Requirements for the Automatic Warning System

Synopsis
This standard defines the functional requirements for the Automatic Warning System.

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Part A

Issue Record
This standard will be updated when necessary by distribution of a complete replacement.
Amended or additional parts of revised pages will be marked by a vertical black line in the adjacent margin.

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Responsibilities
Railway Group Standards are mandatory on all members of the Railway Group* and apply to all relevant activities which fall within the scope of each individual’s Railway Safety Case. If any of those activities are performed by a contractor, the contractor’s obligation in respect of Railway Group Standards is determined by the terms of the contract between the respective parties. Where the contractor is himself a duty holder of a Railway Safety Case then Railway Group Standards apply directly to the activities described in his Railway Safety Case.
*The Railway Group comprises Railtrack and the duty holders of Railway Safety Cases accepted by Railtrack.

Compliance
The provisions of this Railway Group Standard are mandatory for signalling design and implementation work undertaken on schemes for which the Scheme Plan is approved on or after 7th February 1998 and for ‘new build’ or ‘life-extended’ rolling stock for which the design specification is issued on or after 7th February 1998. Retrospective action, in respect of the track sub-system, shall be at the discretion of the Infrastructure Controller with the agreement of the train operator(s). Retrospective action, in respect of the vehicle sub-system, shall be at the discretion of the train operator, with the agreement of the Infrastructure Controller(s).

Health and Safety Responsibilities
In authorising this Standard, Railtrack PLC makes no warranties, express or implied, that compliance with all or any of Railway Group Standards in sufficient on its own to ensure safe systems of work or operation. Each user is reminded of its own responsibilities to ensure health and safety at work and its individual duties under health and safety legislation.

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Telephone: 085 78774 or 0171 557 8774 (BT)
Facsimile: 085 79072 or 0171 557 9072 (BT)
Requirements for the
Automatic Warning System

Part B

1 Purpose
This standard defines the functional requirements for the Automatic Warning System (AWS).

2 Scope
This standard applies to The Automatic Warning System developed by British Rail (originally British Transport Commission) and sometimes referred to as The British Railways Automatic Warning System (BRAWS).

This standard applies to both train-borne equipment and track-side equipment up to the signal interlocking interface.

This standard applies where the line speed does not exceed 225km/h.

3 Definitions
All key terms referred to in this standard are defined in GK/RT0002 except those defined below, which are printed in bold throughout this standard:-

All-black & black and yellow
The two indications that the visual indicator provides, though not simultaneously.

All-black
The normal status of the visual indicator when not at black and yellow (see 9.5.4 and Appendix B).

Black and yellow
The status of the visual indicator following a caution acknowledgement (see 9.5.4 and Appendix B).

Extra-strength
As applied to track mounted magnets and vehicle mounted detection elements, this refers to the system which is required on d.c. electrified lines.

Initial Delay Period
The time lag, after detecting a south magnet field, following which non-detection of a north magnet field results in commencement of the caution acknowledgement period.

Caution Acknowledgement Period
The time lag, following the initiation of a warning, during which the driver has the opportunity to make an acknowledgement before the system initiates a brake application.

Standard-strength
As applied to track mounted magnets and vehicle mounted detection elements, this refers to the system used on lines other than those using d.c. electrification.
4 Responsibilities

4.1 General
The Railway Group member in control of any part of the system is responsible for the design, provision and maintenance of that part under their control in order that the total system meets the requirements of this standard.

4.2 Track Sub-system
The Infrastructure Controller (mainly Railtrack) shall be responsible for the track sub-system and its control by the signalling system and shall ensure that it continuously meets the performance and interface requirements of this standard.

Note: The use of track equipment to Track Sub-system specifications as listed in Appendix C, will be considered to meet the requirements of this standard. Use of any other combination of equipment, will require validation against the whole of this standard.

4.3 Vehicle Sub-system
The Train Operator shall be responsible for the vehicle sub-system and its control of the train braking system and shall ensure that it continuously meets the performance and interface requirements of this standard.

4.3.1 Verification that the vehicle sub-system meets the requirements of this standard shall form part of the Vehicle Acceptance Process.

Note: The use of trainborne equipment to Vehicle Sub-system specifications as listed in Appendix C, connected in accordance with manual MT169 will be considered to meet the requirements of this standard. Use of any other combination of equipment, will require validation against the whole of this standard.

5 Application

5.1 Provision of AWS
AWS shall be provided as part of the infrastructure and train system as determined by GK/RT0016.

5.2 System Developments
In order to maintain the overall AWS functionality and integrity, the requirements of this standard are to be met by, for example, sub-system developments and vehicle installation/maintenance programmes.

The physical size/space envelope, weight, installation, supply details, ergonomics etc. of the applicable sub-system’s equipment are therefore to be defined as interface and compatibility requirements at the detailed specification level.

Any development in one sub-system shall maintain compatibility with all other sub-systems.

Any change in a vehicle sub-system shall maintain compatibility with the track sub-system(s) over which it will be permitted to operate, including any existing track equipment which does not fully meet the requirements of this standard.

