

UIC Code 541-06

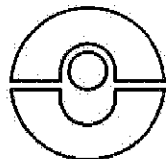
OR

1st edition, 1.1.92

**Brakes**

**Regulations concerning the construction  
of the various brake components**

**Magnetic brakes**



International Union of Railways

**NUMERISATION DANS  
L'ETAT DU DOCUMENT**

541-06

- 2 -

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**Leaflet to be classified in volumes:**

- IV - Operating
- V - Transport stock

**Amendments**

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| <i>N°1</i> | <i>1-1-96</i> |
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**Introductory remarks**

Obligatory provisions are preceded by an asterisk: \*

The double line (||) in the margin denotes amendments made on the date shown at the foot of the page.

Enforcement of this leaflet is governed by the provisions shown under the heading "Application" at the end of the document.

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**Note**

This leaflet forms part of a series which also includes:

- Leaflet no. 505-2 : Kinematic gauge for coaches and vans used on international services
- Leaflet no. 515 : Coaches - Running gear
- Leaflet no. 540 : Brakes - Air brakes for freight and passenger trains
- Leaflet no. 541-1 : Brakes - Regulations concerning the construction of the various brake components
- Leaflet no. 541-3 : Brakes - Disc brakes and disc brake linings
- Leaflet no. 541-4 : Brakes - Brake-shoe inserts of composite material
- Leaflet no. 541-5 : Brakes - Electropneumatic brakes for passenger and freight trains
- Leaflet no. 542 : Brake parts (Interchangeability)
- Leaflet no. 543 : Brakes - Regulations relative to the equipment and use of vehicles
- Leaflet no. 544-1 : Brakes - Braking power

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- Leaflet no. 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 brake-weight
- Leaflet no. 545 : Brakes - Inscriptions, marks and signs
- Leaflet no. 546 : Brakes - High power brakes for passenger trains
- Leaflet no. 547 : Brakes - Air brake - Standard programme of tests
- Leaflet no. 550 : Power supply installations for passenger stock

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**0 - General**

The electromagnetic brake - in abbreviated form the Mg brake - is an additional brake acting directly on the rail and its operation is thus independent of rail/wheel adhesion. Its action is based on the applied magnetic force. The force applied is produced by the electromagnetic effect or by a permanent magnet. Where required, the Mg brake is fitted to coach bogies in order to supplement the air brake. The obligatory requirements of this leaflet apply to this rolling stock only. Appendix 1 shows, as an example, a diagrammatic arrangement for the Mg brake as fitted to a bogie.

**1 - Efficiency**

\* 1.1 - The Mg brake comes into operation during emergency brake applications (the R + Mg braking position, marked by R + Mg or by Mg only on the changeover control). The brake shoes shall be applied to the rails within 3 s of the pressure in the main pipe - as measured with the vehicle isolated - falling to a level below 3.0 bars. The circuit is closed at the moment the shoes are lowered. At 20 km/h, the brake shall become ineffective. At accelerating speeds, the Mg brake shall become effective again on the speed exceeding 50 km/h. When pressure in the main pipe exceeds 3.0 bars, the Mg brake shall become ineffective independently of the speed.

1.2 - The braking force produced by friction between the magnetically excited shoes and the rail results from the combined effect of the magnetic force applied and the coefficient of friction pole element/rail. Appendix 2, Figure 1, shows, for example, the direction of the lines of force in the magnetic field of an electromagnetic shoe under excitation.

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\* 1.3 - Since the braked mass of the magnetic brake cannot be determined independently of the air brake, the braked mass inscribed on the vehicle is the value R + Mg. If, for a coach fitted with the magnetic brake, it is necessary to obtain a braked mass of 208 % - in relation to the total mass (tare + load) of the vehicle - the Mg brake shall be capable of providing a braked mass of 28t. This is obtained if, at 160 km/h, 4 magnetic shoes are each capable of providing a braking force of at least 4 kN, but without exceeding 10 kN.

\* 1.4 - The Mg brake is applied and released by means of the RIC - R - Mg changeover control.

When the air brake is isolated by the cut-off valve, the Mg brake shall also become inoperative.

\* 1.5 - The Mg brake shall be capable, when in its working position, of negotiating switch and crossing work incorporating fixed crossings where the tangent of the crossing angle is  $\text{tg } \alpha \geq 0.034$  (1 : 30).

\* 1.6 - The magnetic brake shoes are maintained in the raised position by springs and are lowered pneumatically.

**2 - Design characteristics****\* 2.1 - Mechanical characteristics**

2.1.1 - The Mg brake is incorporated in the bogie with the brake shoes located between the wheels in line with the centre of the rail.

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When the shoes are in the raised position, the suspension system shall prevent any pendular motion in order to ensure compliance with the conditions laid down in Leaflet 505-2 "Kinematic gauge for coaches and vans used on international services" <sup>1)</sup> and Leaflet 515 "Coaches - Running gear".

In the operative position, the magnetic shoes are centrally located over the rail by magnetic force.

When in the raised position, the magnetic shoes must not cause any damage to track equipment used for shunting movements.

In the operational position, the shoes have a lateral play of  $X = 20 \text{ mm} + q \text{ mm}$ , in which "q" is the lateral play between axle and bogie underframe as defined in Leaflet 505-2. The braking effort is transmitted to the bogie through a control mechanism. The distance between shoes is  $A = 1510 \text{ mm}$ . Appropriate devices (e.g. tie bars) shall be provided to maintain the shoes in a parallel position to each other.

A bogie shall always comprise two shoes of identical construction.

2.1.2 - The shoes shall be of articulated design, formed of movable intermediate elements and fixed end elements (no rigid intermediate elements) (see figure 2 of Appendix 2). The end elements shall be designed with the appropriate geometry to accommodate both the characteristics of crossings with a tangent above or equal to 0.034 and the check rails. End elements of the types approved for international traffic, as shown in the diagrams forming Appendix 3, meet these requirements. A list of approved types is given in Appendix 4.

1) Except for height above rail level (dimension C of Appendix 2) when in the position of rest.

