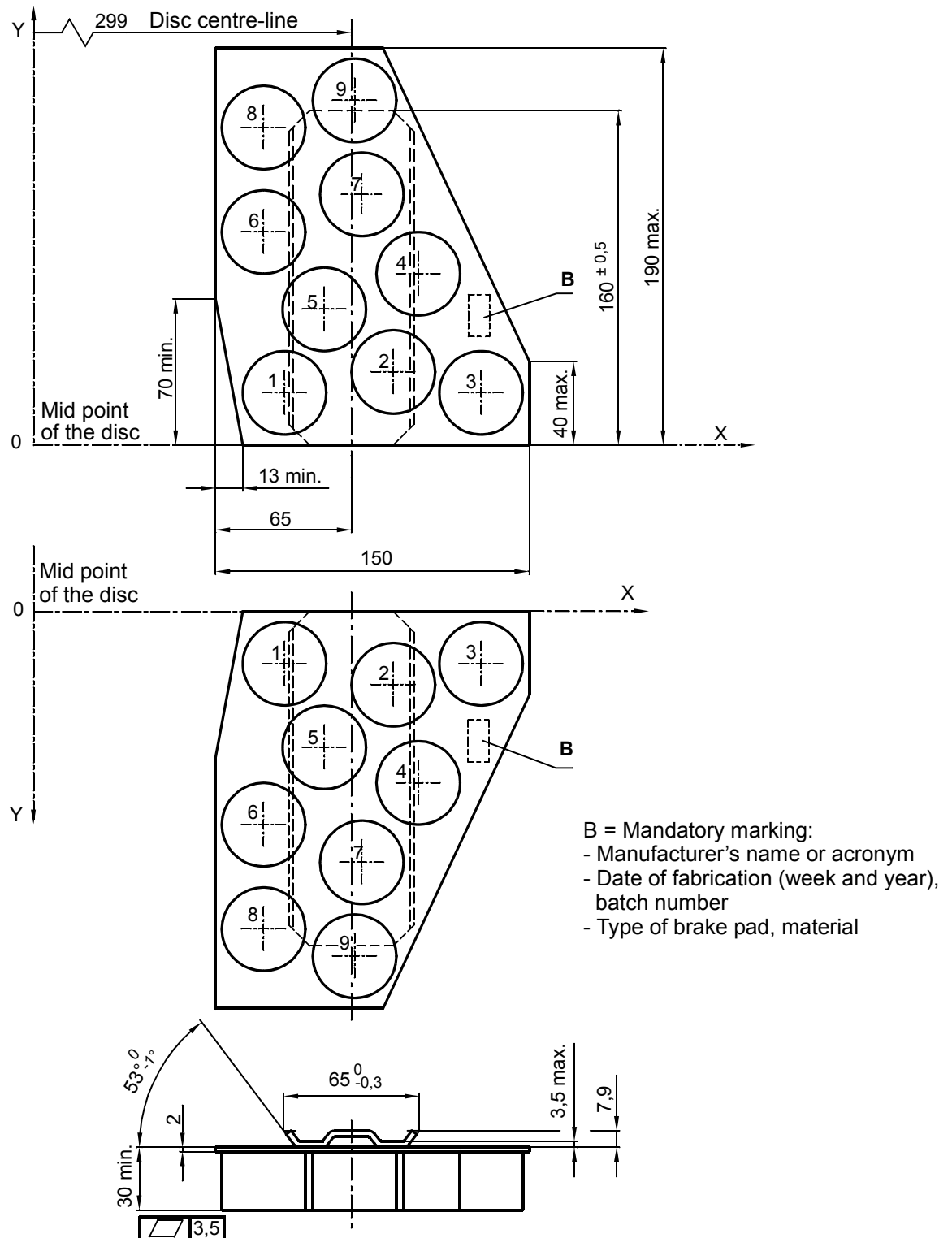
View B (right hand model)



- Left hand model: same drawing but a mirror image.
- The pictorial display and the dimensions of the grooves are merely given as examples.
- For one part pads (350 cm²), the two halves are joined together.

a	b	d
24	31,9	19
35	42,9	30

A.3 - Brake pad halves made of sintered material, surface area 200 cm²



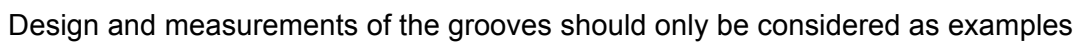
NB : The sum of the rubbing surfaces in this case is the sum of the surfaces of the nine circular shaped rubbing elements of a pad half.

