

1st edition, October 2010

Translation

O R

Brakes - Electropneumatic brake (ep brake) and Passenger alarm signal (PAS) for vehicles used in hauled consists

Frein - Frein électropneumatique (frein ep) et signal d'alarme des voyageurs (SAV) pour les véhicules utilisés dans les compositions avec engins moteurs

Bremse - Elektropneumatische Bremse (ep-Bremse) und Notbremsanforderung (NBA) für Fahrzeuge in lokbespannten Zügen



UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
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IV - Operation management

V - Vehicles

VI - Traction

Application:

With effect from 1.01.2010

All members of the International Union of Railways

This leaflet is applicable to rolling stock on lines where the infrastructure manager specifies a passenger alarm signal (PAS) complying with the current leaflet.

The operational and technical specifications of UIC leaflet 541-5, 4th edition are not compatible with the specifications of the current leaflet.

Record of updates

1st edition, October 2010

New UIC leaflet approved on 14 October 2009 by the Research and Technical Platform (PTR) of the UIC, applicable from 1.1.2010. The present leaflet applies to vehicles which are running on lines for which, as far as the alarm signal is concerned, the infrastructure manager specifies the passenger alarm signal (PAS). As regards the effect of braking following the activation of an alarm signal by a passenger, this system distinguishes between lines in stations and open track, due to differences in the potential dangers associated with each. On lines where the emergency brake override device (SAFI - EBO) remains permissible, UIC leaflet 541-5, 4th edition, remains valid. The SAFI-EBO system makes no distinction between types of line

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

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Summary

This leaflet regulates the implementation of the electropneumatic brake (ep brake) and of the passenger alarm signal (PAS) of vehicles which can be coupled at will in order to make up variable compositions hauled by a locomotive for operational requirements.

The ep brake and the PAS are two systems with respective interactive functions, due to their monitoring devices. Both systems are supplied via the 9-pole ep pipe. The ep brake and PAS systems are intended for coaches, whereas freight wagons are only fitted with the ep brake.

The ep brake and PAS devices can be activated independently of each other.

This leaflet is structured in 2 main parts:

- Part I: General and functional requirements (see points 1 and 2)
- Part II: Specific requirements for vehicles in trains hauled by a locomotive and fitted with a 9-pole ep pipe (see points 3 to 10)

The detailed technical specifications relating to the application for compositions with traction units with 9-pole ep pipe are described in the appendices.

o 1 - General points

1.1 - Definitions and abbreviations

The terminology used in this leaflet is explained in the Glossary - [page 67](#) and List of abbreviations - [page 66](#).

1.2 - Electropneumatic brake (ep brake)

1.2.1 - Aim

A braking system with automatic brake, as described in *UIC Leaflet 540* ([see Bibliography - page 68](#)), has certain physical limits.

Braking is controlled by a reduction in pressure in the main brake-pipe (BP) of the automatic brake. The speed of propagation of the depression wave along the train is limited. This phenomenon, which does not allow the simultaneous application of brakes on the vehicles ([see Glossary - page 67](#)), causes reactions in long trains. Moreover, it causes the stopping distances for the rake to be lengthened in comparison with those of a single vehicle.

Release of the brake is controlled by an increase in pressure in the main brake-pipe of the automatic brake.

In both cases, the volume of air which must flow out through the driver's brake valve causes loss of time. This creates a clear displacement between the variations in pressure in the BP at the head and at the rear of the train.

The aim of the electropneumatic brake is to minimise the response time during brake application and release and to ensure that the braking actions occur simultaneously along the train. In order to do this, electrovalves driven by the driver's brake valve cause simultaneously on each vehicle either the emptying or the refilling of the BP, in order to assist the pneumatic functioning of the driver's brake valve.

1.2.2 - Functioning principle

1.2.2.1 - Preparation of commands of the electropneumatic brake

The ep brake device ([see List of abbreviations - page 66](#)), supplementary to the automatic brake, comprises the following principal elements:

- the ep unit of the driver's brake valve,
- the ep control,
- the supplementary electropneumatic local unit of the distributor valve.