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Any new shoe in which the end element fails to comply with this condition must undergo an individual validation process - at railway level - involving tests on a crossing with a tangent of 0.034. If the tests prove satisfactory, the drawing of the corresponding end element will be added to Appendix 3 by the UIC Sub-Committee for Braking.

The width b of the friction plates shall be 65-72 mm and the maximum width B of the shoes 140 mm.

The total length L over which the Mg brake is applied shall be at least 1,000 mm.

It shall be possible for all friction plates to be replaced easily while on the vehicle. The limit of wear of the shoe shall be clearly identifiable from the shoe itself.

## 2.2 - Characteristics of the electromagnetic brake

\* 2.2.1 - Leaflet 550 "Power supply installations for passenger stock" must be observed. The Mg brake operates at a voltage of 24 to 120 V DC supplied by the vehicle battery. Both poles of the Mg brake shall be protected. The Mg brake fuses and the other fuses of the vehicle shall be installed in separate locations in order to avoid any confusion.

\* 2.2.2 - The induced voltage peaks likely to arise when the power supply to the Mg brake is cut off shall be attenuated by appropriate measures.

2.2.3 - In cases where both bogies are fitted with electromagnetic brakes, it is recommended that current consumption should vary from 160 A for a nominal voltage of 24 V to 35 A for a nominal voltage of 120 V.

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This applies to Mg brakes manufactured of cast steel.

\* 2.2.4 - The power supply shall be designed so as to ensure that, in the Mg brake position, the Mg brake is ready to come into action at any moment. The connection of the Mg brake to the electrical system of the vehicle shall be such that, even in the absence of any voltage from the battery, the Mg brake is not automatically neutralised.

2.2.5 - Further considerations:

- Additional electrical protection equipment to cut off the power supply in cases of circuit breaker contact burn-out; an electrical circuit preventing supply of current to one shoe only on the bogie in the event of a failure;

safeguards to ensure that the Mg brake has sufficient capacity available in relation to other current consuming equipment, etc.,

- Information concerning the electrical circuitry and wiring;

- Manner in which coils are wound;

- Information concerning insulation resistance;

\* 2.2.6 - Wiring on bogies shall conform to Leaflet 505-2. Cables shall be installed in a manner which ensures their protection from flying stones.

**2.3 - Characteristics of the Mg brake using permanent magnets**

In abeyance.

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\* 2.4 - Pneumatic characteristics

2.4.1 - Activation of the Mg brake in accordance with § 1.1 shall be by means of a pressure-operated control (manostat) regulated by the pressure in the main brake pipe.

2.4.2 - The air brake shall be completed by a brake-pipe emptying accelerator and/or an electropneumatic brake.

2.4.3 - The Mg brake is supplied with compressed air from a separate auxiliary reservoir recharged from the main reservoir pipe via a non-return valve. Drawing of this compressed air supply from the main brake pipe is prohibited.

A pressure of 6.0 bars shall suffice to bring the shoe into a fully operational state.

**3 - Notes for the guidance of operators**

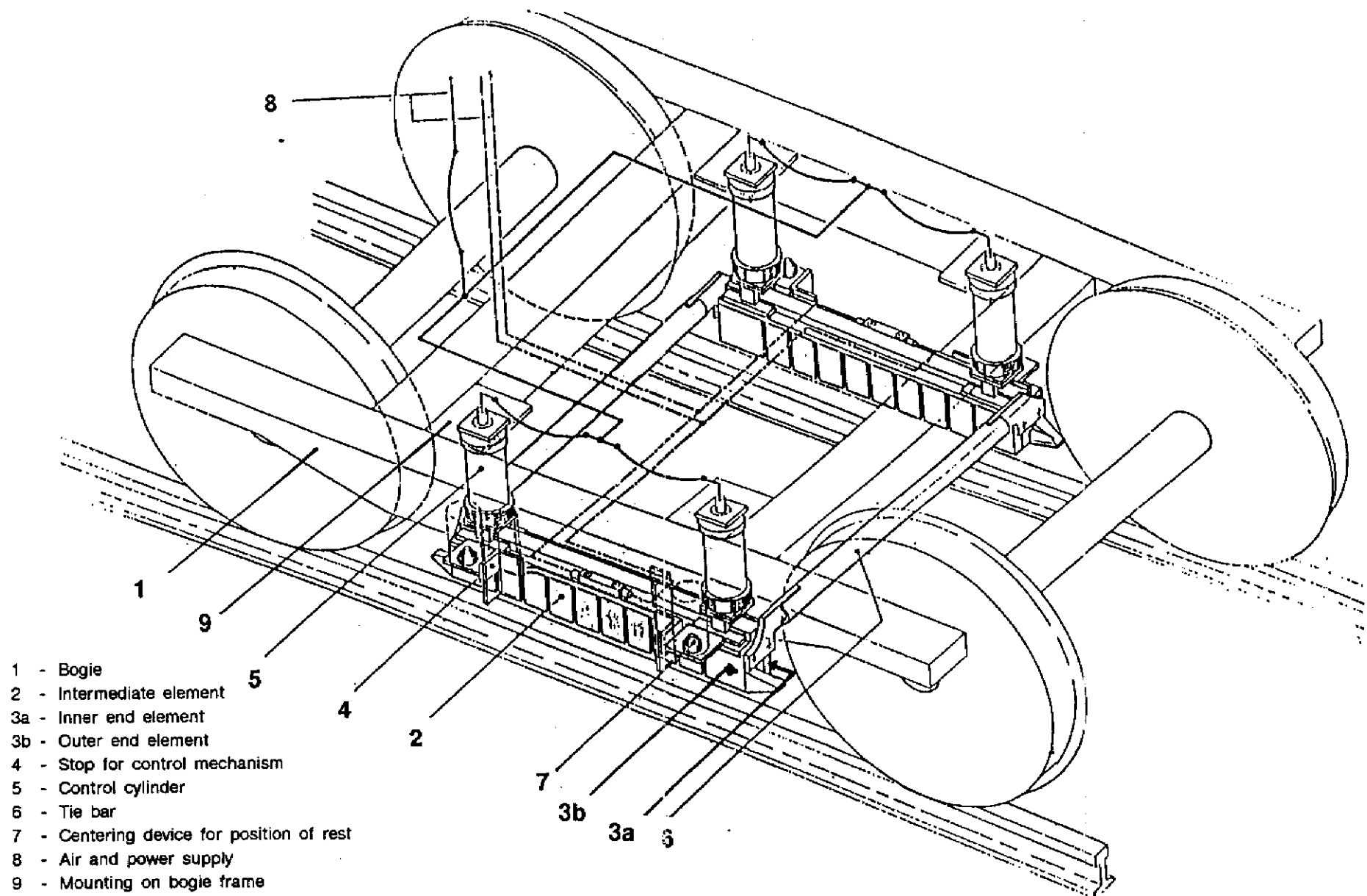
\* 3.1 - A control device shall be provided to control not only the lowering of the shoes, but also the flow of current when the vehicle is stationary after an emergency brake application has been made. The control devices shall be located on both sides of the vehicle.