5.3 Operation of New or Modified Vehicles or Operation over New Routes
In granting Authority to Operate for any new or modified rolling stock, or for stock to operate over new routes, in accordance with GO/RT3270, the Infrastructure Controller shall take account of the vehicle sub-system sensitivity in relation to the performance characteristics of the existing track sub-system equipment.
6 General Description

The AWS is an aid to the driver, the primary function of which is to draw attention, by audible indications in the cab, with a visible reminder, to the approach to certain signals, signs, level crossings and warnings for temporary and permanent speed restrictions. The AWS shall do this by presenting an audible "warning" indication or an audible "clear" indication in accordance with GK/RT0016.

The brakes shall be applied automatically if an AWS warning indication is not acknowledged physically, within a set time period.

A visible reminder shall be presented, to the driver, after the acknowledgement of a warning indication, which shall remain presented until the next AWS track sub-system is encountered.

7 System Architecture

The AWS comprises two sub-systems: the track sub-system and the vehicle sub-system.

7.1 Track Sub-system

The track sub-system shall provide the following:

a) A means of providing a permanent south polarity magnetic field of the required strength and pattern.

b) Where required, a means of providing a north polarity magnetic field, of the required strength and pattern, capable of being energised by the signalling system.

c) Where required, a means of suppressing the permanent south polarity magnet's field.

It is essential, for safe and reliable operation of the system, that no other system, capable of creating a significant magnetic field, be permitted within the area to be scanned by a vehicle sub-system.

7.2 Vehicle Sub-system

The vehicle sub-system shall provide the following:

a) A means of detecting the magnetic fields of the track sub-system magnets.

b) A means of providing two distinct audible indications: 'clear' and 'warning', for the driver, in response to the appropriate track sub-system state, with the 'clear' indication having the higher frequency.

c) An interface with the vehicle braking system that enables an AWS brake demand to be actioned and the traction power to be shut off if a warning indication is not acknowledged, within a set time period.

d) An interface between the driver and vehicle sub-system that enables the acknowledgement of a warning indication.

e) A retained means of providing a visual reminder, to the driver, that there has been an acknowledgement of a warning indication. This reminder shall remain presented until the next track sub-system is encountered.

f) A means of emergency isolation in the event of a system failure, enabling the vehicle to proceed.

g) A means of providing a visual system isolation status indication.

h) A means of functionally testing certain vehicle sub-system equipment operating features.
8 Track Sub-system

8.1 General Description
The track sub-system shall consist of two magnets of opposite polarities mounted centrally in the track on the approach side of the feature which requires the indication. The first magnet shall create a permanent magnetic field with south pole uppermost, immediately followed, where required, by a second ‘electro’ magnet which, when energised with the correct electrical polarity, has its north pole uppermost. Certain configurations of track sub-system may require the permanent south polarity magnetic field to be suppressed such that it is not detected by a passing vehicle sub-system. There are various installation configurations required for the track sub-system, detailed later in this section. These arrangements are derivatives of one general track sub-system arrangement.

Two variants shall be required of each magnet types, as defined in 8.6; either standard-strength or extra-strength. In d.c. electrified areas there is substantial electromagnetic interference from other systems. This interference affects the operation of the system and as a result less sensitive detection elements and extra-strength magnets need to be utilised. This less sensitive detection only operates with extra-strength magnets and shall therefore be referred to as the extra-strength detection element.

8.2 Interface with Signalling Control Systems
The AWS track sub-system shall be suitable for the signalling system that it is required to interface with. Due regard shall be given to the interface requirements and operating characteristics of the track sub-system and signalling control system to ensure that neither one adversely affects the operation, reliability and safety of the other.

8.3 Sub-system Installation
Installation designs shall allow for all track support types and be, where possible, interchangeable between track support types.

Due regard shall be given to the installation design to ensure the track sub-system and track supports are not adversely affected.

Certain sleeper (track support) types have mounting holes for AWS, these shall be utilised where provided. The hole details and sleeper types are defined in Group Standard GC/EH0005.

The installation design shall ensure the track sub-system magnet’s magnetic centres are positioned within 10mm of the track centre line and in accordance with 8.4.

The installation design shall ensure the track sub-system magnets remain outside all kinematic gauging requirements defined in GM/RT2149.

8.4 Installation Arrangements
The following installation arrangements shall utilise standard-strength AWS track equipment for non d.c. electrified lines and extra-strength for d.c. electrified lines. Any electromagnet referred to shall be omitted where required by application criteria or where the signalling control system does not require/provide for energisation.
On d.c. electrification systems, AWS track equipment shall not be positioned within 3.5m in either direction of cross track high current feeders, traction return bonds or impedance bonds and generally not within 75m on the approach to these features. In cases of difficulty, the latter distance may be reduced to the distance covered in 1.5 seconds at permitted speed.

Note: Under no circumstance shall the top surface of any magnet be greater than 12mm above rail level.

8.4.1 Uni-directional Lines
This arrangement consists of a permanent magnet and an electromagnet located in the track, in that order in the direction of travel (See Figure 1).

