Magnetic Track Brakes

Synopsis
This document sets out requirements for driver-actuated magnetic track brakes fitted to rail vehicles used on the GB mainline railway.
Magnetic Track Brakes

Issue Record

<table>
<thead>
<tr>
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This document will be updated when necessary by distribution of a complete replacement.

Supply

The authoritative version of this document is available at www.rssb.co.uk/railway-group-standards. Enquiries on this document can be submitted through the RSSB Customer Self-Service Portal https://customer-portal.rssb.co.uk/
# Magnetic Track Brakes

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Part 1 Purpose and Introduction

1.1 Purpose

1.1.1 This document is a standard for the integration and compatibility management of Magnetic Track Brakes (MTBs) on rail vehicles for use on the Great Britain (GB) mainline railway.

Other Legislation and Standards

1.1.2 This document should be read in conjunction with the Locomotive and Passenger Rolling Stock Technical Specification for Interoperability (LOC & PAS TSI) 2014 (commission regulation (EU) 1302/2014), the Control Command and Signalling Technical Specification for Interoperability (CCS TSI) 2016 (commission regulation (EU) 2016/919) and BS EN 16207:2014, as there are requirements for MTBs within these documents that are not duplicated. This RIS sets out additional requirements for the installation and use of MTBs on the GB mainline railway. Railway Group Standards (RGSs) are referenced throughout the document where they are relevant to the installation and use of MTBs.

1.1.3 MTBs are described in the LOC & PAS TSI Clause 4.2.4.8 as one example of a braking system independent of wheel/rail adhesion condition as 'a means of providing additional braking performance when the requested performance is higher than the performance corresponding to the limit of the available wheel rail adhesion.'

1.1.4 Clause 4.2.4.8.2 of the LOC & PAS TSI sets out mandatory requirements for MTBs, specifically:

- (1) Requirements on magnetic brakes specified by the CCS subsystem are referenced in clause 4.2.3.3.1 of this TSI.
- (2) A magnetic track brake is allowed to be used as an emergency brake, as mentioned in the TSI INF, clause 4.2.6.2.2.
- (3) The geometrical characteristics of the end elements of the magnet in contact with the rail shall be as specified for one of the types described in the specification referenced in Appendix J-1, index 31.
- (4) Magnetic track brake shall not be used at speed higher than 280 km/h.

Note: Appendix J-1, index 31 is UIC document 541-06: Jan 1992, of which the relevant requirements are now incorporated within BS EN 16207:2014.

1.1.5 The CCS TSI and reference document ERA/ERTMS/033281 set out additional mandatory requirements which are applicable to MTBs, particularly relating to electromagnetic compatibility. The use of MTBs is an open point.

1.1.6 BS EN 16207:2014 sets out additional requirements relating to the design, construction and testing of MTBs.

Context of this Rail Industry Standard

1.1.7 This RIS sets out requirements and guidance for the use of MTBs on the GB mainline railway, to facilitate meeting compatibility requirements with GB signalling, infrastructure and operation, in cases when it is chosen to operate MTBs.
1.1.8 The content of this RIS is informed by the output of RSSB research report T1099 entitled ‘Enabling Magnetic Track Brakes on GB Mainline Rail’. A full copy of the T1099 report is available on the RSSB SPARK rail knowledge hub, which is accessible via the RSSB website.

1.1.9 This RIS considers and includes requirements and guidance around the foreseen scenario where the MTBs are activated by the driver. It does not include requirements for MTBs which are automatically activated, for example due to any train control system. This does not seek to preclude the installation of automatically triggered MTBs, if so chosen. However, in such a case there may be additional requirements beyond the scope of this document.

1.1.10 Any implementation of MTBs will be supported by a risk assessment, such as Common Safety Method for Risk Evaluation and Assessment (CSM RA), which assesses design and vehicle integration, infrastructure and signalling compatibility, operation and maintenance.

1.1.11 Guidance on applying the CSM RA is available in GEGN8646.

1.2 Scope

1.2.1 The scope of this RIS is the GB mainline railway as defined in the Railway (Interoperability) Regulations 2011 (as amended) (RIR 2011), and does not apply to metros, trams and other light railway systems.

1.2.2 The scope of this RIS is restricted to driver actuated MTBs, fitted primarily on mainline vehicles within the scope of RIR 2011.

1.2.3 This document sets out technical and operational requirements for the introduction and use of MTBs, covering the integration of MTBs in vehicles, management of compatibility between MTBs and infrastructure, and operation and maintenance of MTBs.

1.2.4 This document does not contain requirements or guidance relating to eddy current track brakes.

1.3 Application of this document

1.3.1 Compliance requirements and dates have not been specified since these will be the subject of internal procedures or contract conditions.