\* 3.2 - In order to ensure that the Mg brake functions in a regular manner, the main reservoir pipe (2nd pipe) shall also be coupled. A reliable supply of power must be available from the batteries.

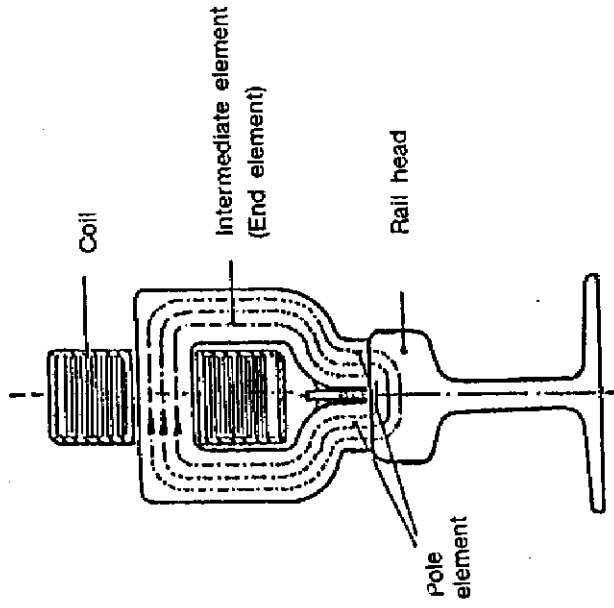
\* 3.3 - The braked mass R + Mg shall be inscribed on the vehicles in accordance with the provisions of Leaflet 545.

3.4 - When the train brake test is performed, the Mg brake and the continuity of the main reservoir pipe (2nd pipe) shall be tested in addition to the air brake.

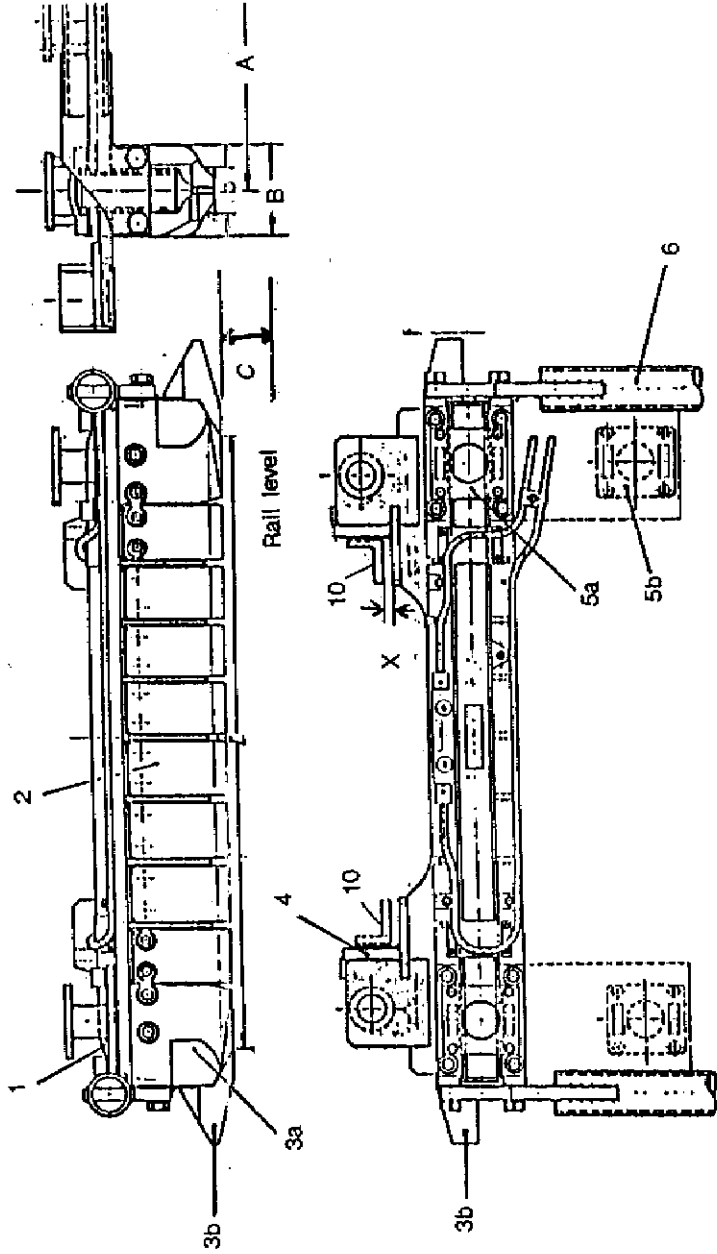
Example showing a diagrammatic arrangement of the electromagnetic brake on a bogie