![Figure 1](image1)

8.4.2 Bi-directional Lines
There are two basic layouts for bi-directional working:

(a) Applicable to signals in both directions
Where signal spacing permits an electro-permanent-electro arrangement, the permanent magnet is used for both signals with each electromagnet being controlled from its associated signal. This layout provides the applicable indications for signals in both directions. (See Figure 2)

![Figure 2](image2)
(b) Applicable to a Signal in One Direction Only
Where the arrangement in (a) cannot be used, a permanent magnet fitted with a suppressor coil (usually referred to as a suppressor magnet) and an electromagnet shall be fitted. The suppressor coil, when energised, shall suppress the field of the permanent magnet. This requires the addition of directional controls from the signalling system for the suppressor coil. This layout provides the applicable indications for a signal in one direction only. (See Figure 3)

Figure 3

8.5 Track Sub-system Operating Requirements
The track sub-system shall be capable of fulfilling the applicable indication requirements listed below.

8.5.1 Warning Mode
The track sub-system shall only provide a south polarity magnetic field of the defined strength and pattern.

8.5.2 Clear Mode
The track sub-system shall provide a south polarity magnetic field of the defined strength and pattern, followed in the direction of travel by a north polarity magnetic field of the defined strength and pattern, when interfacing with and energised by the applicable signalling control circuits.

8.6 Track Sub-system Equipment
The following main items of equipment are required.

a) Permanent Magnet
b) Electromagnet
c) Suppressor Magnet
d) Depot Test Point Magnet
e) “Portable” Permanent Magnet for Temporary Speed Restrictions (TSR) and Emergency Speed Restrictions (ESR)

Two variants of each item shall be required. The first variant shall be referred to as standard-strength, and shall be utilised for installation arrangements on non-d.c. electrified lines. The second variant shall be referred to as extra-strength, and shall be utilised for installation arrangements on d.c. electrified lines.
A variant or variants of a permanent magnet shall be required, standard-strength and extra-strength for TSRs and ESRs. These magnets shall meet the magnetic requirements of the corresponding permanent magnet, but the housing may be minimised and the method of mounting may be by clamping between the rails. The method of mounting shall not affect the operation of track circuits or other train detection equipment.

The primary purpose of the Depot Test Point Magnet is to act as a check that train-borne receiver elements are in working order, prior to vehicles entering service. By modifying the performance of these magnets, as compared to the Permanent Magnets, it is possible to provide an effective screen against weak or faulty receivers entering service.

The magnet designs shall ensure that the complete requirements of Section 7 are complied with. The performance requirements are defined below.

### 8.6.1 Standard-strength Track Equipment

For all track magnets, the maximum flux density, in the area shown in Figure 4, measured 115mm (+1, -0mm) above rail level shall be less than 18mT.

The flux density levels within the magnets’ field spread, outside the area shown in Figure 4, shall be within the required limits that enable the system to function as defined when installed in accordance with this Standard.

In order to facilitate the design of vehicle sub systems, the change in flux density shall be reasonably predictable at heights of 115mm to 225mm above rail level reference.

#### 8.6.1.1 Standard-strength Permanent Magnet

In free air, the South Polarity flux density, in the area shown in Figure 4, measured 115mm (+1, -0mm) above rail level shall be greater than 3.5mT.

#### 8.6.1.2 Standard-strength Electromagnet

In free air, when energised by the applicable supply, the North Polarity flux density, in the area shown in Figure 4, measured 115mm (+1, -0mm) above rail level shall be greater than 3.5mT.

In its de-energised state the flux density, in the area shown in Figure 4 shall be nominally zero (less than 0.7mT).

#### 8.6.1.3 Standard-strength Suppressor Magnet

The magnet shall incorporate a permanent magnet and perform, in the suppressed and un-suppressed states, as defined below.

In the un-suppressed state, performance shall be as for the standard-strength permanent magnet given in 8.6.1.1.
In the suppressed state, when energised by the applicable supply, in free air, the flux density, in the area shown in Figure 4, measured 115mm (+1, -0mm) above rail level shall be less than 0.7mT.

![Figure 4](image)

8.6.1.4 Standard-strength Depot Test Magnet
In free air, the South Polarity flux density, in the area shown in Figure 5, measured 115mm (+1, -0mm) above rail level shall be greater than 3.1mT and less than 3.5mT.

![Figure 5](image)

8.6.2 Extra-strength Track Equipment
The maximum flux density, throughout the area shown in Figure 6, measured 193mm (+1, -0mm) above rail level shall be less than 20mT.

The flux density levels within the magnets' field spread, outside the area shown in Figure 6, shall be within limits that enable the system to function as defined when installed in accordance with this Standard.

In order to facilitate the design of vehicle sub systems, the change in flux density shall be reasonably predictable at heights between 133mm and 255mm above rail level reference.

8.6.2.1 Extra-strength Permanent Magnet
In free air, the South Polarity flux density, in the area shown in Figure 6, measured 193mm (+1, -0mm) above rail level shall be greater than 4.1mT throughout and also greater than 5.1mT in the shaded area shown 35mm either side of the transverse magnetic centre line.
8.6.2.2 Extra-strength Electromagnet
In free air, when energised by the applicable supply, the North Polarity flux density, throughout the area shown in Figure 6, measured 193mm (+1, -0mm) above rail level shall be greater than 4.1mT and also greater than 5.1mT in the area shown 35mm either side of the transverse magnetic centre line.

In its de-energised state the flux density, in the area shown in Figure 6, shall be nominally zero (less than 1.2mT).