1.3.2 The Standards Manual and the Railway Group Standards (RGS) Code do not currently provide a formal process for deviating from a Rail Industry Standard (RIS). However, a member of RSSB, having adopted a RIS and wishing to deviate from its requirements, may request a Standards Committee to provide opinions and comments on their proposed alternative to the requirement in the RIS. Requests for opinions and comments should be submitted to RSSB by e-mail to proposals.deviation@rssb.co.uk. When formulating a request, consideration should be given to the advice set out in the ‘Guidance to applicants and members of Standards Committee on deviation applications’, available from RSSB’s website.
1.4 Health and safety responsibilities

1.4.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

1.5 Structure of this document

1.5.1 This document sets out a series of requirements that are sequentially numbered.

1.5.2 This document also sets out the rationale for the requirement. The rationale explains why the requirement is needed and its purpose. Rationale clauses are prefixed by the letter ‘G’.

1.5.3 Where relevant, guidance supporting the requirement is also set out in this document by a series of sequentially numbered clauses and is identified by the letter ‘G’.

1.6 Approval and Authorisation

1.6.1 The content of this document was approved by Rolling Stock Standards Committee on 08 December 2017.

1.6.2 This document was authorised by RSSB on 26 January 2018.
Part 2  Magnetic Track Brake Design and Vehicle Integration

2.1  MTB type

2.1.1 Only high suspension type MTBs, as defined in BS EN 16207:2014, shall be installed on GB mainline vehicles.

Rationale

G 2.1.2 High suspension type MTBs can accommodate the primary suspension movements and track geometry changes that can occur on the GB mainline network.

Guidance

G 2.1.3 The requirements of BS EN 16207:2014 only cover high suspension types of MTBs.

G 2.1.4 The installation of MTBs on existing vehicles can require compliance with RIR 2011 if the modification is deemed an upgrade or renewal as defined by RIR 2011.

G 2.1.5 RIR 2011 and the Railways and Other Guided Transport Systems (Safety) Regulations (as amended) 2006 (ROGS 2006) permit certain types of non-mainline vehicles and operations to be excluded from mainline requirements. Such vehicles are typically vehicles which predominantly operate over non-mainline infrastructure but also partly operate over parts of the mainline network. These can include trams, metros and light rail vehicles. Guidance on non-mainline vehicles can found in RSSB research report T1049 entitled ‘Operating non-mainline vehicles on mainline infrastructure - Guidance on the regulatory requirements’. This report can be found on the RSSB SPARK rail knowledge hub.

G 2.1.6 Low suspension type MTBs are only considered suitable for vehicles with smaller suspension movements, and are therefore normally used on non-mainline vehicles such as trams, metros and light rail vehicles. High / low suspension type MTBs could be used on vehicles, such as Tram Trains, that operate partly as metros or trams and partly as mainline vehicles.

G 2.1.7 For vehicles that predominantly operate on non-mainline infrastructure but also operate on the GB mainline network, a suitable and sufficient risk assessment (such as the CSM RA process) is required to be carried out to ensure appropriate controls are identified and implemented when operating on the mainline.

2.2  MTB activation

2.2.1 The MTBs shall be capable of being activated by both:

a) A non-latching switch (that is, one which automatically deactivates the MTB equipment on release of the switch) which it is possible to operate from the normal driving position.

b) A driver-initiated emergency brake command.

2.2.2 Use of either of the above activation methods shall deploy the MTBs.
Rationale

G 2.2.3 Activation of the MTBs via a non-latching switch enables the driver to respond appropriately to any scenario in which MTBs could provide a benefit in addition to the wheel-rail braking, and enables them to disengage the MTBs as appropriate, for example immediately before the train comes to rest to mitigate against high levels of jerk, or when the additional braking force is no longer required.

G 2.2.4 Activation of the MTBs by a driver-initiated emergency brake command ensures that the MTBs are utilised in an emergency scenario, including when the driver is not able to operate the non-latching switch.

Guidance

G 2.2.5 Further information about scenarios in which the use of MTBs could be beneficial is given in clause G 4.1.3.

G 2.2.6 Good practice is to consider human factors issues and ergonomics when determining the details of the driver’s MTB controls. GMRT2161 sets out further requirements for the positioning of driver controls.

G 2.2.7 Although the MTB is activated by a driver-initiated emergency brake command, the MTB does not have to be considered part of the emergency brake function. BS EN 16207:2014 sets out additional requirements in the event that the MTB is considered as a part of the emergency brake function.

2.3 Air supply

2.3.1 In cases where MTBs require a compressed air supply for operation, the vehicle brake air supply shall be sufficient for all combinations of brake and Wheel Slide Protection (WSP) applications, including the effect of MTB operation, without these suffering any degradation or deterioration of performance.