**Figure 1 - Direction of the lines of force in the magnetic field of an electromagnetic brake shoe**



**Figure 2 - Example of brake shoe with detailed nomenclature of parts**



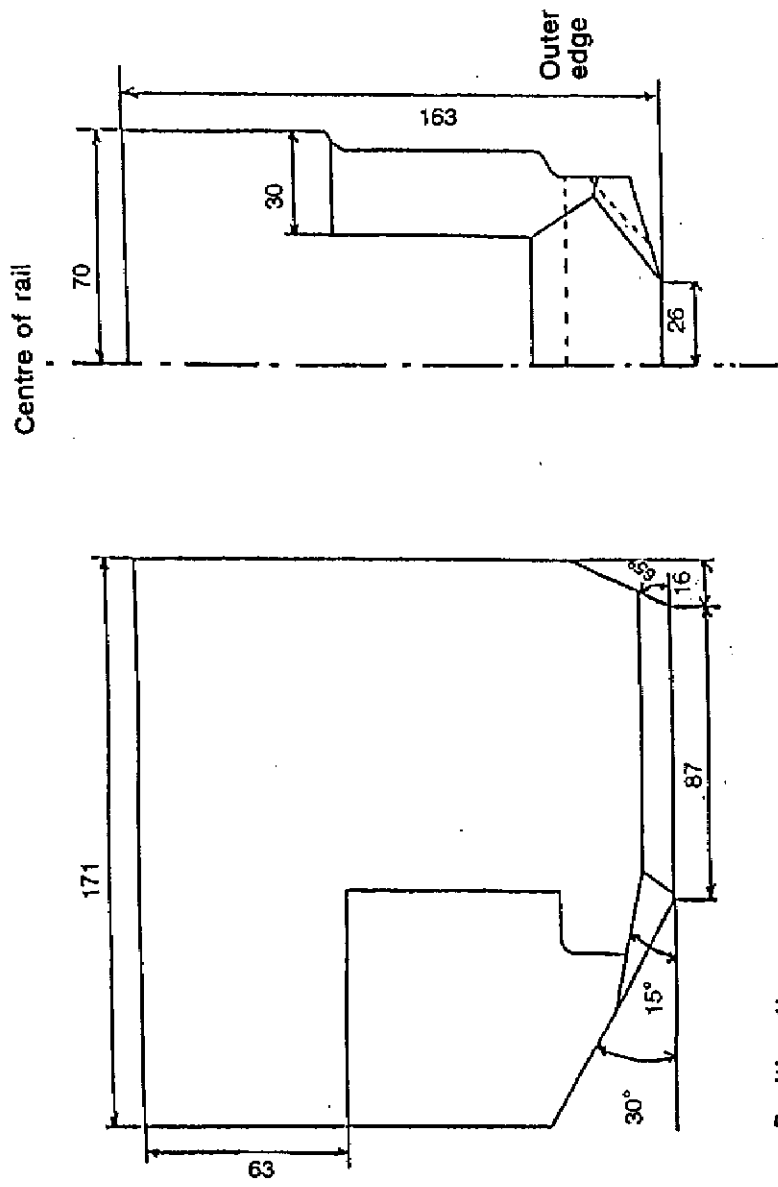
- A = 1510 mm
- b = 65 mm to 72 mm
- B max = 140 mm
- L = min. 1 000 mm
- X = 20 mm + q mm
- C ≥ 100 mm (when new)

**Positions:**

- 1 - Coil with armature
- 2 - Intermediate element
- 3a - Inner end element
- 3b - Outer end element
- 4 - Stop for control mechanism
- 5a - Mounting of control cylinder, e.g. on magnet
- 5b - Mounting of control cylinder, e.g. on tie bar
- 6 - Tie bar
- 10 - Bogie underframe stop