A.4 - Brake pad holder for brake pads (175 cm² and 200 cm²)

Reserved for two drawings



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Appendix B - Requirements for organic and sintered brake pads ($v_{\max} = 300 \text{ km/h}$)

Approval of organic and sintered disc brake pads of high speed multiple unit trains ($v_{\max} = 300 \text{ km/h}$) with single stage contact pressure on the friction test bench

- B.1:** Test programme No. 1, $v_{\max} = 300 \text{ km/h}$
- B.2:** Instantaneous coefficient of friction μ_a
- B.3:** Average coefficient of friction μ_m

B.1 - Test programme No. 1 ($v_{\max} = 300 \text{ km/h}$)

UIC-approval for organic and sintered brake pads in high speed trains ($v_{\max} = 300 \text{ km/h}$) for a maximum energy of 13,8 [MJ] with single stage applied pressure

Pad half	composite 200 cm ² (A.1 - page 11), sinter: surface area 200 cm ² (A.3 - page 13)		
Brake disc	Ø 640 x 80 mm, with reduced fan capacity, made of cast iron or spheroidal graphite cast iron or steel		
Mass per brake disc	4 t	Wheel diameter	890 mm
Arrangement of the pads	H.3 - page 70		

Brake application No.	Speed v (km/h)	Force F _B (kN)	Initial temperature θ_0 (°C)	Remarks
R1 to Rx	120	22,5	20-100	x brake applications to bed-in up to at least 85% contact pattern, running in peaks on the pad must carry load. W.
1 - 12	50	15	50-60	Brake applications to a stand dry, after a cooling interval.
2 - 13	80	15	"	
3 - 14	120	15	"	
4 - 15	160	15	"	
5 - 16	200	15	"	
6 - 17	120	10	50-60	Brake applications to a stand dry, after a cooling interval.
7 - 18	160	10	"	
8 - 19	200	10	"	
9 - 20	120	22,5	50-60	Brake applications to a stand dry, after a cooling interval.
10 - 21	160	22,5	"	
11 - 22	200	22,5	"	
23	120	22,5	50-60	Standardising brake application.
24 33 42	50	15	20-30	Brake applications to a stand damp, after a cooling interval.
25 34 43	80	15	"	
26 35 44	120	15	"	
27 36 45	160	15	"	
28 37 46	200	15	"	
29 38 47	120	10	"	
30 39 48	120	22,5	"	
31 40 49	160	22,5	"	
32 41 50	200	22,5	"	
51 to 60	120	22,5	50-60	10 brake applications to dry the brake pad. W.
61	80	-	20-30	Continuous brake applications of 20 kW for 20 minutes. Brake application to a stand dry, immediately after the continuous braking, without a cooling interval. W.
62	80	15	"	
63 66 69	250	15	50-60	Between the end of brake application No. 70 and start of brake application No. 71, 2 minutes stop, then acceleration with 0,3 m/s ² (E = 9,7 MJ). W.
64 67 70	250	10	"	
65 68 71	250	22,5	"	
72 75 78	270	15	50-60	Between the end of brake application No. 79 and start of brake application No. 80, 2 minutes stop, then acceleration with 0,3 m/s ² (E = 11,3 MJ). W.
73 76 79	270	10	"	
74 77 80	270	22,5	"	
81 to 90	200	22,5	20-100	10 brake applications for the regeneration of the brake pads for v = 300 km/h. W.
91 94 97	300	15	50-60	Brake applications to a stand dry, after a cooling interval (E = 13,9 MJ). W.
92 95 98	300	10	"	
93 96 99	300	22,5	"	
100 102 104	320	22,5	50-60	Additional brake applications only when using sintered pads mass per disc 4.5 t; (checking the coefficient of friction with increased brake loading). W.
101 103 105	320	22	"	
106 107 108	120	15	50-60	Checking the level of the coefficient of friction.
109 to 118	200	22,5	20-100	10 brake applications to a stand dry, to regenerate the pads before the continuous braking. W.
119	80	-	20-30	Continuous braking of 30 kW for 20 minutes. Braking to a stand dry immediately after the continuous brake application without a cooling interval. W.
120	80	15	-	

Brake application time $t_s = 4 \pm 0,2 \text{ s}$.

