**Rail Industry Standard**
**RIS-0799-CCS**
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# ERTMS/ETCS Baseline 3 Onboard Subsystem Requirements

## Synopsis

This document sets out the industry agreed requirements and guidance for the Great Britain (GB) application of the ERTMS/ETCS Baseline 3 onboard subsystem to existing (retrofit) vehicles that operate on the GB mainline railway, and new build rail vehicles that will operate on the GB mainline railway.

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### Issue record

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### Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

| Superseded documents | Sections superseded | Date when sections are superseded |
|---|---|---|
| RIS-0797-CCS issue one | All | 03/06/2023 [proposed] |
| RIS-0798-CCS issue one | All | 03/06/2023 [proposed] |

### Supply

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# Contents

# Part 1 Purpose and Introduction

## 1.1 Purpose

1.1.1 This document sets out the industry agreed requirements for:

a) The retrofitment of a European Rail Traffic Management System/European Train Control System (ERTMS/ ETCS) Baseline 3 onboard subsystem to existing rail vehicles that operate on the GB mainline railway; and
b) The fitment of an ERTMS/ETCS Baseline 3 onboard subsystem to new rail vehicles that will operate on the GB mainline railway.

1.1.2 This document is part of a wider suite of requirements that are intended to optimise the performance and operation of an ERTMS/ETCS railway. It is complementary to the European Union Agency for Railways (ERA) specifications for ETCS Baseline 3 Release 2, which are set out in the Control, Command and Signalling National Technical Specification Notice (CCS NTSN).

1.1.3 The requirements in this document are aligned with the GB Digital Rail generic requirements suite that is intended to optimise the performance and operation of a GB ERTMS/ETCS railway. Its adoption supports the safe integration of the ETCS onboard subsystem with the ETCS trackside subsystem and operational rules for the GB mainline railway. The GB Digital Rail generic requirements suite is published on the Network Rail System Requirements and Integration (SR&I) webpage. The link to the SR&I webpage can be found on the standards landing page for this RIS on the RSSB's website (www.rssb.co.uk).

1.1.4 This document can be adopted by rolling stock owners (ROSCOs), suppliers and railway undertakings under their respective safety/quality management system or when specifying products and services.

1.1.5 An agreement to implement an ETCS onboard subsystem that does not fully conform to the requirements in RIS-0799-CCS, including generic approved products not developed in accordance with RIS-0799-CCS, would be informed by a risk assessment that has been consulted with relevant stakeholders and considers operational compatibility and ETCS onboard subsystem related hazards that arise in the operational context where the system will be put into use.

### Scope

1.1.6 The requirements in this document describe the ETCS-related functionality and the application and integration of the ETCS onboard subsystem optimised for application on the GB mainline railway at all required levels of operation.

1.1.7 Rail vehicle type specific requirements and domain knowledge for particular rolling stock fleets are not included. Those requirements are expected to be defined by the contracting entity or their appointed agent.

### How these requirements are intended to be used

1.1.8 The requirements can be used in the specification of:

a) An ERTMS/ETCS onboard subsystem that will be retrofitted to an existing rail vehicle; and
b) New rail vehicles that incorporate an ERTMS/ETCS onboard subsystem.

1.1.9 The requirements in this document apply to both retrofit and new train implementations unless otherwise stated in the requirement text.

1.1.10 Each requirement is assigned to one of the following categories, which is intended to help users identify which requirements to specify in contracts:

a) **Normative**: Conformity with the normative requirements supports technical compatibility of the ETCS onboard subsystem with the ETCS trackside subsystem and optimisation in relation to the GB mainline railway, or supports a subsystem feature that is deemed to be cost effective and in the long-term interests of the railway industry. Satisfaction of normative requirements is expected to be a requirement of individual delivery contracts.
b) **Application specific**: Conformity with application specific requirements might not be relevant or applicable to every implementation of an ETCS onboard subsystem to every rail vehicle. Conformity is expected where an application-specific requirement is applicable. Conformity with application-specific requirements is expected to be a condition of individual delivery contracts, if it is appropriate to the implementation being considered.
c) **Preferred**: A requirement of lower importance which, whilst not essential, the industry would prefer were satisfied. Conformity with preferred requirements is expected to be a requirement of individual delivery contracts if they are considered within individual delivery scope.

**Why conformity is necessary or desirable**

1.1.11 Every requirement has a supporting rationale, which describes why conformity is necessary for a normative or application specific requirement or desirable for a preferred requirement.

a) Technical compatibility; necessary or desirable to support technical compatibility with the GB mainline railway network or the route(s) on which the rail vehicle(s) will be operated. Further requirements for route technical compatibility assessment are set out in RIS-8270-RST.
b) Integration with train operations, the rail vehicle or another CCS system; so that the rail vehicle is capable of being operated as part of a train on the GB mainline railway, including the interfaces with the train driving task.
c) Performance; necessary or desirable to support the overall performance of the railway system in the operational context.
d) Safe integration; necessary or desirable to control one or more of the hazards listed in *Appendix A*.
e) Economic; necessary or desirable to realise cost efficiencies.
f) Reliability; necessary or desirable to meet reliability targets.
g) Availability; necessary or desirable to meet availability targets.
h) Asset management; necessary or desirable to support rail vehicle asset management processes, including maintenance, repair and faulting tasks.

i) Efficiency; necessary or desirable to reduce waste and support future rail vehicle or CCS subsystem enhancements.
j) Train driver learning; necessary or desirable to support migration to an ERTMS/ETCS railway.