2.3.2 MTB operation shall not have any adverse impact on the performance of other vehicle or unit equipment which utilises the air supply.

Rationale

G 2.3.3 The installation of the MTB must not compromise the effective operation of the vehicle / unit.

Guidance

G 2.3.4 Since the installation of MTBs can increase the demand on the compressed air supply, it can require additional capacity of the air supply. The guidance in GMRT2045 on WSP activity can be adapted to assess whether additional capacity is required.

G 2.3.5 The installation of MTBs can require review of the operational restrictions when working vehicles with compressor defects in multiple.

G 2.3.6 As part of the risk assessment supporting the introduction of MTBs, failure situations that could affect the normal operation of the vehicle / unit will be considered, and, if necessary, procedures for making the train fit to travel developed.
2.4 Structural design

Guidance

G 2.4.1 BS EN 16207:2014 sets out structural requirements for MTBs. Additional structural requirements for vehicles for use on the GB mainline railway are set out in GMRT2100. GMRT2100 requires the effects of locally generated accelerations, forces and resonances to be considered, arising from, amongst other items, brake equipment, which includes MTBs.

G 2.4.2 Where the MTB is to be used to standstill or at speeds below those stated in BS EN 16207:2014, additional loads can be generated by the operation of the MTB. In such a case the limits set out in GMRT2100 might not be sufficient, and differing limits might need to be applied.

G 2.4.3 Where MTBs are retro-fitted to rolling stock originally manufactured without MTBs, the risk of MTB detachment will be considered, for example due to obstacles on the track. It might be necessary to install lifeguards and / or secondary restraints to retain the MTBs. Due to their location on the bogies, damaged or detached MTBs could present a risk of derailment.

G 2.4.4 RIS-2273-RST contains specific requirements for inspection and testing of brake systems following an incident or accident. Those requirements are to be applied to MTBs irrespective of whether or not the MTBs were activated during the incident in question.

2.5 Vehicle dynamic behaviour

2.5.1 When the dynamic behaviour of a vehicle equipped with MTBs is assessed, this shall be performed with the maximum possible downward force applied by the MTBs to the rail.

Rationale

G 2.5.2 The downward force applied to the rail by MTBs could have an effect on vehicle wheel unloading and resistance to derailment, for example in the case of failure of the electromagnet element of the MTBs.

Guidance

G 2.5.3 During operation, MTBs exert a downward force on the rail, resulting from the actuators lowering them down into contact with the rail head. When operating normally, the attractive force between the MTBs and the railhead would be expected to counteract this downward force.

G 2.5.4 Applicable requirements for assessing vehicle dynamic behaviour are set out in LOC & PAS TSI, BS EN 14363:2016 and GMRT2141.
2.6 Gauging

2.6.1 Any MTB installation shall be designed to contact only the railhead of the running rail when deployed, and no other part of the infrastructure.

Rationale

G 2.6.2 MTBs contacting other parts of the infrastructure would risk damaging the infrastructure and / or the MTBs.

Guidance

G 2.6.3 Current GB gauging standards do not specifically refer to MTBs.
G 2.6.4 GERT8073 includes requirements concerning the location of wheels, and explains that other items in close proximity to the wheels may use the space. This can be taken to include deployed MTBs.
G 2.6.5 GERT8073 sets out lower sector vehicle gauges which also apply to MTBs, including to the pole shoes when in the raised position.
G 2.6.6 Further requirements are identified in GMRT2173.

2.7 Interfaces to energy subsystems

Guidance

G 2.7.1 GMRT2111 and GMRT2113 set out requirements for vehicles operating over certain types of electrified lines on the GB mainline railway.
G 2.7.2 MTBs do not directly interface with the energy subsystem.
G 2.7.3 Because MTBs, when deployed, contact the running rails, their use in electrified areas can result in their being subjected to either energy subsystem fault currents or traction system return currents flowing in the running rails. Consequently, if incorrectly designed, the MTB installation could form an unintended current path and suffer damage.
G 2.7.4 Details of the energy subsystem fault current levels and traction system return current levels can be found in GLRT1210 and GLRT1212. Where it is intended to operate over other types of energy subsystem, details can be sought from the relevant infrastructure manager (IM).

2.8 Train deceleration

Guidance

G 2.8.1 Track compliant with the INF TSI, and other modern track types built in accordance with GCRT5021, are designed to have a longitudinal resistance compatible with a vehicle deceleration rate of 2.5 m/s².
G 2.8.2 The LOC & PAS TSI requires that the maximum average deceleration generated by all installed braking systems shall be lower than 2.5 m/s². These requirements are
applicable to new vehicles and to upgrades or renewals that affect braking performance.