W. = weigh

Rotation and ventilation conditions

	Test bench speed (km/h)			Speed of the cooling air (km/h)	
	v	dry	wet	dry	wet
During the brake application	> 200	v	-	v = 100	10
	≤ 200	v	v	v/2	10
Between brake applications		100	50	80	10

Weighing

The pads shall be weighed after they have bedded-in and after brake applications No. 60, 62, 71, 80, 90, 99, 105, 118 and 120.

The actual wear of the pads shall be given for the brake applications No. 1 to 60, 61 to 62, 63 to 71, 72 to 80, 91 to 99, 100-105 and 119 to 120.

The permissible wear of the composite pads for the brake applications No. 1 to 120 (without brake applications 100 to 105) is 0,61 cm³/MJ.

The permissible wear of the sintered pads for the brake applications No. 1 to 120 (including brake applications 100 to 105) has yet to be specified.

Interruptions

During the tests interruptions of up to 3 days before tests No. 1, 12, 23, 63, 72, 91 and 100 are allowed.

Temperatures

During the brake applications care must always be taken to see that the starting temperature has fallen to the values given.

For the brake applications No. 1, 12, 23, 63, 72, 91 and 100, a starting temperature between 20°C and 60°C is permissible.

Conditions for the spraying with water

The brake applications under wet conditions shall be carried out with a water quantity of 25 l/h.

During wet brake applications, the spraying of the brake discs during the cooling intervals between the tests No. 23 to 50 shall not be interrupted.

After brake application No. 23, the spraying shall only begin when the brake disc temperature has reached 80°C.

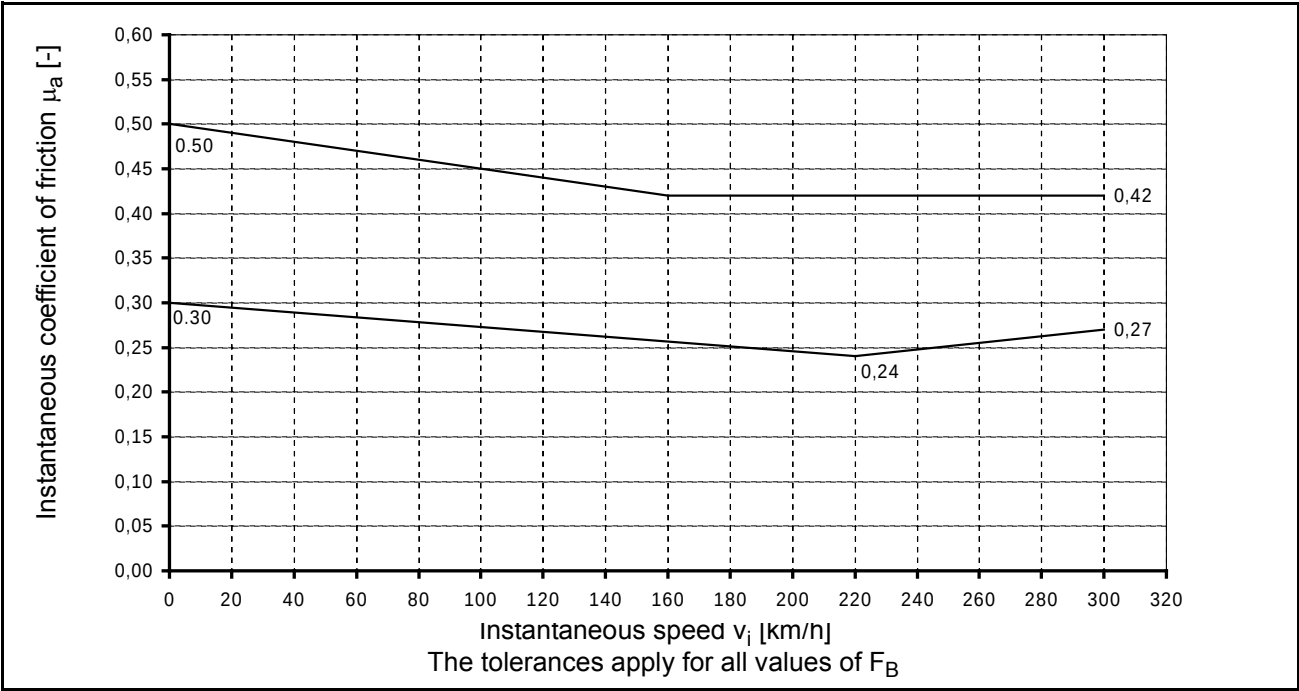
After brake application No. 50, the spraying shall be discontinued.