## 1.2 Application of this document

1.2.1 Compliance requirements and dates have not been specified because these are the subject of internal procedures or contract conditions.

1.2.2 If you plan to do something that does not comply with a requirement in this RIS, you can ask a Standards Committee to comment on your proposed alternative. If you want a Standards Committee to do this, please submit your deviation application form to RSSB. You can find advice and guidance on using alternative requirements on RSSB's website www.rssb.co.uk.

## 1.3 Health and safety responsibilities

1.3.1 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.

## 1.4 Structure of this document

1.4.1 This document sets out a series of requirements that are sequentially numbered. This document also sets out the rationale for the requirement, explaining why the requirement is needed and its purpose and, where relevant, guidance to support the requirement. The rationale and the guidance are prefixed by the letter 'G'.

1.4.2 Some subjects do not have specific requirements but the subject is addressed through guidance only and, where this is the case, it is distinguished under a heading of 'Guidance' and is prefixed by the letter 'G'.

## 1.5 Approval and authorisation of this document

1.5.1 The content of this document will be approved by CCS Standards Committee on 6 April 2023 [proposed].

1.5.2 This document will be authorised by RSSB on 28 April 2023 [proposed].

# Part 2 ETCS Onboard Subsystem Requirements

## 2.1 Subsystem level requirements

### 2.1.1 ETCS onboard subsystem: Technical compatibility with ETCS trackside subsystems

2.1.1.1 The ETCS onboard subsystem shall be compliant with the mandatory specifications for ETCS Baseline 3 Release 2, including all agreed solutions to error change requests compatible with Baseline 3 Release 2. (Normative)

**Rationale**

G 2.1.1.2 Network technical compatibility: The ETCS comprises the trackside subsystem and onboard subsystems, which have to be compatible in order for the system to operate correctly.

G 2.1.1.3 Network technical compatibility: An ETCS onboard subsystem that includes all solutions to error corrections compatible with Baseline 3 Release 2 will be technically compatible with the trackside subsystem while avoiding hazards associated with known errors in the specifications.

G 2.1.1.4 Integration with train operations: An ETCS onboard subsystem that is incompatible with the ETCS trackside subsystem might not be capable of being integrated into the GB mainline railway.

**Guidance**

G 2.1.1.5 It is planned to fit the GB mainline railway with the ETCS trackside subsystem against Baseline 3 Release 2 of the ETCS specifications. ETCS trackside requirements have been included in the GB Digital Rail generic requirements suite to cater for the current position where ETCS onboard subsystems do not implement all of the error corrections. This is an interim state and implementation of the onboard error corrections will remove this constraint on the trackside application.

G 2.1.1.6 Compliance with the mandatory specifications includes compliance with those Subset 026 clauses identified in Subset 026 section 9 that 'must be fulfilled by a SRS compliant ERTMS/ETCS onboard'. Although partial fulfullment is permitted by the CCS NTSN, it can lead to technical or operational compatibility issues arising between vehicles and the trackside when the vehicle extends its area of use. Future upgrades to address compatibility issues is likely to be costly to industry and are to be avoided.

G 2.1.1.7 The Baseline 3 Release 2 specifications are listed in the CCS NTSN, Annex A, Table A 2.3.

G 2.1.1.8 The ERA technical opinion OPI 2020-2 provides details of error change requests and their solutions, and is available on the ERA website. In future, error corrections are not expected to be published in technical opinions, instead the 2023 CCS TSI will be proposing a new methodology for publishing error correction solutions.

### 2.1.2 ETCS onboard subsystem: Impact on rail vehicle route availability

2.1.2.1 Retrofitting a rail vehicle with an ETCS onboard subsystem shall maintain the existing route availability of the rail vehicle to which it is fitted. (Normative)

**Rationale**

G 2.1.2.2 Route technical compatibility: A rail vehicle that is fitted with an ETCS onboard subsystem should be able to operate on all routes and lines over which it was able to operate prior to ETCS fitment.

**Guidance**

G 2.1.2.3 The route availability of a rail vehicle, determined according to the processes defined in GERT8006, is used for the determination of the compatibility of rail vehicles with underline bridges on a route. It is the comparison between the route availability number of a rail vehicle with the route availability number of an underline bridge at the permissible speed of the vehicle, that determines the outcome of a route level assessment of technical compatibility for the vehicle, and may result in restrictions on where the rail vehicle is permitted to operate, and therefore its use, being imposed.