G 2.8.3 This requirement helps manage the compatibility of rail vehicles with the longitudinal resistance of track compliant with the INF TSI and other modern track types built in accordance with GCRT5021.

G 2.8.4 Requirements concerning other track types, which might not be able to withstand train deceleration rates of up to 2.5 m/s², are set out in 3.1.

2.9 Recording of activation

2.9.1 The activation of MTBs shall be automatically recorded.

Rationale

G 2.9.2 Recording the use of MTBs enables their use to be monitored, so that it can be verified that MTBs are only used infrequently, and so that any locations at which concentrations of applications occur can be identified.

Guidance

G 2.9.3 Restricting the use of MTBs to infrequent activation and ensuring their activation is not concentrated at specific locations is necessary to manage their continued compatibility with the infrastructure of the GB mainline network.

G 2.9.4 The on-train data recorder (OTDR) or another data recorder is a possible way of achieving this requirement.

G 2.9.5 In case the recording device becomes temporarily unavailable, any operational restrictions will be set out in the relevant instructions. Further guidance is given in RIS-3437-TOM.
Part 3 Infrastructure and Signalling Equipment Compatibility

3.1 Track compatibility

Guidance

G 3.1.1 Some sections of track may not be capable of withstanding the longitudinal rail forces generated by increased train deceleration rates arising from MTB operation (which may be up to 2.5 m/s²); therefore, these sections need to be identified during the route compatibility assessment process, such that appropriate operating rules can be developed. This supports the requirement in the OPE TSI for the IM to provide to the railway undertaking (RU) information about the acceptable braking effort across a route for any brake system that does not use wheel/rail adhesion.

G 3.1.2 Compatibility of MTBs with infrastructure was assessed in RSSB research report T1099.

G 3.1.3 The majority of track was considered compatible with the use of MTBs, provided the total train deceleration rate did not exceed 2.5 m/s², being the performance level required of track built in accordance with the INF TSI or GCRT5021.

G 3.1.4 Types of track that might not be compliant for the purposes of MTB compatibility include:

a) Sections of track with a Temporary Speed Restriction (TSR) or Emergency Speed Restriction (ESR).

b) Sections of track with condition-based speed restrictions.

c) Jointed track, bull-head rails fastened with keys, flat bottom rail with spike fastenings, where the condition may not comply with the requirements set out in GCRT5021.

d) Sections of track with a risk of thermally induced track buckling.

G 3.1.5 Types of switches and crossings that might not be compliant for the purposes of MTB compatibility include:

a) Non-chamfered switches, or switches without a locking mechanism capable of resisting the potential upwards force generated by an activated MTB.

b) Crossings flatter than 1:30.

G 3.1.6 The presence of non-compliant track would not be expected to be a barrier to the operation of vehicles equipped with MTBs, or to the use of MTBs in emergency scenarios. Further guidance is given in 4.3.

G 3.1.7 GERT8270 sets out requirements for assessing route compatibility.

3.2 Signalling compatibility

Guidance

G 3.2.1 Some signalling assets may not be compatible with vehicles fitted with MTBs or with the use of MTBs; therefore, these assets need to be identified during the route compatibility assessment process, such that appropriate operating rules can be developed.
G 3.2.2 Compatibility of MTBs with signalling equipment was assessed in RSSB research report T1099.

G 3.2.3 For the majority of signalling assets the output of the assessment in T1099 was that no credible interference mechanism could be foreseen because of MTB operation. These assets are set out in Appendix A.

G 3.2.4 For a limited number of types of signalling asset, the risk of incompatibility with MTBs or MTB operation was assessed in T1099 to be medium (meaning further understanding is needed to assess whether there could be a credible mechanism of interference) or high (meaning a credible mechanism of interference can be foreseen). These assets are set out in Appendix B.

G 3.2.5 GERT8270 sets out requirements for assessing route compatibility.

### 3.3 Energy asset compatibility

**Guidance**

G 3.3.1 Compatibility of MTBs with energy supply equipment was assessed as an addendum to RSSB research report T1099.

G 3.3.2 For the majority of energy assets the output of the assessment was that no credible interference mechanism could be foreseen whereby the MTB could interfere with the correct operation of the energy asset. These assets are set out in Appendix C.

G 3.3.3 For a limited number of types of energy asset, the risk of incompatibility with MTBs or MTB operation was assessed to be medium (meaning further understanding is needed to assess whether there could be a credible mechanism of interference) or high (meaning a credible mechanism of interference can be foreseen). These assets are set out in Appendix D.
Part 4  Operation

4.1  Driving instructions

4.1.1  The RU shall define operating instructions for MTBs that set out scenarios for their use.

Rationale

G 4.1.2  To maintain compatibility with GB mainline infrastructure, it is necessary to ensure MTBs are only deployed infrequently. This can be achieved by limiting their use to specific scenarios.