The driver's brake valve determines the target value of the pressure in the main brake-pipe. The driver's brake valve alters progressively, in stages and according to certain gradients, the target pressure value in the main brake-pipe.

The ep unit of the driver's brake valve produces electrical application and release impulses so that the target value in the main brake-pipe is achieved more quickly. These impulses are transmitted via the ep control to all the electropneumatic local units.

1.2.2.2 - Local implementation and transmission of commands from the electropneumatic brake in the train

The electrical application and release impulses are transmitted via the ep control to the electropneumatic local units, comprising two electrovalves, one for application and the other for release. These two electrovalves are controlled by electrical impulses for application and release transmitted by corresponding electrical circuits. The electrovalves are calibrated to achieve a precisely determined pressure gradient $\Delta P/\Delta t$. On application and release, the pressure in the main brake-pipe of the rake is virtually synchronous with the target pressure value requested by the driver's brake valve.

During ep braking the main brake-pipe is set at atmospheric pressure directly and locally.

The large volume of air necessary for release is supplied by an additional pipe, the main pressure pipe (MP). Connected throughout the whole length of the train, this will top up the air reserve which each vehicle has taken from its auxiliary tank. During the release phase of the ep brake, the BP (see [List of abbreviations - page 66](#)) is resupplied locally via electropneumatic local units by auxiliary tanks.

The functioning principle of the electropneumatic brake is outlined in [Appendix A - page 41](#).

1.2.3 - Permanent monitoring

In view of the increase in braked mass due to the ep brake, it is necessary, when a fault appears (to be discussed in more detail later), to inform the driver (see [Glossary - page 67](#)) immediately by an alarm. In this case, the ep brake is known as the "monitored" ep brake. Such permanent monitoring concerns:

- the level of ep application (failure of signal or mistaken transmission of an ep release command) or
- the continuity of ep control conductors (see [Glossary - page 67](#)) used to transmit the application command: inadmissible loop resistance.

1.2.4 - Possibility of testing before departure

It is necessary to check that the ep brake is in working order at each train formation or change of composition. The test can be carried out in association with the pneumatic brake test. The aim of this test is to check the integrity of the control circuits of the ep brake over the whole length of the train and to verify that the commands on the leading vehicle are functioning correctly.

1.3 - Passenger Alarm Signal (PAS) Equipment

1.3.1 - Aim

In case of emergency or illness affecting the safety or wellbeing of the passengers, all passengers shall be able to contact the driver by activating an alarm signal handle to stop the train and receive assistance.

In order that assistance may be rendered as quickly as possible or to take into consideration the potential danger represented by the increasing number of tunnels encountered on certain lines, as well as the density of train traffic in some suburbs of very large cities, it may be necessary, for reasons of efficiency or security, to be able to allow the train to continue its progress, despite the activation of an alarm signal, outside the station area. Depending on the situation encountered, the train driver shall be able, in certain cases, to decide on a course of action (for example, exiting from a tunnel in case of fire) and to choose the most suitable place to stop for evacuating or rescuing people.

Consequently, the effects on the train of an activated alarm signal vary, depending on the location of the train and the lines on which it is travelling. Generally, the effects on the train of an activated alarm signal are:

- **Event (activated alarm signal) occurring within the station area** (for example, due to a person being pinned between the doors or between the platform and the train): immediate halt of the train at the platform.
- **Event occurring outside the station area** (for example, fire or a passenger becoming unwell): transmission of the activated alarm signal to the train driver in order to inform him that an incident has occurred in the train and to ensure that the train is brought to a halt by the driver in a place which is suitable for assistance to be rendered (away from a tunnel, gallery or bridge).
In the case of trains running at high speed, activation of an alarm signal handle at a speed greater than a threshold speed of between 200 and 250 km/h shall cause an immediate drop in speed (without waiting for the period of time) by the activation of automatic service braking (fall in pressure in the main brake-pipe greater than or equal to 0.6 bar) After confirmation that the signal has been noted, as indicated in point 1.3.2 hereafter, the automatic braking is deactivated and the driver can proceed and halt at will.