8.6.2.3 Extra-strength Suppressor Magnet
The magnet shall incorporate a permanent magnet and perform, in the suppressed and un-suppressed states, as defined below.

In the un-suppressed state, performance shall be as for the extra-strength permanent magnet given in 8.6.2.1.

In the suppressed state, when energised by the applicable supply, in free air, the flux density, throughout the area shown in Figure 6, measured 115mm (+1, -0mm) above rail level shall be less than 1.2mT.

Figure 6

8.6.2.4 Extra-strength Depot Test Magnet
In free air, the South Polarity flux density, in the area shown in Figure 5, measured 193mm (+1, -0mm) above rail level shall be above 4.7mT and less than 5.1mT.

8.6.3 General Requirements for Track Equipment
If the magnet's magnetic centre is not positioned on the physical centre it shall be clearly marked. The marking shall not be eroded in service.

The magnetic centre shall not exceed 0.325 metres from either extremity of the permanent magnets housing (including fixings).

The magnetic centre shall not exceed 0.325 metres from the extremity of the electromagnet housing (including fixings) intended to be adjacent to the permanent magnet. If the design is symmetrical, indications shall be given as to the intended orientation. This indication shall not be eroded in service. Where the design of the housing makes the intended orientation obvious (e.g. by incorporating a running off ramp in the housing) further indication shall not be required.
9 Vehicle Sub-system

9.1 Vehicle Sub-system Description
This description may be read in conjunction with Appendix A. Descriptions of the various vehicle sub-system states, equipment items and system function timings are expanded in 9.4, 9.5 and 10 respectively.

The vehicle sub-system shall meet the requirements of GM/RT2161 and GM/RT2185.

When the vehicle sub-system is operative in its operational ready state, no audible indication shall be given and the visual indication shall be in the last set mode.

On the detection of the magnetic south pole, the vehicle sub-system shall commence its initial delay period and change the visual indication to show all-black (if it was not already in this state). During this period, the sub-system shall maintain its status unless a north pole of an energised electromagnet is detected.

If a north pole of a magnet is subsequently detected within the initial delay period, the vehicle sub-system shall return to its operational ready state and provide clear indications. The clear indications shall be an audible clear tone and a visual indicator showing all-black.

If a magnetic north pole is not detected within the initial delay period the vehicle sub-system shall commence its caution acknowledgement time period. During this period, the system shall give an audible warning tone and ensure the visual indication remains all-black. If the driver actions a system caution acknowledgement, the system shall silence the warning tone, change the visual indication to black and yellow and revert to its operational ready state. The visual indication shall remain black and yellow as a reminder to the driver that a system caution acknowledgement was made at the last AWS track sub-system.

If the driver fails to action a system caution acknowledgement within the caution acknowledgement period, the vehicle sub-system shall initiate a fail-safe, full service brake application. The sub-system shall still allow the driver to action a system caution acknowledgement. This acknowledgement shall return the sub-system back to its operational ready state and change the visual indication to black and yellow. The brake system shall release when a system caution acknowledgement occurs. Whether this releases the vehicle brake immediately or after a specific duration will depend on the braking system design.

The vehicle sub-system shall derive the supply from the vehicle control supply.

Three variants of the vehicle sub-system shall be required, as defined in 9.3. These variants utilise one or both of the types of receiver detection element (standard-strength and extra-strength). The two detection element types are required because of the reason detailed in 8.1.

The vehicle sub-system shall have provision for system isolation.

If the vehicle sub-system power supply is lost for any reason other than system isolation, the vehicle sub-system shall initiate a full service brake application.

9.2 Interface with Other Vehicle Systems and Installation
The vehicle sub-system interface and installation details shall be specified within the applicable vehicle installation specification. Compliance with this installation specification shall ensure that variations in system interfaces do not affect the safety and reliability of the AWS or other vehicle systems (e.g. Automatic Train Protection system, brake system etc.) and that the AWS system remains electrically isolated from all other circuits and conductive parts.
Compliance with the vehicle installation specification shall ensure the positional requirements of the applicable vehicle equipment defined in 9.5. of this standard are met.

9.3 Vehicle Installation Arrangements
Installation arrangements for the vehicle sub-system shall be in accordance with the applicable requirements of this section.

9.3.1 D.C. Electrified Area Vehicle Sub-system
This vehicle sub-system shall be installed on vehicles which are only powered via the third/fourth rail (i.e. captive within d.c. electrified areas which utilise extra-strength track equipment). This sub-system shall have a receiver with an extra-strength detection element.

9.3.2 Non D.C. Electrified Area Sub-system
This vehicle sub-system shall be installed on vehicles that are:
- a) Excluded from d.c. electrified areas and thus only operate in areas that utilise standard-strength track equipment.
- b) Not fitted with a power changeover or d.c. electrified area detection facility but used in both non d.c. electrified areas and d.c. electrified areas. The use of this vehicle sub-system in these circumstances shall be subject to an appropriate risk assessment because it is possible that the standard-strength detection element may suffer from spurious detections in a d.c. electrified area. Note this vehicle sub-system shall not be used in place of the d.c. electrified area system for captive vehicles.

This vehicle sub-system shall have a receiver with a standard-strength detection element.