Guidance

G 4.1.3  Examples of scenarios in which appropriate usage of MTBs could provide a benefit include:

a)  Braking to prevent or reduce the impact of a collision with another vehicle or an obstruction on the track.

b)  Under low wheel-rail adhesion conditions when the braking performance of the vehicle is reduced.

c)  To help prevent overspeeding on steep gradients.

G 4.1.4  Activation of MTBs can generate high rates of change of acceleration (jerk) of the vehicle, which can pose a risk to passengers inside the rail vehicle. Generally, the jerk rates are higher at lower speeds. Guidance on jerk limits can be found in GMRT2045.

G 4.1.5  Balancing the risks of injuries arising from high jerk rates with the risks that can be controlled by application of the MTBs will inform the operating rules around the usage of MTBs.

G 4.1.6  Factors that may need to be considered can include service deceleration requirements, seating / grab-pole arrangements, passenger usage profiles, the presence of other objects in the vehicle (for example service trolleys, luggage), operational speeds, MTB material properties, the number of MTBs installed or active on the train.

G 4.1.7  The limitations in BS EN 16207:2014 on low speed operation do not apply in cases where the application of the MTBs is manually controlled by the driver, provided the resulting additional loads are considered in the vehicle design. RUs may however choose to incorporate a low-speed cut off to help avoid excessively high rates of deceleration which could otherwise occur just before the train comes to a standstill.

G 4.1.8  It is permissible to operate MTBs together with sanding equipment.

G 4.1.9  It is also permissible to operate MTBs on rails that are treated with friction modifiers (eg Sandite).
4.2 Driver training

Guidance

G 4.2.1 MTBs are a novel system on the GB mainline network; therefore drivers may not be familiar with their function and operation.

G 4.2.2 Driver training, which includes exposure to the jerk rates generated by MTB operation, can help drivers to appreciate when application of MTBs will be appropriate.

G 4.2.3 MTBs offer an improvement in braking performance compared with that achieved by typical wheel-rail braking, particularly in low rail-head adhesion conditions. However, as the braking force of MTBs is generated by friction between the MTB pole shoes and the rail-head, their braking performance in low rail-head adhesion conditions can be lower than that achieved by MTBs in normal conditions.

4.3 Management of use

4.3.1 Operating rules (for example, the Sectional Appendix) shall be developed by the RU and IM for management of the usage of MTBs on sections of track that may not be capable, on either a permanent or a temporary basis, of withstanding the longitudinal rail forces generated by train deceleration rates of up to 2.5 m/s².

4.3.2 Operating rules shall be developed by the RU and IM for management of the usage of MTBs where signalling assets which may not be compatible with MTBs are installed.

Rationale

G 4.3.3 The development of appropriate operating instructions / restrictions / procedures is necessary to manage the consequences of operation of MTBs on sections of track which may not be fully compatible with their use.

Guidance

G 4.3.4 Appropriate operating instructions / restrictions / procedures will be informed by the output of the compatibility assessment.

G 4.3.5 Any operating rules will consider the potential safety benefit from the operation of MTBs against the potential impact on the infrastructure.

G 4.3.6 The procedures put in place may require the use of MTBs to be reported to the IM if activated in specific sections of track on which their use might not be compatible, as a result of which follow-up actions may be required, such as inspection of the track.

G 4.3.7 Lineside signage may be an appropriate method of identifying specific sections of track on which MTB usage might not be compatible.

G 4.3.8 Sections of track with a TSR or ESR may be classified as sections of track on which MTB usage might not be compatible.
Part 5 Maintenance

5.1 MTB maintenance

Guidance
G 5.1.1 When retrofitting MTBs to any existing vehicle, a revision to the existing maintenance plan is necessary to take account of the change to the vehicle and incorporate MTB maintenance requirements.

G 5.1.2 Maintenance requirements could include:
   a) Check and set-up of height above rail-head.
   b) Check of MTB and MTB component security.
   c) Check of wear on contact surfaces, and replacement of worn pole shoes.
   d) Check for and removal of weld-ons.
   e) Check of electrical and pneumatic connections.
   f) Verification of MTB operation.

G 5.1.3 Checks and maintenance to any device used for recording the operation of MTBs may also be required if the device does not already have an appropriate maintenance plan, or has been installed for this purpose.

5.2 Effects of Electro Magnetic Fields (EMF) on maintenance staff

Guidance
G 5.2.1 The Control of Electromagnetic Fields at Work Regulations 2016, requires employers to undertake risk assessments and limit exposure of staff to electric and magnetic fields. Under these regulations, employers will have to assess if it is safe for Persons at particular risk, including staff wearing pacemakers or other medical devices, to safely work in the proximity of, or undertake maintenance work on, MTBs.