1.3.2 - Functioning principle

The PAS equipment must be capable of carrying out the following functions:

- Activation of an alarm signal handle available to passengers (PAS) in the train shall generate an alarm message to the train driver in the driver's cab.
- The passenger shall receive confirmation that the activation of the alarm signal handle has been noted within the train.
- **Activation of the passenger alarm signal within the station area:** activation of an alarm signal handle in the station area shall immediately trigger braking which cannot be overridden by the acknowledgement device of the PAS alarm message.

- **[R]¹**: It is permissible for the driver to be able to cancel an emergency braking, in exceptional circumstances and by taking conscious action, including within the station area, by activating a dedicated isolation device, independent of the acknowledgement device of the alarm message. The device is located in the driver's cab or in the equipment cabinet situated next to it.
- **Activation of the passenger alarm signal outside the station area**: Activation of an alarm signal handle outside the station area shall not automatically trigger braking, to avoid the train stopping in an unsuitable place. The driver shall be in a position to decide on the most suitable place for stopping the train. For this reason, activation of an alarm signal handle shall be limited to the generation of an alarm message. Nevertheless, if the driver does not acknowledge the alarm message within a given time, braking is then automatically triggered. This braking may be overridden by the driver at any moment.
- Activation of other alarm signal handles in the train shall not affect the process which has already begun.
- **[R]**: It is permissible for the driver to be informed of any other activation.
- The ability of the system to transmit the activation signal of an alarm signal handle to the train driver shall be monitored by dedicated technical devices if the reliability of the system in alerting the train driver to the activation is insufficient ($10^{-6}/h$). Furthermore, the signalling to the driver that an alarm signal handle has been activated shall be designed in such a way as to tolerate a simple breakdown in the information transmission chain. The train driver shall have the ability to render the PAS in service or out of service. When the PAS device is out of service, activation of an alarm signal handle shall immediately cause the train to brake to a halt. In this mode of functioning the PAS is also called Pneumatic Alarm Signal.
- In coaches which are fitted with an alarm signal and which can be coupled at will to make trains of variable composition, depending on operational needs, each coach shall be equipped locally with an exhaust valve for the alarm braking. In order to ensure override of the automatic alarm braking, it shall be possible for the exhaust valve to be overridden by an EBO electric signal originating from the leading vehicle (see List of abbreviations - [page 66](#) and Glossary - [page 67](#)).
- Outside the station area, the EBO signal is active unless there is confirmation, within the framework of the period of time T, that the activation of the passenger alarm signal has been noted.

The following alternative is used on SBB:

- It is possible to choose, as an alternative, a solution as per point [5.2.1.3 - page 19](#) or point [5.2.1.4 - page 19](#). The EBO signal is then emitted permanently and, if emergency braking is necessary (either within the station area or outside it and without confirmation of notice once the period of time T has elapsed), the pressure in the BP is lowered in the leading vehicle.
- The signal transmission principle is outlined in Appendix [A - page 41](#)

1. [R] = optional measure

o 2 - Design principles of "ep Brake" and "PAS" devices

2.1 - Equipment required

The following equipment is required in the drafting, processing and transmission of messages and commands of the PAS and ep brake system:

- display and control components in the driver's cab,
- mechanical or pneumatic switching components activated by the driver's brake valve or by the BP,
- active electropneumatic components in the train,
- components for controlling the equipment for the passenger alarm system and the brake test in the train,
- electropneumatic control pipe (FEP line) for the purposes of transmitting information and commands in the train,
- equipment control centre for the PAS and ep brake for the purposes of processing messages and commands in the leading vehicle.

2.2 - General design requirements

The electric control shall be designed in such a way that it cannot be affected by other electrical circuits of the vehicle or track installations, or vice versa. In view of the importance of the tasks entrusted to the PAS and the ep brake, the correct functioning of the equipment must be absolutely certain. With this in mind, the basic design principles of the circuits shall be observed in order to ensure, with the ep brake and/or the PAS being normally in service:

- monitoring of the entirety of the train

For this it is necessary that

- the vehicle which forms the rear of the train is differentiated electrically from the other vehicles of the train,
- before the departure of the train, it shall be possible to ensure, by appropriate monitoring, that this particular vehicle only occurs once in the train and that it is situated at the rear of the train,
- [R]¹: there shall be constant verification that this situation remains unchanged.