9.3.3 Dual Electrified Area Sub-system
This vehicle sub-system shall be installed on dual a.c./d.c. powered vehicles and other vehicles regularly used in both non d.c. electrified areas and d.c. electrified areas. Vehicles which are a.c./d.c. powered shall be fitted with a power changeover facility and vehicles not so fitted shall be equipped with a d.c. electrified area detection facility (of suitable integrity, defined in 9.5.11).

This sub-system shall have either a single receiver fitted with a standard-strength detection element and an extra-strength detection element or two individual receivers, one fitted with an extra-strength detection element and the other with a standard-strength detection element.

9.4 Vehicle Sub-system Operating Requirements
The vehicle sub-system shall be capable of fulfilling the operating state requirements listed below and shown in the flow chart in Appendix A.

9.4.1 System Function Test State
The vehicle sub-system shall enter this state when the system is initialised and where required, by a manually selected system function test facility, as defined in 9.5.13. In this state the system function test facility shall:
- a) Test the functionality of the audible warning indication.
- b) Prove the presence of the reset circuit supply.
- c) Maintain an AWS brake demand.
- d) Ensure that the operational ready state is returned to after fulfilling these requirements.

9.4.2 Operational Ready State
When the vehicle is operative the vehicle sub-system shall normally be in its operational ready state. In this state the sub-system shall:
- a) Be capable of detecting the track sub-system magnetic fields.
- b) Ensure that the audible warning indications are silent.
c) Ensure that there is no AWS brake demand.

d) Ensure that the visual indication is maintained in the last set mode (all-black or black and yellow as appropriate).

9.4.3 Primed State
When the vehicle sub-system is in its operational ready state and detects a south pole of a track sub-system magnet it shall enter its primed state. In this state the sub-system shall

a) Enter its initial delay period.

b) Ensure that the duration of primed state is limited by initial delay period.

c) Ensure that the visual indication shows all-black.

The maximum duration of the primed state is limited by the initial delay period as defined in 10.1.

9.4.4 Clear Signal Response State
The vehicle sub-system shall ensure that this state can only be entered when a north pole of a track sub-system magnet is detected whilst in the vehicle sub-system’s primed state. In this state the sub-system shall:

a) Ensure that the visual indication shows and remains showing all-black.

b) Provide an audible clear indication (completing the clear signal indication period).

c) Ensure that the operational ready state is returned to after fulfilling these requirements.

9.4.5 Restrictive Response State
The vehicle sub-system shall enter this state when the north pole of a magnet has not been detected within the initial delay period of the primed state. In this state the sub-system shall:

a) Enter its caution acknowledgement period.

b) Provide an audible warning indication.

c) Be capable of accepting system caution acknowledgement.

d) Ensure that the visual indication remains showing all-black.

The maximum duration of the restrictive response state is limited by the caution acknowledgement period as defined in 10.2.

9.4.6 Restrictive Acknowledgement State
The vehicle sub-system shall ensure that this state can only be entered when the system caution acknowledgement has been operated and released during the restrictive response state or restrictive non-acknowledgement state. In this state the sub-system shall:

a) Ensure that the visual warning indication shows and remains showing black and yellow.

b) Prove that the visual warning indication shows black and yellow before allowing the system to reset.

c) Silence the audible warning indication.

d) Cancel the AWS brake demand if initiated.

e) Ensure that the operational ready state is returned to after fulfilling these requirements.

9.4.7 Restrictive Non-acknowledgement State
The vehicle sub-system shall enter this state when the caution acknowledgement period has expired without a valid acknowledgement. In this state the sub-system shall:

a) Initiate and maintain an AWS brake demand.

b) Continue to provide the audible warning indication.
c) Be capable of accepting system caution acknowledgement.
d) Ensure that the visual indication is maintained showing all-black.

9.4.8 System Isolation State
The vehicle sub-system shall enter this state when the sub-system is isolated. In this state the system isolator shall:
a) Ensure that all indications, except the isolation status indication, are inoperative.
b) Ensure that no AWS brake demand is or can be actioned.
c) Ensure that the supply is isolated from the vehicle sub-system.

9.4.9 System Power-off State
The vehicle sub-system shall enter this state when the sub-system power supply is lost for reasons other than a system isolation. In this state, the sub-system shall:
a) Initiate and maintain an AWS brake demand.

9.5 Vehicle Sub-system Equipment
The vehicle sub-system shall comprise of equipment that fulfils the appropriate functions and associated requirements, as listed below.

9.5.1 Receiver
The receiver shall detect within one millisecond, in passing, the magnetic fields of the track sub-system magnets positioned in accordance with this standard.

The receiver/s shall provide the necessary signals to enable the vehicle sub-system to function as defined.

The receiver shall not be mounted outside the applicable vehicle gauge

The vehicle sub-system receiver shall be mounted within 18 metres of all driving positions that it provides with indications.

The receiver position, with respect to driving positions, shall be consistent between stock of the same type/class.

Vehicles fitted with a dual electrified area vehicle sub-system shall have the standard-strength and extra-strength detection elements mounted in a relative position that ensures no confusion is caused due to a noticeable variation in the warning time, with respect to the applicable track sub-system.