G 5.2.2 The magnetic field generated by MTBs poses a potential risk to maintenance staff working in close proximity to, or undertaking testing of, MTBs. Depot procedures can be used to manage this risk and ensure that any exposure to the magnetic field remains within safe limits. This could be managed through appropriate signage, exclusion zones and training.

G 5.2.3 GLGN1620 provides guidance on the application of the Control of Electromagnetic Fields at Work Regulations 2016 to the GB rail industry.
Appendices

Appendix A  List of signalling assets assessed by T1099 to have no credible mechanism for interference from MTBs

A.1  Track circuits
A.1.1  Track circuits of the following types:
• DC Low Voltage AC IMMUNE
• DC Low Voltage PLAIN
• DC Diode (Rectified AC)
• DC Medium Voltage AC IMMUNE
• DC Medium Voltage PLAIN
• DC MV AC IMM DC TOL
• AC 50 HZ Vane
• AC WR QUICK RELEASE
• Aster 1 WATT
• Aster SF15 / U Type
• TI21
• TI21 Low
• EbiTrack 200
• EbiTrack 400
• FREQ DERIVED FS2500
• FREQ DERIVED FS2600
• Reed - Jointed
• High Voltage Impulse (HVI) GEC ALSTOM
• Rail Circuits

A.2  Automatic Warning System (AWS) equipment
A.2.1  AWS Equipment of the following types:
• AWS Type Yellow Electro Mk1 (Parallel and Series)
• AWS Type Yellow Electro Mk2 (Parallel and Series)
• AWS Type Green Electro Mk1 (Parallel and Series)
• AWS Type Green Electro Mk2
• AWS Type Yellow Supp (casting extends below sleeper level)
• AWS Type Yellow Supp (casting does not extend below sleeper level)
• AWS Type Green Supp Mk2
• AWS Type Vortok Yellow YE
• AWS Type Vortok Yellow YS
• AWS Type Vortok Green

A.3  Filament lamp signals
A.3.1  Filament lamp signals of the following types:
Magnetic Track Brakes

- Conventional SL35 (Heads and Position Light Junction Indicators (PLJI) all areas except SIMIS-W interlockings)
- Conventional SL35 (Heads and PLJIs SIMIS-W interlockings only)
- Conventional SL35 (Miniature Stop Light (MSL)/ Miniature Warning Light (MWL) light units)
- 8000 hour SL35 (main filament interlockings)
- 8000 hour SL35 (where BR 942 spec relays are used as a UECR on PLJIs)
- Other 12 V Lamps (all except electric lit semaphores)
- Other 12 V lamps (electric lit semaphores only)
- 4 V lamps (electric lit semaphores)
- 4.5 V lamps (electric lit semaphores)
- 6 V lamps (electric lit semaphores)
- 110 V (all signals and indicators fed direct from busbar)
- 110 V (all signals and indicators not fed direct from busbar)

A.4 Quartz halogen signals

A.4.1 Quartz halogen signals of the following types:
- SD321 Colour light (Manchester South)
- 10 V 50 W (SIMIS)
- 12 V Quartz halogen lamps (except fibre optic heads)
- 12 V Quartz halogen lamps (fibre optic main heads)
- 10 V Quartz halogen lamps (all applications)

A.5 Light Emitting Diode (LED) signals

A.5.1 LED signals of the following types:
- Light Engine Mk 1
- Light Engine Mk 2
- Input to Signal Lamp Module (SLM)

A.6 Other signalling assets

A.6.1 Other signalling assets of the following types:
- Overspeed [Sensor] System (OSS) Nominal (Yellow)
- OSS Opposite (Blue)
- Train Stop System (TSS) Nominal (Green)
- TSS Opposite (Brown)
- OSS+
- Tilt Authorisation and Speed Supervision (TASS) Balise
- Eurobalise - Ansaldo (Cambrian)
- Signalling cables
- Reed Frequency Division Multiplex (FDM)
- Relays
- Clamplock body
- Reed Point Detection
- Track Circuit Assistor Interference Detector (TCAID)
- SILEC Treadles
- Wheel Impact Load Detector
- Selective door opening
Appendix B  List of signalling assets assessed by T1099 to be at medium or high risk of suffering compatibility issues arising from MTB operations

B.1  Track circuits

B.1.1 Track circuits of the following types:
- DC Coded
- TRACK CCT-REED JOINTLESS
- JEUMONT/LUCAS Impulse
- WESTRAK/RELAYENDFED