- security of functioning

For this it is necessary that

- the transmission continuity of PAS messages be monitored constantly right up to the rear of the train,
- the transmission path for the electrical control of the ep brake be monitored right up to the rear of the train,
- the efficiency of transmission of PAS commands be monitored as far as the last unit,

1. [R] = optional measure

- the credibility of the signal for transmission and return of the commands for braking, release of the brake and override be verified constantly on the leading vehicle.

- security

It must be guaranteed that the most likely risks of interruption (breakage of a cable, fall in voltage, damage to a contact)

- shall be signalled to the driver,
- shall not affect the functioning of the compressed-air brake,
- shall not cause unwanted application of the brake,
- shall not cause unwanted overriding of the exhaust valve of the alarm brake.

It is forbidden to mount electrical circuits in parallel on the application electrovalves, other than those which are functionally strictly necessary.

- accessibility

It is a requirement:

- that it shall be possible to engage from the driver's cab:
 - the ep brake function alone,
 - the PAS function alone or combined with the ep brake function,
- that, in the leading vehicle or coach, the serial insertion of the control equipment (relay contacts, push buttons) into the conductors shall be forbidden.

3 - Requirements common to the ep brake and the PAS

The electrical link between the leading vehicle and the train consists of an electric cable (FEP line or ep control) comprising 9 poles and described in point 6.1 - page 23.

At the ends of the vehicles, the connection frames shall contain:

- at each end of the vehicle, a female socket, a plug on a flying cable (connected in parallel) and an open-circuit socket

The following equipment is also permitted, as an alternative:

- **[R]:** on power units: two female sockets, connected in parallel, situated at each end of the vehicle,
- **[R]:** on driving trailers: on the driver's cab side, two female sockets connected in parallel, on the other side, one female socket and one plug on a flying cable (connected in parallel), as well as an open-circuit socket,

The functions described here require the use of conductors A, 2, 3, 4 and D of the ep control; the conductors shall be galvanically isolated from the battery and from the mass of the vehicle (in order to avoid parasitic currents present along the train).

The electrovalves of the vehicles' ep brake are controlled by a given nominal voltage of 72 or 110 V DC by conductors 3 and 4 which have a common return line (-) over conductor 2.

The emission of control commands via the corresponding conductors is administered by a control centre situated in the leading vehicle.

Control commands of the PAS are transmitted by a given voltage of 110 V DC between conductors A (+) and 2 (-).

The transmission paths to be monitored are all connected to a resistor situated at the rear of the train. Monitoring is ensured as follows: each loop is supplied by a stable current and the corresponding fall in voltage is checked.

The ep control thus comprises two twisted and cross-armoured conductors and two contacts located in the socket reserved for any transmission of data over the entire train (train bus). Continuity of screening shall be ensured in the connector. Transmission of information over the train bus shall not cause any interference with the ep brake or PAS.

4 - Requirements concerning the ep brake

The requirements described below are applicable for a reference train formed of a traction unit and vehicles, equipped with a maximum of 30 electrovalves.

As the trains under consideration are trains which can normally be divided during operation, the electrical design of the ep brake is based on the principle of the working current, in order to make the utilisation of this brake available and reliable.

It is possible to take the ep brake into account in the braking performance (deceleration or braked mass) if the command and control of the ep brake is designed in such a way that all the requirements specified in this section are satisfied.

The electrical and pneumatic functioning principle of the ep brake is outlined in Appendix [A - page 41](#).

4.1 - Prerequisites concerning the braking system

The compressed air brake and its components must conform to the specifications of *UIC Leaflet 540*.

The driver's brake valve must conform to the specifications of *UIC Leaflet 541-03* as an interface with the ep brake ([see Bibliography - page 68](#)).

4.2 - Functional requirements

4.2.1 - Drafting of commands for the application and release of the ep brake

4.2.1.1 - Application command

If the driver's brake valve in the driver's cab in service orders an application by means of a reduction in pressure in the main brake-pipe, the ep brake emits an application command. The application command is transmitted as long as the actual pressure in the main brake-pipe is greater than the recorded pressure of the driver's brake valve.

[R]: It is permissible that, if the driver's brake valve is in the emergency braking position, the ep application command shall be transmitted continuously.