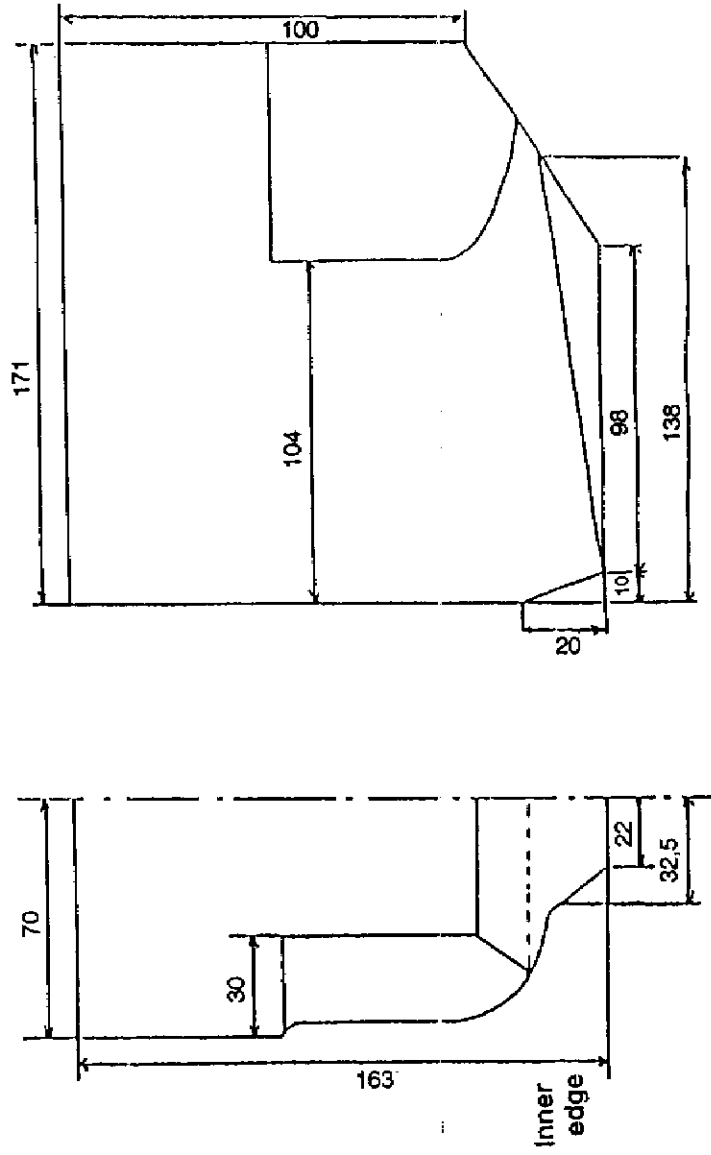


**Type 1 - End elements of Mg brake**



Position 1b

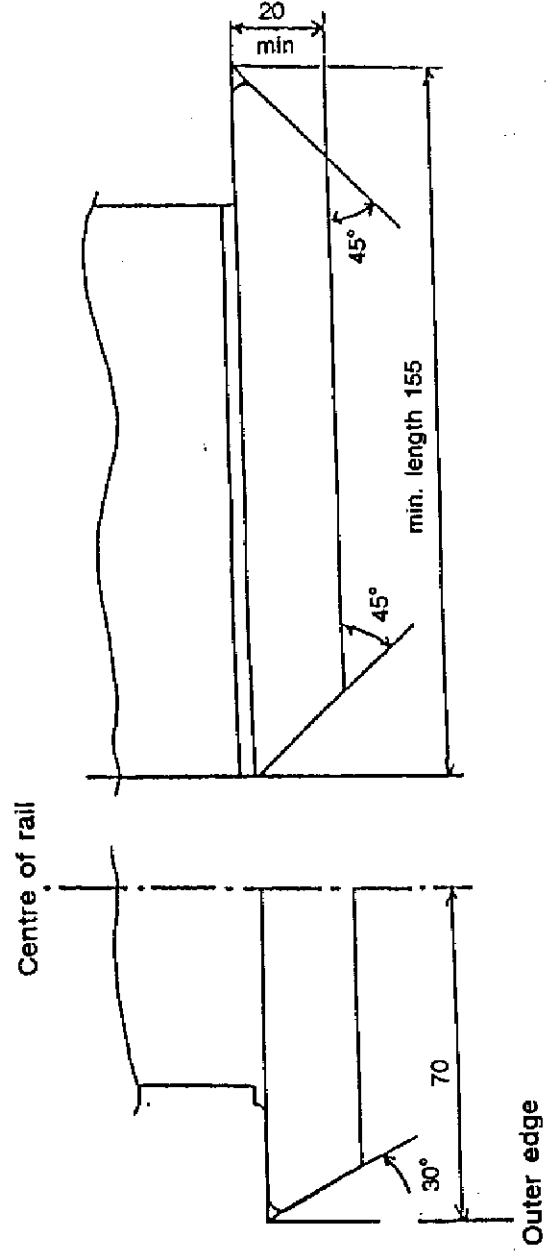
**Centre of rail**



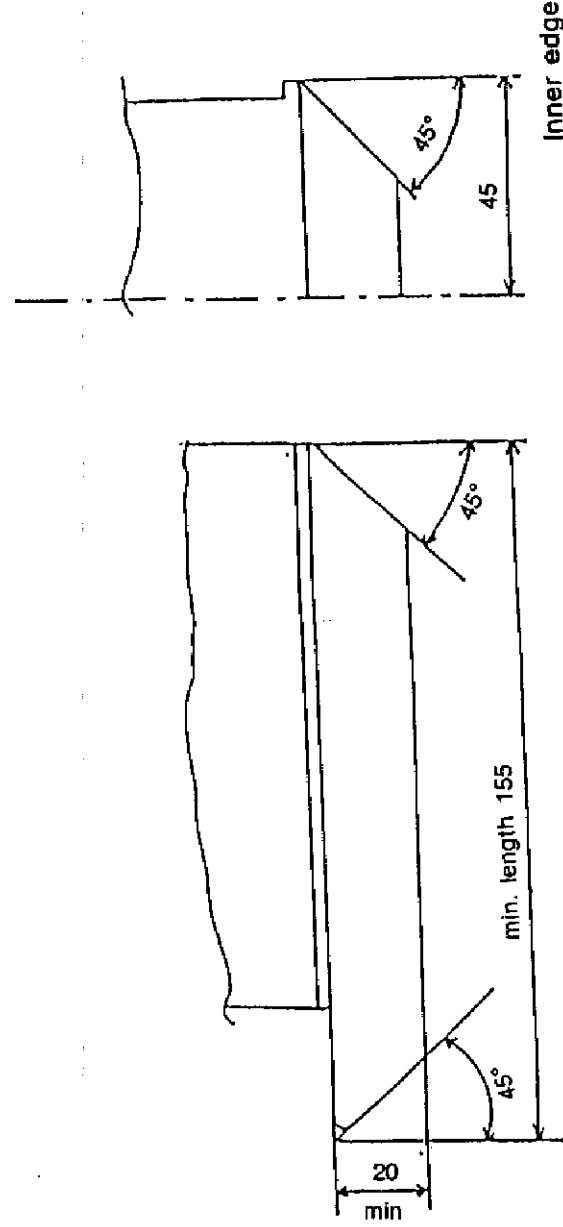
Position 1a

Mainly in use on SNCF

Type 2 - End elements of Mg brake



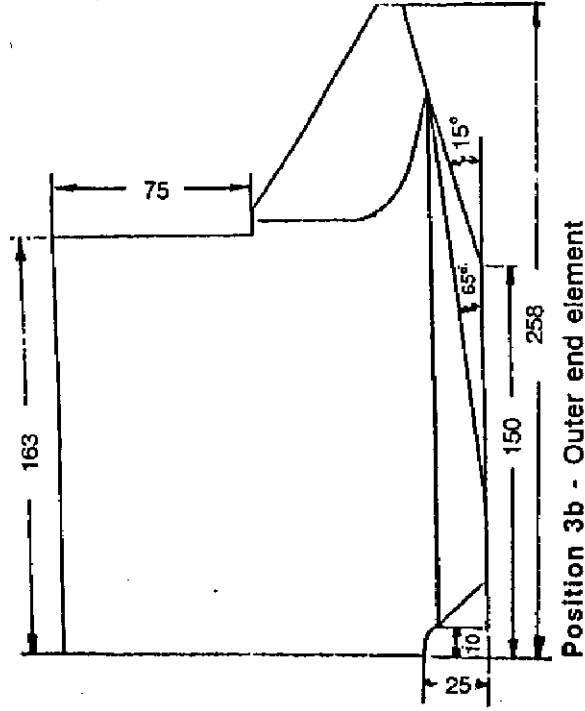