The receiver/s shall have the appropriate detection element or elements dependent on the vehicle installation arrangement. The three installation arrangements are defined in 9.3.

9.5.1.1 Standard-strength Receiver
The receiver standard-strength detection element shall be capable of detecting standard-strength track equipment defined within this standard. This receiver shall function under all running conditions, once installed on the vehicle.

The standard-strength detection element shall be operated by a magnetic flux density of 3.1mT, presented at 115mm above rail level, directly below the receiver.

The standard-strength detection element shall not be operated by a magnetic flux density of less than 1.5mT, presented at 115mm above rail level.

9.5.1.2 Extra-strength Receiver
The receiver **extra-strength** detection element shall be capable of detecting **extra-strength** track equipment defined within this standard. This receiver shall function under all running conditions, once installed on the vehicle.

The **extra-strength** detection element shall be operated by a magnetic flux density of 5.0mT, presented at 193mm above rail level, directly below the receiver.

The **extra-strength** detection element shall not be operated by a magnetic flux density of less than 3.5mT, presented at 193mm above rail level.

**9.5.2 Decoder**

The decoder, which may be a relay unit or processor based unit, shall process the control signals, reset signals and the signals from the receiver. The decoder shall:

a) Control the indications.

b) Control the relevant system function timings.

c) Initiate the brake demand.

d) Interface with the junction box or incorporate the function of the junction box.

**9.5.3 Power Supply Unit**

The power supply unit shall obtain its supply from the vehicle control supply. Due regard shall be given to the operating characteristics of the vehicle sub-system equipment, including this power supply unit and vehicle control supply to ensure either one does not adversely effect the operation of the other.

The power supply unit shall provide the supply for the vehicle sub-system circuits.

The power supply design shall ensure that the supply for the vehicle sub-system are electrically isolated all other circuits.

The supply for the detection and control circuits shall be incapable of operating the acknowledgement circuitry under any conductor fault conditions.

**9.5.4 Visual Indicator**

The visual indicator shall provide two states of visual indication. These states shall be **all-black** and **black and yellow** in colour. The visual indication shall be in accordance with the requirements defined in Appendix B.

The indicator shall have a means of proving to the vehicle sub-system that the indication displays **black and yellow**.

The indicator should be in the line of vision of the track ahead. There should be no need to turn from this line in order to observe the indicator.

The visual indications, provided by the indicator, shall be clearly visible, from all applicable driving positions, under all conditions within a vehicle cab.

Duplicate indicators in the same vehicle cab shall be synchronised in their operation.

**9.5.5 Audible Warning Indication**

The indicator shall produce a steady alarm/horn tone distinguishable from all other indications.

The indicator shall have a sound level of 90-95dBA measured at a distance of one metre from the front of the equipment, as installed in the vehicle.
The indicator shall have a preferred alarm/horn tone frequency of 800Hz ± 20Hz. Deviation from this frequency shall be subject to an appropriate safety case.

The indication shall be clearly audible, from all applicable driving positions under all conditions within a vehicle cab.

9.5.6 Audible Clear Indication
The indicator shall produce a bell/simulated chime tone for 0.5 to 1.5 seconds distinguishable from all other indications. The rise time shall be less than 50 milliseconds.

The indicator shall have a sound level of 90-95dBA measured at a distance of one metre from the front of the equipment, as installed in the vehicle.

The indicator shall have a preferred bell/simulated chime tone frequency of 1200Hz ± 20Hz. Deviation from this frequency shall be subject to an appropriate safety case.

The indication shall be clearly audible, from all applicable driving positions, under all conditions within a vehicle cab.

9.5.7 System Caution Acknowledgement
The system caution acknowledgement shall be in the form of a push button, positioned so that the driver can easily operate it when seated at the active driving position.

The configuration of the system caution acknowledgement shall ensure that the system caution acknowledgement push button applicable to the active driving position only is operable.

The system caution acknowledgement shall be capable of being proved in both normal and operated positions.

The system caution acknowledgement push button shall be configured within the vehicle sub-system such that a caution acknowledgement can only be given when it is pressed and released during the restrictive acknowledgement and restrictive non-acknowledgement states. A caution acknowledgement shall not be given if the system caution acknowledgement push button is pressed before the restrictive acknowledgement state is entered and then released during or after.

The system caution acknowledgement push button configuration shall ensure the vehicle sub-system functions as defined when it is continuously held pressed and operated when not required.

9.5.8 Brake system interface
The brake system interface shall enable the vehicle sub-system to initiate and cancel an AWS brake demand.

9.5.9 System isolator
The system isolator shall enable the vehicle sub-system to be isolated. This shall ensure all indications are inoperative, no AWS brake demand is/can be actioned and the power supply unit is isolated.

The system isolator shall be provided with a means that enables a vehicle sub-system isolation to be detected.

9.5.10 Power Changeover Facility
The system power changeover facility may be used on dual a.c./d.c. powered vehicles. Where provided, this shall ensure the correct receiver detection element is selected, i.e. the extra-strength detection element is selected when the vehicle is obtaining power from the d.c. traction supply and the standard-strength detection element is selected when it is not.

If a failure occurs in the system power changeover facility then the standard-strength detection element shall be selected.