4.2.1.2 - Release command

In the absence of an ep brake application command, if the driver's brake valve in the driver's cab in service orders the brake to be released by means of increasing the pressure in the main brake-pipe, the ep brake emits a release order. The order to release is transmitted as long as the actual pressure in the main brake-pipe is lower than the recorded pressure of the driver's brake valve. However, this order must be cancelled after a certain period (maximum 60 seconds) in order to avoid a false continuous command.

[R]: It is permissible, in case of emergency or alarm braking ([see Glossary - page 67](#)), for the ep application command to be emitted automatically, even if the driver's brake valve issues a release command.

4.2.2 - Isolate or put into operation the ep brake in the leading vehicle

A device shall allow the ep brake to be put into, or taken out of, service (examples, an interruptor, a selector switch of functioning mode or a menu-driven software command).

The selected functioning mode shall be identifiable without ambiguity at all times.

A combination with the device for selecting the functioning mode of the PAS is permissible (see point 5.1.2 - page 17).

4.2.3 - Signalling of the status of the ep brake

The functional status of the ep brake shall be signalled to the driver. This is done by means of a white or yellow display "failure of ep brake" ("H-ep", see Appendix H - page 55) in the leading vehicle. The display signals:

- non-availability of the ep brake,
- defective functioning of the ep brake,
- a fault in the transmission cable of the ep brake.

In "ep" functioning mode, the display shall be available and immediately visible as soon as it is ordered.

4.2.4 - Monitoring of functioning of ep brake after it has been put into operation or warning of disturbance

When the "ep" brake is put into operation, the optical message "H-ep" ("failure of ep brake") shall flash in the driver's cab for as long as the disturbance remains and the brake test has not been carried out.

The luminous signal for non-functioning is acknowledged (switched off) by the positioning of the driver's brake valve on application, then release, provided that no abnormality is detected. Switching off this message thus indicates that the ep brake is in service. The driver's action enables the correct functioning of the transmission of application and release commands to be monitored.

The optical message (H-ep), when flashing, indicates that the ep brake is not in service.

It is permitted for this visual signal to illuminate as well as to flash.

4.2.5 - Monitoring of the functioning of the ep brake in the train

Once the train has been assembled, the ep brake shall enable verification that all the vehicles of the train have been accounted for correctly, particularly the last vehicle (see Glossary - page 67) which ensures that the electrical lines of the ep control are connected. In addition, it shall enable verification of the transmission paths for the ep brake commands. The verification is referred to as "ep brake test" in the rest of the document.

[R] Activation of the ep brake test by means of a centralised, dedicated command

The leading vehicle is fitted with a centralised control device for the ep brake test (examples, an interrupter, either dedicated or combined with the device for isolating the ep brake, or a menu-driven software command). When the ep brake is in service and at a halt, the "S-ep-test" device ("ep brake test", see Appendix H - page 55) enables the ep brake test to be activated and the state of transmission paths of the ep brake commands to be displayed. The functional checks performed by the ep brake (see point 4.4.2 - page 14) are only possible at a standstill and after activation of the function "Implementation of the ep brake test".

Monitoring of the functioning of the ep brake on an intermediate vehicle or on the rear vehicle

The monitoring requires manual intervention for intermediate vehicles and the rear vehicle: activation of a push button "S-P" (see Appendix G - page 53) of the ep brake. These vehicles are fitted with an "S-P" push-button on every side.

Activation of an "S-P" push button of the ep brake in the train, as well as the state of the signalling and transmission devices, shall be signalled immediately in the driver's cab.

The signalling associated with the ep brake test (H-SEP, see Appendix G) may appear in the form of a combination of 3 white luminous lights, or by the display of appropriate messages on a screen. This signalling shall inform the driver of the following states:

- brake test on an intermediate vehicle,
- rear of the train,
- brake test on the rear vehicle,
- interruptions.

If the leading vehicle has a diagnostics and monitoring system associated with the ep brake, it is possible for relevant information regarding the functioning of the ep brake (in operation, defective, applied, etc.) to be shown on the signalling screen of this system.