B.2  Axle counters

B.2.1 Axle Counters of the following types:
- Frauscher RSR123 Axle Counter Head
- Siemens AzS ZP D 43 Wheel Detection Equipment (use DEK43 Head)
- Siemens AzS ZP V 43 Wheel Detection Equipment (use DEK43 Head)
- Siemens AzS ZP AzSME DEK43 Head
- Siemens ACM100 WSD Wheel Detector
- Thales AzL70 (SK11 Head)
- Thales AzL70-30 (Sk30 Head)
- Thales AzL90M (Sk30 Head)
- Thales AzLM (Sk30H Head)
- Thales AzLM (Sk30K Head)

B.3  Other signalling assets

B.3.1 Other signalling assets of the following types:
- High Performance Switch System (HPSS) Linear Variable Differential Transformer (LVDT)
- Automatic Train Protection (ATP) Loops
- Hot Axle-Box Detector (HABD)

Note: Types of signalling assets first introduced to the network later than the date of completion of the T1099 signalling workshop (June 2016) will also need to be considered as part of this Appendix.
Appendix C  List of energy assets assessed to have no credible mechanism for interference from MTBs

C.1  AC energy assets

C.1.1 AC Energy assets of the following types:

- Extra strength (green) Automatic Power Control (APC) magnet: 19 mm ± 6 mm above rail level
- Standard strength (yellow) APC magnet: 45 mm ± 6 mm above rail level
- Super strength (white) APC magnet: 20 mm to 50 mm below running rail level
- Cross track power cables (within under track crossings)
- Parallel or adjacent power cables (AC)
- Bonding cables for traction AC (structure to rail, track to track cross-bonds, return current cables)
- Cables for power supply and Supervisory Control and Data Acquisition (SCADA) for motorised switches
- Low Voltage (LV) / data cabling for control / monitoring of electrification trackside assets that cross tracks at ballast level
- Pilot wires for protection
- Motorised switches
- SCADA for motorised switches
- Soulé devices

C.2  DC energy assets

C.2.1 DC Energy assets of the following types:

- Conductor rail (steel or aluminium)
- Conductor rail cable connections
- Conductor rail guard boarding
- Conductor rail DC Electric Track Equipment (ETE) switches
- Conductor rail heating equipment
- Traction conductor rail jumpers
- Cross track power cables
- Parallel or adjacent power cables (DC)
- Bonding cables for traction DC (for example, track to track cross-bonds, return current cables etc)
- Power supply, and SCADA for motorised ETE switches
- LV / data cabling for control / monitoring of electrification trackside assets that cross tracks at ballast level
- Pilot wires for protection
- Motorised ETE switches
- SCADA for motorised ETE switches
- Soulé devices
Appendix D  List of energy assets assessed to be at medium or high risk of suffering compatibility issues arising from MTB operations

D.1  AC energy assets

D.1.1  AC Energy assets of the following types:

- APC sensor, if APC receiver is on the same bogie as MTBs
- Impedance bonds
- Running-rail fishplate bonding

D.2  DC energy assets

D.2.1  DC Energy assets of the following types:

- Track Current Relays (TCR)
- Impedance bonds
- Running-rail fishplate bonding
### Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Alternating Current.</td>
</tr>
<tr>
<td>Average Deceleration</td>
<td>The mean value of deceleration with respect to the stopping or slowing distance in a specific speed range. (As defined as &quot;mean deceleration&quot; in FprEN 14478:2017)</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current.</td>
</tr>
<tr>
<td>Eddy Current Brake</td>
<td>Brake in which the brake force is generated by 'Eddy current' generation in the reaction part. (As defined in FprEN 14478:2017)</td>
</tr>
<tr>
<td>Emergency Brake (EB)</td>
<td>An application of a predefined brake force in a predefined maximum response time in order to stop the train with a defined level of brake performance.</td>
</tr>
<tr>
<td>High / Low Suspension Type MTB</td>
<td>Variation of MTB where the magnets are held in a rest position like the high suspension type MTB, and can then be displaced to a lowered position by an energy source. When in the lowered position they function as for the low suspension type MTB.</td>
</tr>
<tr>
<td>High Suspension Type MTB</td>
<td>Variation of MTB where the magnets are held in a rest position, and, when activated, an energy source is used to lower the magnets in to contact with the rails.</td>
</tr>
<tr>
<td>Jerk</td>
<td>First derivative of deceleration with respect to time. (As defined in FprEN 14478:2017)</td>
</tr>
<tr>
<td>Low Suspension Type MTB</td>
<td>Variation of MTB where the magnets are suspended immediately above the rail surface, and, when activated, the magnets become energized and attracted to the rail.</td>
</tr>
<tr>
<td>Magnetic Track Brake (MTB)</td>
<td>Brake in which the brake force is generated by the friction between rail surface and pole shoe(s), forced magnetically into contact with it. The force may be provided by an electromagnet or a permanent magnet. (As defined in FprEN 14478:2017)</td>
</tr>
<tr>
<td>Maximum Average Train Deceleration</td>
<td>The greatest value of average deceleration achievable by a consist of vehicles, measured between any two speeds within its operational speed range.</td>
</tr>
<tr>
<td>On Train Data and Recorder (OTDR)</td>
<td>Equipment provided on a train to record data about the operation of its controls and performance in response to those controls. A TDR may also be referred to as an On Train Monitor Recorder (OTMR), Data Logger or Event Recorder.</td>
</tr>
<tr>
<td>Pole Shoes</td>
<td>Friction elements of the MTB that produce the braking force.</td>
</tr>
<tr>
<td>Sicheres</td>
<td>A signalling interlocking system supplied by Siemens.</td>
</tr>
<tr>
<td>Société Industrielle de Liaisons Électriques (SILEC)</td>
<td>A French manufacturer of electro-mechanical treadles.</td>
</tr>
</tbody>
</table>
### Magnetic Track Brakes