Where this facility is provided, operation of the system caution acknowledgement shall cause both the selected and non-selected receiver detection elements to be reset.

**9.5.11 D.C. Electrified Area Detection Facility**
The d.c. electrified area detection facility shall be used on vehicles required to operate regularly in both non d.c. electrified and d.c. electrified areas when a power changeover facility is not provided. This facility shall detect when the vehicle is operating in a d.c. electrified area and ensure that the correct receiver detection element is selected, i.e. the extra-strength detection element is selected when the vehicle is operating in a d.c. electrified area and the standard-strength detection element is selected when it is not.

If a failure occurs in the d.c. electrified area detection facility then the standard-strength detection element shall be selected.

Where this facility is provided, operation of the system caution acknowledgement shall cause both the selected and non-selected receiver detection elements to be reset.

**9.5.12 System Isolation Status Indication**
The system isolation status indication shall provide all driving positions with a clearly visible system status indication. This indication shall show whether or not the vehicle sub-system is isolated.

**9.5.13 System Function Test Facility**
The system function test facility shall be in built in to the vehicle sub-system sequence and function automatically on initialisation only. Where it is possible to operate the vehicle outside an AWS area, under another warning system or vehicle control system, a manually selectable facility shall be provided.

The system function test facility shall be capable of fulfilling the requirements of the system function test state defined in 9.4.1.

Due regard shall be given to the design of the system function test facility to ensure the safety and reliability of the vehicle sub-system is not affected.

**10 Vehicle Sub-system Function Timings**
The system shall have the following function timings

**10.1 Initial Delay Period**
The vehicle system after detecting a south magnet field commences its initial one second time delay period (+0, -0.1 seconds). This time period allows the system to operate as defined at a speed of 5 kph or above. This time is derived from a magnet spacing of 0.75m, as defined in 8.4.

**10.2 Caution Acknowledgement Period**
The vehicle system after the expiry of the initial delay period without a north magnetic field being detected, commences its caution acknowledgement period.
The duration of the caution acknowledgement period shall be 2 seconds (±0.25 seconds). For vehicles with a maximum speed of less than 160 km/h, the duration of the caution acknowledgement period may be increased to 2.7 seconds (±0.37 seconds).

11 Approval, Maintenance and Failure of Equipment

11.1 Approval
Specifications shall be provided to define all requirements and details for all track sub-system equipment.

Specifications shall be provided to define all requirements and details for all vehicle sub-system equipment.

The vehicle and track sub-system specifications and any subsequent alterations shall ensure compliance with this standard and compatibility with other existing equipment is maintained.

Approval for both the track and vehicle sub-system equipment and specifications shall be in accordance with GK/RT0104. Approval and change control shall be the responsibility of the design authority.

11.2 Maintenance
Maintenance shall meet the requirements of GK/RT0170 and additionally, maintenance and repair of the vehicle sub-system shall be in accordance with GK/EH H205.

11.3 Failures
Failure reporting and investigation of the track and vehicle sub-systems shall be in accordance with GK/RT0106.

In order to facilitate the reporting of AWS faults, a fault code may be used. Where a fault code is used, the following shall apply:

<table>
<thead>
<tr>
<th>Required</th>
<th>Actual</th>
<th>Fault Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audible ‘Clear’ Indication</td>
<td>Audible ‘Warning’ and ‘Clear’ Indications</td>
<td>1</td>
</tr>
<tr>
<td>Audible ‘Clear’ Indication</td>
<td>Audible ‘Warning’ Indication instead of Audible ‘Clear’ Indication</td>
<td>2</td>
</tr>
<tr>
<td>Audible ‘Clear’ Indication</td>
<td>Nothing received</td>
<td>3</td>
</tr>
<tr>
<td>Audible ‘Warning’ Indication</td>
<td>Audible ‘Clear’ and ‘Warning’ Indications</td>
<td>4</td>
</tr>
<tr>
<td>Audible ‘Warning’ Indication</td>
<td>Audible ‘Clear’ Indication instead of Audible ‘Warning’ Indication</td>
<td>5</td>
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<tr>
<td>Audible ‘Warning’ Indication</td>
<td>Brake application without Audible ‘Warning’ Indication</td>
<td>6</td>
</tr>
<tr>
<td>Audible ‘Warning’ Indication</td>
<td>Nothing received</td>
<td>7</td>
</tr>
<tr>
<td>Nothing</td>
<td>Audible ‘Warning’ Indication</td>
<td>8</td>
</tr>
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12 Safety and Reliability

The AWS shall be designed and maintained to meet the safety, integrity and reliability levels necessary to meet the safety targets of the Infrastructure Controller’s and Train Operator’s Safety Cases and Licences.
Appendix A: Vehicle Sub-system Sequence Flow Chart

Note:
The System Isolation State and System Function Test State are not shown.
Appendix B: Visual Indicator

General Layout

(number of segments: minimum 8 - maximum 10)

<table>
<thead>
<tr>
<th>STATUS</th>
<th>Background</th>
<th>Segments</th>
</tr>
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<tbody>
<tr>
<td>All-black</td>
<td>Black</td>
<td>Black</td>
</tr>
<tr>
<td>Black and Yellow</td>
<td>Black</td>
<td>Yellow</td>
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Dimensions