4.2.6 - Ensure monitoring of the application loop of the ep brake after the ep brake has been put into operation

The ep brake shall monitor the continuity of the electric application command lines right up to the rear of the train (monitoring of ep brake application loop, see Appendix G).

In service, the monitoring system signals to the driver, by means of an optical signal of the ep brake (white or yellow light -H-ep, see Appendix H), that there is a break or short-circuit in the ep brake engagement loop. The correct functioning of the monitoring system is tested during brake tests.

4.3 - Pneumatic requirements

When the ep brake is applied, the pressure in the BP shall be lowered from 5 bars to 3,5 bars over a period of between 3,5 and 5 seconds.

When the ep brake is released, the pressure in the BP shall rise from 3,5 to 4,9 bars over a period of between 7 and 10 seconds, assuming a pressure in the auxiliary tanks of between 5,3 and 5,5 bars.

The periods are monitored on one single vehicle linked to the compressed air brake, having a BP which was filled to 5 bars before being isolated. The periods are counted from the application of the continuous signal controlling the electromagnetic valve for application and release of the ep brake.

For the same braking instruction, the same level of force shall be developed, with or without the ep brake.

The electrical command shall be the same for all braking conditions R, P or G.

If the electrical command of the ep brake is out of service, the compressed air brake shall continue to function normally, without the necessity of undertaking any modification to the vehicle, in order to satisfy the requirements of *UIC Leaflet 540*.

The design of the ep brake shall allow integration into a rake of vehicles partially fitted with the ep brake providing, at the minimum, continuity of the main air supply pipe, the main brake-pipe and ep control cable (9 conductors). Integration shall be possible at any point in the train. Calculation of the braked mass shall take this into account.

The brake shall be activated simultaneously, in pneumatic control and control assisted by the ep brake, from the same driver's brake valve and carrying out the same manoeuvres.

If the control assisted by the ep brake is used (electric control), no harmful repercussions may occur to the distributors valves of the pneumatic brake, even in long, heavy trains. It shall be possible to carry out service and emergency braking, as well as repeated cycles of brake application and release, in stages.

Electrical installations shall be implemented in such a way as to fulfil the requirements of specifications and standards in force with regard to protection of people.

If, by accident, the simultaneous command of the "ep application" and "ep release" electrovalves were to occur, this shall not cause an increase in pressure in the main brake- pipe.

[R]: It is even recommended that such an irregularity shall cause a lowering of pressure in the BP.

Whatever the vehicle, the "application" command of the ep brake shall take priority over the "release" command of the ep brake.

It shall be possible for the ep brake to be put into/taken out of service at will.

In case of failure, it shall be possible to isolate the ep brake on the leading vehicle in order to avoid any effect which is negative or compromises safety.

Isolation of the compressed air brake on a vehicle shall also render the ep brake of the vehicle out of service. On existing vehicles, it is permissible to have a device for isolating the FEP which interrupts the link between the auxiliary tank and the main air supply pipe.

The filling stroke at high pressure from the driver's brake valve, if there is one, shall be blocked when the ep brake is in operation.

4.4 - Electrical requirements

4.4.1 - Leading vehicle: design and components of the ep brake

4.4.1.1 - Control of ep brake functions

The connection between the input signals and the processing of the output signals for the ep brake control is provided by the control centre of the ep brake.

The ep brake may be controlled by means of dedicated equipment or by the control computer of the vehicle, incorporating a module dedicated to the ep brake.

The switching principle of the inputs and outputs of the control centre of the ep brake is described in Appendix H - page 55.

Incorporation of the ep brake control into the control centre of the PAS is permissible.

If the leading vehicle is taken out of service the energy supply of the control centre of the ep brake is cut.

4.4.1.2 - Transmission of ep brake commands

From the leading vehicle, ep brake application and release commands are transmitted by means of the following electrical circuit supply of the ep control (DC at free potential (U_{ep}): nominal voltage 72 V DC or 110 V DC, see point 6.3.3 - page 30):

- application of ep brake: by means of the control device K1-SER (see Appendix G - page 53), electrical supply of conductor 4 (+) and return of current over conductor 2 (-);
- release of ep brake: by means of the control device K1-DES (see Appendix G), supply of conductor 3 (+) and return of current over conductor 2 (-).