Further conditions

- The brake applications shall be carried out in the given sequence.
- The number of bedding-in brake applications necessary for the contact pattern of at least 85% (to remove all peaks) to be achieved shall be given in the test report.

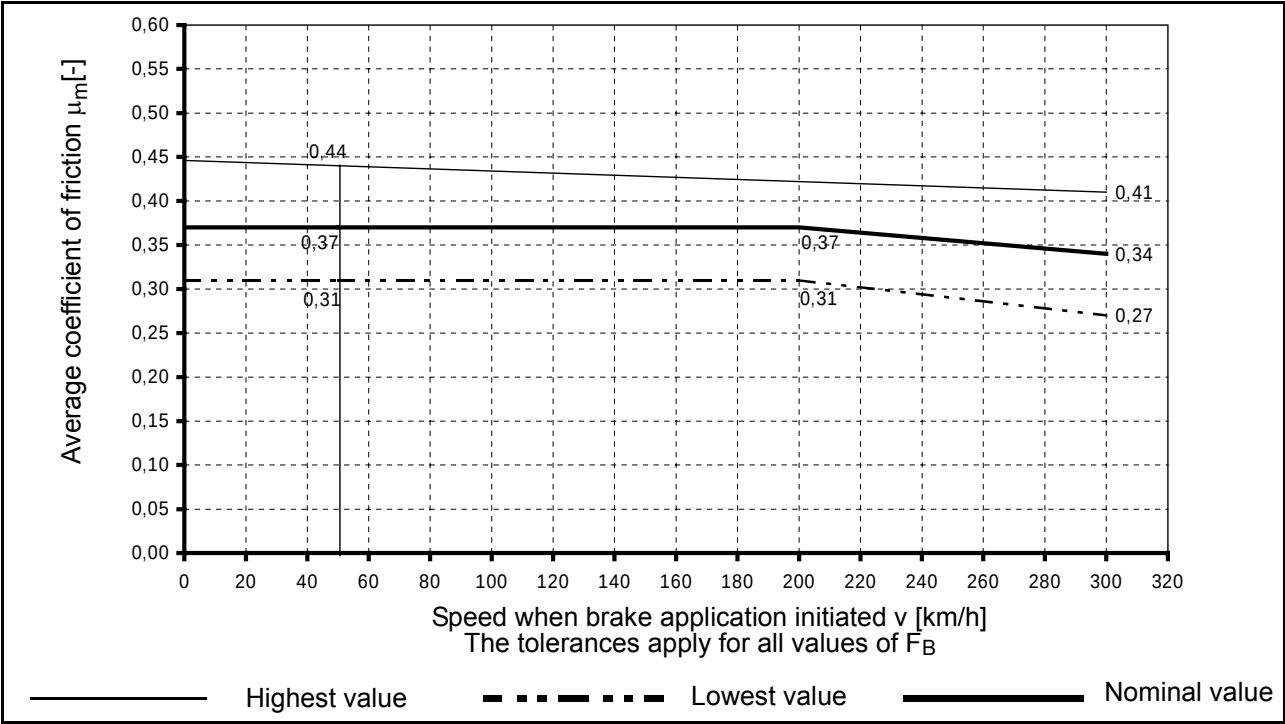
B.2 - Instantaneous coefficient of friction

Brake pads for high speed trains, for use with high energy values
Tolerances for the instantaneous coefficient of friction (μ_a) with a dry disc