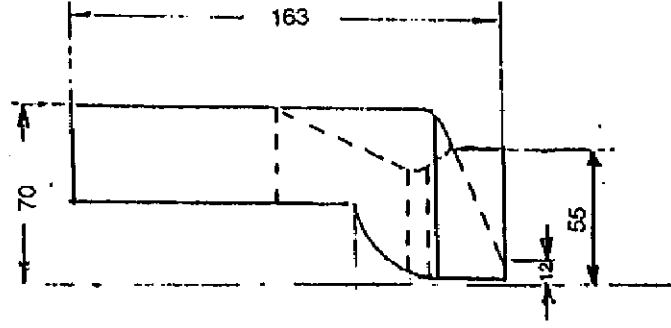
Position 3b



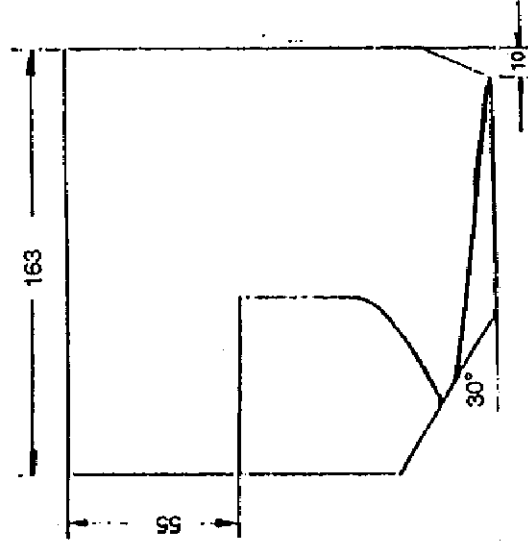
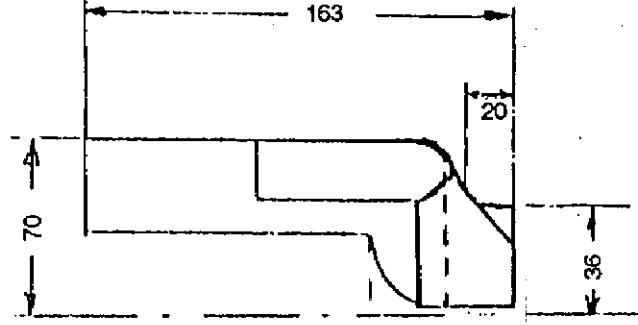
Position 3a

Mainly in use on SNCF

**Type 3 - End elements of Mg brake**



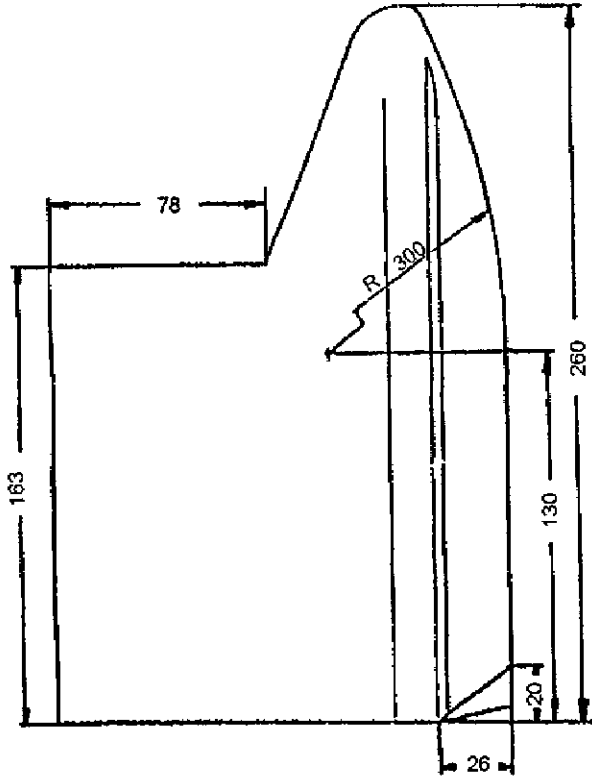
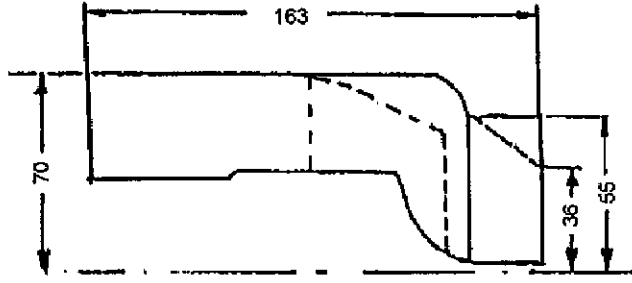
**Position 3b - Outer end element**