4.4.1.3 - Monitoring of ep brake commands

The monitoring inputs into the control centre of the ep brake (see Appendix G) allow verification that the commands transmitted by the ep brake from the driver's cab in service, of application and release respectively, are correctly transmitted and taken into account in the train (state of the train's ep brake in accordance with the control) or whether parasitic commands respectively on conductors 4-2 and 3-2 are subjected to an untimely control (presence of a parasitic voltage).

These checks are carried out by components K2-SER (see point 6.3.5 - page 31) and K2-DES (see point 6.3.7 - page 31).

4.4.1.4 - Monitoring of the ep brake application loop

The monitoring device known as "SEP" (Monitoring of the EP brake application loop see details in Appendix B - page 42), subject of the function of point 4.2.4 - page 10, monitors the continuity of electrical control cables for application right up to the rear of the train (see point 6.3.2.3 - page 30). It continuously measures the resistance between conductors 4-2.

In service, the monitoring system signals to the driver by means of the luminous "ep" signal that the transmission of signals between conductor 4-2 is faulty due, for example, to a break or a short circuit.

Implementation of the brake test enables the corresponding states of the control loop and corresponding functions to be recognised.

In order to avoid causing an untimely warning of failure during the application and release phases, the monitoring device is overridden by means of the connection of an equivalent resistance to the resistance of the rear of the train.

4.4.2 - Ep brake test

At the rear of the train, in order to ensure that the application loop of the ep brake is closed, and thus ensure its correct functioning, conductors 4 and 2 of the 9-pole ep control shall be linked in series by means of the following components (see Appendix G - page 53):

- "S-Q" contact of the rear of the train (see point 6.1.2.4 - page 25),
- "S-P" push button (open-circuit contact, see point 6.1.3.1 - page 26),
- resistance "R1" of the rear of the train (see point 6.3.2.1 - page 30),
- coupling diodes (see point 6.3.1 - page 29).

5 - Requirements imposed for the PAS

The requirements described below are applicable for a reference train formed of a traction unit and a maximum of 15 vehicles (length of train = 400 m).

As the trains under consideration are trains which can normally be divided during operation, the electrical design of the PAS system is based on the principle of the working current, in order to render the use of this system available and reliable.

5.1 - Functional requirements

5.1.1 - Activation of an alarm signal handle

Passengers must be given a means of contacting the train staff, in order to request assistance.

To achieve this, the alarm signal handles must be easily spotted and accessible, in accordance with *UIC Leaflet 541-1* (see [Bibliography - page 68](#)).

In the driver's cab in service, activation of an alarm signal handle causes a red signal light H1-PAS to flash in the driver's field of vision (see [Appendix H - page 55](#)) and an acoustic signal H2-PAS (see [Appendix H](#)). The signal lamp shall remain lit as long as an alarm signal handle is activated.

The PAS signal lamp is only deactivated once all the alarm signal handles in the train have been reset.

In the vehicle where the handle has been activated, a signal lamp H-FGN (see [Appendix C - page 44](#)) (at least a flashing red light) enables the train personnel and the passengers to determine in which vehicle an alarm signal handle has been activated.

Moreover, the passenger shall receive acoustic confirmation of the activation of the alarm signal handle by means of one of the following devices:

- loud-speaker, through which a warning can be generated manually by the driver,
- acoustic alarm or loud-speaker through which a warning may be generated automatically from the leading vehicle,
- acoustic alarm or loud-speaker through which a warning can be generated automatically from the vehicle concerned as soon as the alarm signal is activated.

Acoustic warnings shall be audible by all passengers situated in the coach in which the alarm signal handle has been activated (except the passage directly situated between two coaches and the WC compartment).

5.1.1.1 - Activation of an alarm signal handle in the station area

The "station area" extends between the point where the train stops at the platform for passengers to board and disembark and a distance "D" travelled after the train has departed. The stopping point is therefore defined by 2 criteria: immobilisation of the train and the presence of the platform. The presence of the platform can be formed by a marker on the track, opening of access doors or any other appropriate means.