<table>
<thead>
<tr>
<th><strong>Spike Fastenings</strong></th>
<th>Early flat bottom rail fastening systems employing spikes driven into wooden sleepers to secure the rail and/or baseplate.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weld-ons</strong></td>
<td>Accumulation of metallic wear debris that attaches to the underside of the MTB pole shoes, resulting in a reduction in braking performance of the MTB.</td>
</tr>
<tr>
<td><strong>Wheel Slide Protection (WSP)</strong></td>
<td>A system designed to make the best use of available adhesion between wheels and rail by a controlled reduction of the brake force.</td>
</tr>
</tbody>
</table>
References

The Catalogue of Railway Group Standards gives the current issue number and status of
documents published by RSSB. This information is also available from [http://www.rssb.co.uk/railway-group-standards.co.uk](http://www.rssb.co.uk/railway-group-standards.co.uk).

RGSC 01 Railway Group Standards Code
RGSC 02 Standards Manual

Documents referenced in the text

Railway Group Standards

- GCRT5021 Track System Requirements
- GERT8073 Requirements for the Application of Standard Vehicle Gauges
- GERT8270 Assessment of Route Compatibility of Vehicles and Infrastructure
- GLRT1210 AC Energy Subsystem and Interfaces to Rolling Stock Subsystem
- GLRT1212 DC Conductor Rail Energy Subsystem and Interfaces to Rolling Stock Subsystem
- GMRT2045 Compatibility Requirements for Braking Systems of Rail Vehicles
- GMRT2100 Requirements for Rail Vehicle Structures
- GMRT2111 Rolling Stock Subsystem and Interface to AC Energy Subsystem
- GMRT2113 Rolling Stock Subsystem and Interfaces to DC Conductor Rail Energy Subsystem
- GMRT2141 Resistance of Railway Vehicles to Derailment and Roll-Over
- GMRT2161 Requirements for Driving Cabs of Railway Vehicles
- GMRT2173 Requirements for the Size of Vehicles and Position of Equipment

RSSB Documents

- GEGN8646 Guidance on the Common Safety Method for Risk Evaluation and Assessment
- GLGN1620 Guidance on the Application of the Control of Electromagnetic Fields at Work Regulations
- RIS-2273-RST Post Incident and Post Accident Testing of Rail Vehicles
- RIS-3437-TOM Defective On-Train Equipment

Other References

- BS EN 14363:2016 Railway applications. Testing and Simulation for the acceptance of running characteristics of railway vehicles. Running Behaviour and stationary tests
### Magnetic Track Brakes

<table>
<thead>
<tr>
<th>Document Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCS TSI</td>
<td>Commission Regulation (EU) 2016/919 on the technical specification for interoperability relating to the ‘control-command and signalling’ subsystems of the rail system in the European Union</td>
</tr>
<tr>
<td>Control of Electromagnetic Fields at Work Regulations 2016</td>
<td>SI 2016 No. 588</td>
</tr>
<tr>
<td>ERA/ERTMS/033281</td>
<td>Interfaces between control-command and signalling trackside and other sub-systems</td>
</tr>
<tr>
<td>Railways and Other Guided Transport Systems (Safety) Regulations (as amended) 2006</td>
<td>SI 2006 No. 599 - transposition of the European Railway Safety Directive into UK law</td>
</tr>
<tr>
<td>T1049</td>
<td>Operating non-mainline vehicles on mainline infrastructure - Guidance on the regulatory requirements, RSSB research report (December 2014)</td>
</tr>
<tr>
<td>T1099</td>
<td>Enabling Magnetic Track Brakes on GB Mainline Rail, RSSB research report (September 2016)</td>
</tr>
</tbody>
</table>

#### Other relevant documents

- BS EN 14478:2017: Railway applications - Braking - Generic Vocabulary