B.3 - Average coefficient of friction

Brake pads for high speed trains, for use with high energy values
Tolerances for the average coefficient of friction (μ_m) with a dry disc



Appendix C - Requirements for composite brake pads for use on RIC vehicles with $v_{\max} = 140, 160$ and 200 km/h

Test programme for organic brake pads on passenger coaches and multiple units ($v_{\max} = 140, 160$ and 200 km/h) on the friction test bench

- C.1:** Test programme No. 2A, $v_{\max} = 140 \text{ km/h}$
- C.2:** Test programme No. 2B, $v_{\max} = 200 \text{ km/h}$
- C.3:** Test programme No. 2C, $v_{\max} = 160 \text{ km/h}$ (wheel-mounted discs)
- C.4:** Test programme No. 3A, $v_{\max} = 140 \text{ km/h}$
- C.5:** Test programme No. 3B, $v_{\max} = 120 \text{ km/h}$
- C.6:** Instantaneous coefficient of friction μ_a
- C.7:** Average coefficient of friction μ_m
- C.7:** Instantaneous coefficient of friction μ_a (multiple units with wheel-mounted discs)
- C.7:** Average coefficient of friction μ_m (multiple units with wheel-mounted discs)

C.1 - Test programme No. 2A ($v_{\max} = 140 \text{ km/h}$)

UIC-approval for organic brake pads in passenger coaches that run at $v_{\max} = 140 \text{ km/h}$

Type	2A 1	2A 2
Pad half	200 cm ² (A.1 - page 11)	175 cm ² (A.2 - page 12)
Brake disc	Ø 640 x 110 mm (CI) (H.4 - page 71)	Ø 590 x 110 mm (CI) (H.4)
Mass per brake disc	7,7 t	6,2 t
Arrangement of the pads	H.3 - page 70	H.3
Wheel diameter	890 mm	880 mm

Brake application No.	Speed v (km/h)	2A 1	2A 2	Initial temperature θ_0 (°C)	Remarks
		Force applied F_B (kN)	Force applied F_B (kN)		
R1 to Rx	120	31	27	20-100	x brake applications to bed-in the brake pads up to at least 70% contact area. W.
1 13 25	50	31	27	50-60	Brake applications to a stand dry, after a cooling interval.
2 14 26	80	31	27	"	
3 15 27	120	31	27	"	
4 16 28	140	31	27	"	
5 17 29	50	16	14	"	
6 18 30	80	16	14	"	
7 19 31	120	16	14	"	
8 20 32	140	16	14	"	
9 21 33	50	46	40	"	
10 22 34	80	46	40	"	
11 23 35	120	46	40	"	
12 24 36	140	46	40	"	
37	120	46	40	140-150	Brake applications to a stand dry with increased initial temperature.
38	140	46	40	140-150	
39	80	46	40	210-220	
40	80	31	27	50-60	Brake applications to a stand dry, after a cooling interval. W.
41	80	46	40	"	
42	50	-	-	20-30	Continuous brake application with a dissipated load of 25 kW (2A 1) or 20 kW (2A 2) over 20 minutes. Brake application to a stand immediately after continuous braking.
43	50	31	27	-	
44	80	-	-	-	Continuous brake application immediately afterwards without a cooling interval with a dissipated power of 55 kW (2A 1) or 45 kW (2A 2) for 10 minutes. Brake application to a stand immediately after continuous braking. W.
45	80	31	27	-	
46	80	31	27	50-60	Brake applications to a stand after a cooling interval, dry.
47	120	46	40	"	
48	140	31	27	"	
49	50	16	14	20-30	Brake applications to a stand after a cooling interval, wet.
50	50	31	27	"	
51	80	31	27	"	
52	80	31	27	50-60	Brake application to a stand after a cooling interval, dry.
53	120	46	40	50-60	Brake applications to a stand after a cooling interval, dry.
54	140	31	27	"	
55	30	31	27	≤ 30	Brake applications to a stand after a cooling interval, dry. W.
56	30	31	27	"	
57	30	31	27	"	

Brake application time $t_s = 4 \pm 0,2 \text{ s}$.

W. = weigh