The distance "D" which marks the end of the "station area" can be formed in 2 ways:

- distance covered by the train, after which the train is no longer wholly or partially level with the platform. This solution is preferred.
- distance covered by the train of between 80 and 120 meters from its stopping point.

Activation of one or several alarm signal handles in the station area shall immediately cause emergency braking.

The emergency braking remains active until all the activated alarm signal handles are restored to normal position (reset) or until the isolation device dedicated to cancelling the emergency braking is activated (see point 1.3.2 - page 4).

Once the alarm signal has been activated, any other activation of an alarm signal handle in the same vehicle or in other vehicles shall not affect the PAS system, with the exception of the emission of the luminous signal locally, which shall light up or remain lit, and the local acoustic confirmation.

[R]: The acoustic warning in the driver's cab may be deactivated by the driver after confirmation that the alarm signal has been noted by means of one of the following actions:

- triggering of an emergency braking command by the driver,
- acknowledgment by a voluntary action of the driver on another device : corresponding push button (luminous: S-EBO), touching the screen, etc.
- or placing the driver's brake valve in position "filling stroke" or "large-scale feed".

The warning components in the vehicle shall be mounted so that they are visible.

[R]: Reception of the continuous override signal of the emergency braking may be displayed in the coach in an appropriate manner.

5.1.1.2 - Activation of an alarm signal handle outside the station area

As soon as the transmitted signal is received in the driver's cab, the driver shall confirm notice of the first alarm signal handle activated in the following manner:

- If the driver intends to continue moving, he must confirm receipt of the alarm signal by means of a voluntary action on the acknowledgment device S-EBO (see Appendix H - page 55, driver's brake valve in position of filling stroke or dedicated luminous push button situated close to the driver's hand, touch on computer screen, etc.) within a period of time "T" of between 5 and 15 seconds. Confirmation by the driver causes the acoustic warning H2-PAS to stop in the driver's cab and the continuous override signal of the emergency braking EBO to be maintained.

If the driver does not confirm within the specified time period, braking shall be triggered automatically (see point 5.2.1.4 - page 19). The automatic braking can subsequently be deactivated if the driver confirms notice of the signal, in accordance with the procedure described above.

In the case of trains running at high speed outside the station area, activation of an alarm signal handle at a speed greater than a threshold speed of between 200 and 250 km/h shall cause an immediate drop in speed (without waiting for the period of time "T" to elapse) by means of activation of automatic service braking (fall in pressure in the main brake-pipe greater than or equal to 0.6 bar). After confirmation of acknowledgment of the signal, as indicated above, the automatic braking is deactivated and the driver can proceed with brake release at will.

- **[R]:** In the case of acknowledgment with the aim of immediately implementing the emergency braking requested, the corresponding control signal may be generated by the driver's brake valve for emergency braking. Acknowledgement of the PAS also switches off the acoustic signal in the driver's cab.

After activation of the alarm signal, all other activation of an alarm signal handle in the same vehicle or in other vehicles shall not affect the PAS system, with the exception of transmission of the luminous signal locally, which shall light up or remain lit, and of local acoustic confirmation. The optical 'PAS' warning shall, however, remain lit until all the alarm brakes in the train have been restored to their normal position (resetting).

5.1.2 - Isolation or engagement of the PAS system

The PAS system is put into operation by means of a manual command controlled by the driver (for example, a simple in/out of service switch, a functioning mode selector or even a command integrated into software).

[R]: For trains running on specific lines (only in tunnel, heavily populated area), this command may include as an option an additional position called "SAI" (see List of abbreviations - page 66) where activation of an alarm signal handle allows the driver to be alerted and telephone communication to be established between the passenger and the driver, without interaction with the braking system.

The functioning mode selected must be recognisable at all times. This may be achieved by the designations of the positions on the switch or by additional measures.

In case of faults or defects which are impossible to resolve, the PAS system shall be deactivated with the manual in/out of service command.

If the PAS system is faulty or has been deliberately taken out of service by the command described above, activation of an alarm signal handle shall cause immediate emergency braking to a halt.

If the driver's cab is put into service while one or several alarm signal handles of the train are activated, the luminous signal (red flashing light) shall be emitted in the driver's cab in order to inform the driver of this situation.