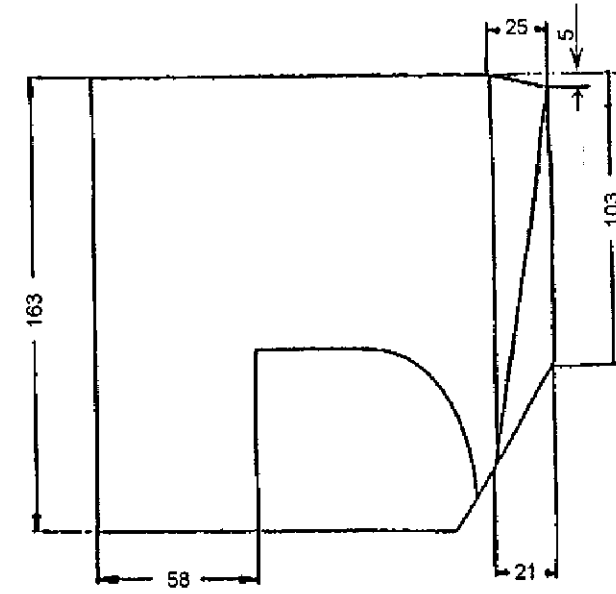
**Position 3a - Inner end element**

Mainly in use on DB

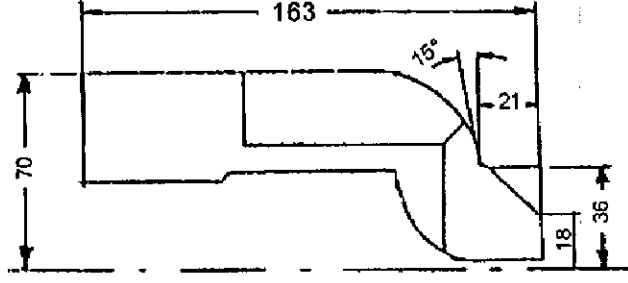
Type 4 - End elements of Mg brake



Position 3b - Outer end element

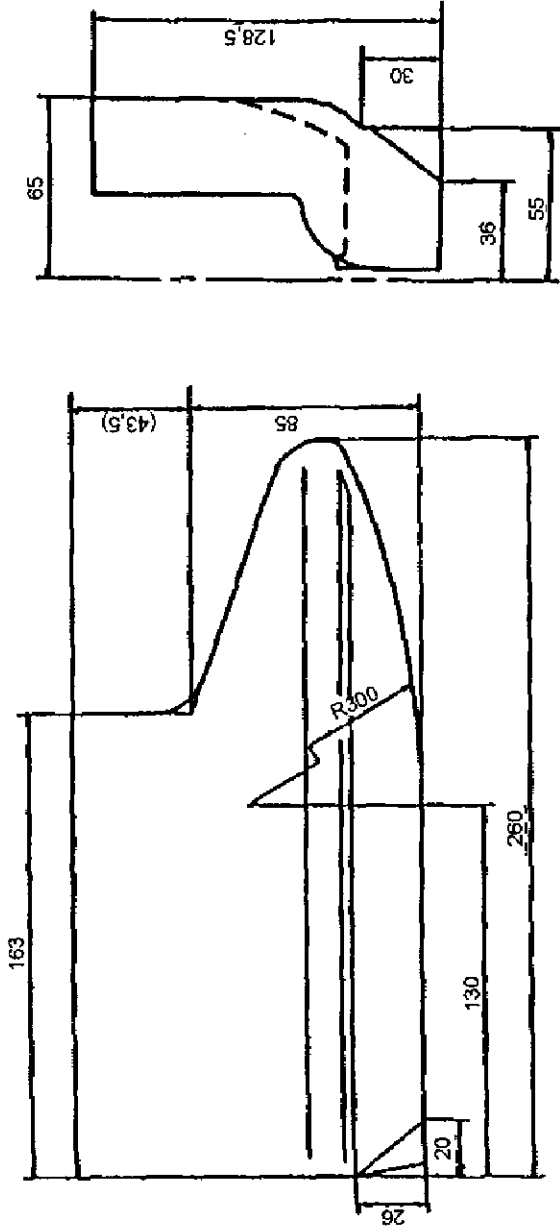


Position 3a - Inner end element

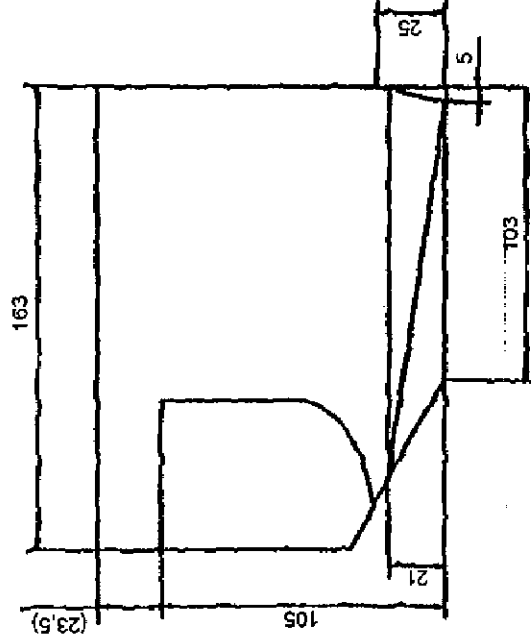


Mainly in use on DB

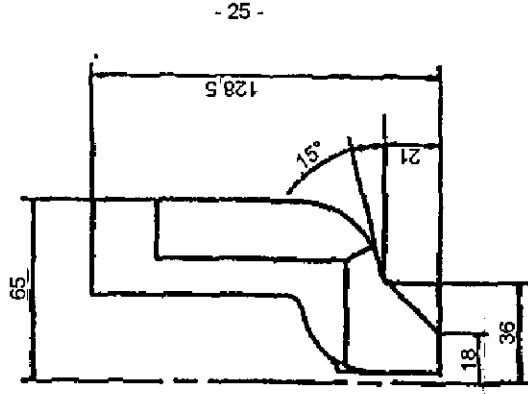
**Type 5 - End elements of Mg brake**



**Position 3b - Outer end element**



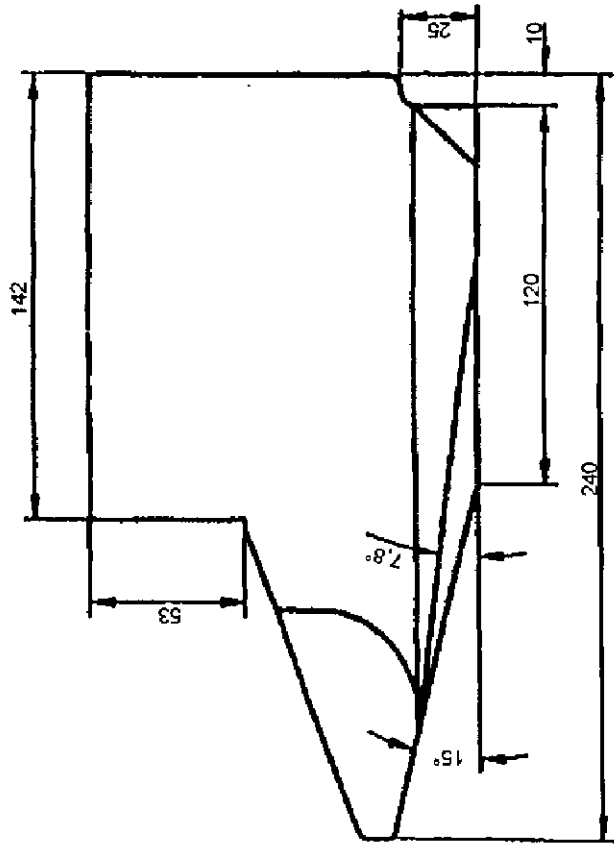
**Position 3a - Inner end element**



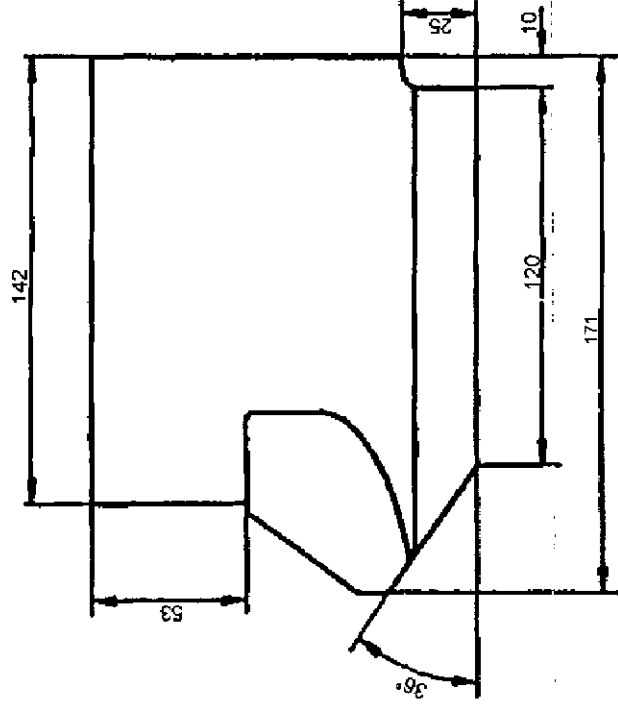
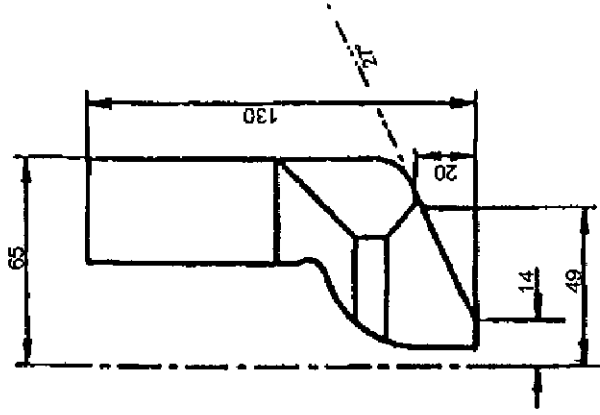
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Mainly in use on DB

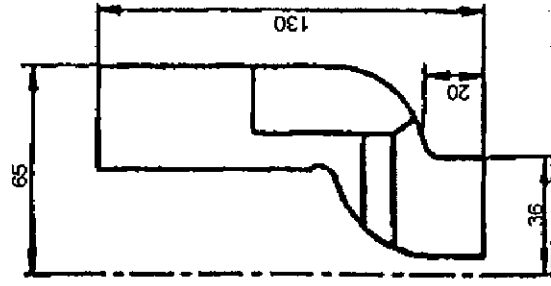
Type 6 - End elements of Mg brake



Position 3b - Outer end element



Position 3a - Inner end element



Mainly in use on DB

## List of Mg brake elements approved for use in international traffic

| Type | Approval requested by | Date of approval | Reference  |
|------|-----------------------|------------------|--|
| 1    | SNCF                  | 1/1/1992         | SNCF drawings nos.<br>10-9002-110, Position 1a<br>10-9002-109, Position 1b   |
| 2    | SNCF                  | 1/1/1992         | SNCF drawing no.<br>10-9007 397 Position 3a<br>10-9007 396 Position 3b   |
| 3    | DB                    | 1/1/1992         | DB drawing .<br>Source :<br>Knorr-Bremse AG,<br>Munich<br>1 G 02 603<br>1 B 32 029                                 |