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<thead>
<tr>
<th>Dimension</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background diameter</td>
<td>42mm</td>
<td>90mm</td>
</tr>
<tr>
<td>Segment circle - Outer diameter</td>
<td>39mm</td>
<td>85mm</td>
</tr>
<tr>
<td>Segment circle - Inner diameter</td>
<td>15mm</td>
<td>20mm</td>
</tr>
<tr>
<td>Arc of segments</td>
<td>11°</td>
<td>18°</td>
</tr>
</tbody>
</table>

Individual designs shall be approved with respect to particular vehicular applications.
# Appendix C: Railtrack S&SD Archive Documents

## TRACK SUB-SYSTEM SPECIFICATIONS

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Is./ Rev.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS10</td>
<td>Standard &amp; Extra Strength Permanent Magnets for AWS And Temporary Speed Restrictions</td>
<td>2</td>
<td>Mar 87/Jul 77/Jan 80</td>
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<tr>
<td>AWS11</td>
<td>AWS Depot Test Magnet</td>
<td>-</td>
<td>Feb 87</td>
</tr>
<tr>
<td>AWS37</td>
<td>AWS New Pattern Electro Inductors &amp; Suppressor Inductors, Standard &amp; Extra Strength</td>
<td>-</td>
<td>Jul 81/Oct 81/ Mar 82/ Mar 83</td>
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</tbody>
</table>

## VEHICLE SUB-SYSTEM SPECIFICATIONS

<table>
<thead>
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<th>Number</th>
<th>Title</th>
<th>Is./ Rev.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS2</td>
<td>ATC (AWS) Non-Return Valve</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AWS3</td>
<td>ATC (AWS) Receiver Plugs &amp; Sockets, Receiver Twin Plug Assembly</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AWS4</td>
<td>ATC (AWS) Receiver Junction Box</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AWS5</td>
<td>ATC (AWS) Bell Plug &amp; Socket</td>
<td>-</td>
<td>-</td>
</tr>
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<td>AWS6</td>
<td>ATC (AWS) Brake Valve</td>
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</tr>
<tr>
<td>AWS15</td>
<td>ATC (AWS) Vacuum Horn - Diesel &amp; Electric</td>
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<td>Nov 61</td>
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<tr>
<td>AWS16</td>
<td>ATC (AWS) Isolating &amp; Change End Switches</td>
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<td>Jun 76</td>
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<tr>
<td>AWS17</td>
<td>ATC (AWS) Electro-Pneumatic Valve</td>
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<td>AWS18</td>
<td>AWS Relay Unit And Pneumatic Valve</td>
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<td>AWS Reset Plunger</td>
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<td>Nov 78</td>
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<td>AWS20</td>
<td>AWS Train Control Indicator for Non-Steam Stock</td>
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<td>May 68</td>
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<tr>
<td>AWS25</td>
<td>AWS Electro-Pneumatic Valve Air</td>
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<td>Dec 67</td>
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<tr>
<td>AWS29</td>
<td>AWS EP Repeat &amp; Horn Relay Unit &amp; Base</td>
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<td>Jul 74/Sep 76</td>
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<tr>
<td>AWS31</td>
<td>AWS Electric Horn</td>
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<td>Oct 75/Dec 78</td>
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<tr>
<td>AWS32</td>
<td>AWS Brake &amp; Horn Relay Unit Base</td>
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<td>AWS35</td>
<td>AWS Relays</td>
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<td>Aug 79/Jul 80/ Aug 80</td>
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<tr>
<td>AWS36</td>
<td>AWS Static Voltage Converter</td>
<td>-</td>
<td>Jan 80/Nov 83</td>
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<tr>
<td>BR1943</td>
<td>Decoder for BR AWS</td>
<td>-</td>
<td>Oct 87</td>
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<tr>
<td>BR1944</td>
<td>AWS Reed Receiver Module Components</td>
<td>-</td>
<td>Jan 89</td>
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</table>
### Requirements for the Automatic Warning System

**BR1945**  Test Specification for AWS Logic Control Unit  
**BR1946**  BR AWS Test Specification, Lightweight Twin Receiver  
            Class 373 & 92 Vehicles  
**BR1947**  BR AWS Test Specification for AWS LED Indicator for  
            Class 373 & 92 Vehicles

<table>
<thead>
<tr>
<th>VEHICLE SUB-SYSTEM ENGINEERING INSTRUCTIONS</th>
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<th>SYSTEM INSTRUCTIONS</th>
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<td>MT169</td>
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</table>
References

GC/EH0005  Track Maintenance Handbook
GK/EH H205  Maintenance Repair and Overhaul of Trainborne S&T Equipment
GK/RT0002  Glossary of Signalling Terms
GK/RT0016  Automatic Warning System
GK/RT0104  Policy for Approval of Signalling Equipment
GK/RT0106  Safety Management of Signalling Failures
GK/RT0170  Asset Management for the Safety of Signalling and Operational Telecommunication Systems and Equipment
GM/RT2149  Kinematic Gauging Requirements for Railway Vehicles
GM/RT2161  Requirements for Driving Cabs of Railway Vehicles
GM/RT2185  Train Safety Systems
GO/RT3270  Route Acceptance of Rail Vehicles