| 4    | DB                    | 1/1/1992         | DB drawing .<br>Source :<br>BSI, Remscheid<br>110 467 F 11 C<br>110 468 F 11 C<br>120 624 F 11 C<br>120 625 F 11 C |
| 5    | DB                    | 1/1/1996         | DB drawing<br>Source : BSI-Remscheid<br>124 413F 11 C<br>124 414F 11 B<br>124 415F 11 B<br>124 416F 11 B           |
| 6    | DB                    | 1/1/1996         | DB drawing<br>Source : Knorr-Bremse<br>München<br>1 G 03 702<br>1 G 03 703   |

1.1.96

## Application

The obligatory character of the regulations applies to all vehicles fitted with the Mg brake as from 1.1.92.

All UIC Railways.

## Record References

*Headings under which the question has been dealt with:*

- Question 5/T/27 - Study of braking conditions for high speed trains.

- Question 5/T/FIC - Point 11.2 - Brakes - Regulations for the construction of the various brake components - Electromagnetic brake.

(Traction & Rolling Stock Committee: Stockholm, June 1991).

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- Question 5/T/FIC - Revision of Leaflets.

a) DB request for modifications to and development of Appendices 3 and 4, and for acceptance-testing of the end elements (with optimised load) of the magnetic brake (low height) designed by BSI and KNORR - BREMSE")

(Sub-Committee 5T for Braking : Paris, January 1996).  
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