G 2.1.2.4 Meeting this requirement is consistent with the industry agreed objective that fitting a rail vehicle with the ETCS onboard subsystem will have no adverse impact on rail vehicle performance, or the GB mainline railway as a whole.

G 2.1.2.5 Where rail vehicles can operate on other networks, as well as the GB mainline railway, this is considered in the ETCS onboard subsystem design.

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### 2.1.3 ETCS onboard subsystem: Impact on rail vehicle gauge clearance

2.1.3.1 Retrofitting a rail vehicle with an ETCS onboard subsystem shall not adversely affect the gauge clearance of the rail vehicle to which it is fitted. (Normative)

**Rationale**

G 2.1.3.2 Route technical compatibility: A rail vehicle that is fitted with an ETCS onboard subsystem should be able to operate on all routes and lines over which it was able to operate prior to ETCS fitment.

**Guidance**

G 2.1.3.3 The gauge clearance of a rail vehicle imposes restrictions on where it is permitted to operate and therefore its use. Meeting this requirement is consistent with the industry agreed objective that fitting a rail vehicle with the ETCS onboard subsystem will have no adverse impact on rail vehicle performance, or the GB mainline railway as a whole.

G 2.1.3.4 Adversely affecting existing gauge clearance would be changing the rail vehicle such that it is no longer compatible with the gauges for which it was cleared prior to the retrofit being undertaken. Compliance with this requirement does not preclude the rail vehicle gauge clearance being maintained or improved.

G 2.1.3.5 Where rail vehicles can operate on other networks, as well as the GB mainline railway, this is considered in the ETCS onboard subsystem design.

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### 2.1.4 ETCS onboard subsystem: Impact on rail vehicle maximum design speed

2.1.4.1 Retrofitting a rail vehicle with an ETCS onboard subsystem shall not adversely affect the maximum design speed of the rail vehicle. (Normative)

**Rationale**

G 2.1.4.2 Performance: A rail vehicle that is fitted with an ETCS onboard subsystem should be able to achieve the same maximum speed as it could prior to ETCS fitment.

**Guidance**

G 2.1.4.3 Meeting this requirement is consistent with the industry agreed objective that fitting a rail vehicle with the ETCS onboard subsystem will have no adverse impact on rail vehicle performance, or the GB mainline railway as a whole.

G 2.1.4.4 This requirement is related to the design speed of the rail vehicle, and not to:

a) The capability for the train driver to amend the maximum train speed as part of train data entry; or
b) The capability for an authorised person to amend the maximum train speed in train data configured in the ETCS onboard subsystem; or
c) Any rounding applied when converting the existing mph rail vehicle design speed into a km/h value in multiples of 5km/h, and the impact of the ETCS onboard supervision to that km/h value when operating in ETCS.

G 2.1.4.5 Compliance with this requirement does not preclude the maximum design speed of the rail vehicle being increased.

G 2.1.4.6 Where rail vehicles can operate on other networks, as well as the GB mainline railway, the design speed is considered in the ETCS onboard subsystem design.

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### 2.1.5 ETCS onboard subsystem: Impact on rail vehicle braking performance

2.1.5.1 Retrofitting a rail vehicle with an ETCS onboard subsystem shall not adversely affect the braking capability of the rail vehicle. (Normative)

**Rationale**

G 2.1.5.2 Route technical compatibility: A rail vehicle fitted with an ETCS onboard subsystem can be operated on lines where trains are operated using a lineside signalling system. The braking capability of the rail vehicle affects the stopping distance. Lineside signal spacing and cautionary aspect sequences affect how much distance (and time) the train driver has to stop the train at the limit of movement authority (MA).

G 2.1.5.3 Safe integration: This requirement is used to control *Hazard OB-H015*.

**Guidance**

G 2.1.5.4 Meeting this requirement is consistent with the industry agreed objective that fitting a rail vehicle with the ETCS onboard subsystem will have no adverse impact on rail vehicle performance, or the GB mainline railway as a whole.

G 2.1.5.5 Compliance with this requirement does not preclude the braking capability of the rail vehicle being improved.

G 2.1.5.6 Where rail vehicles can operate on other networks, as well as the GB mainline railway, braking capability is considered in the ETCS onboard subsystem design.

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### 2.1.6 ETCS onboard subsystem: Impact on rail vehicle operating restrictions

2.1.6.1 Retrofitting a rail vehicle with an ETCS onboard subsystem shall not result in any additional restrictions that would adversely affect operation of the rail vehicle on the routes where it is currently permitted to be operated. (Normative)

**Rationale**

G 2.1.6.2 Economic: Introducing additional operating restrictions could adversely affect the ability of train operators to fulfil their train service provision commitments.

**Guidance**

G 2.1.6.3 Many existing rail vehicles that operate on the GB mainline railway do not conform to current standards and were not authorised under current regulations. It is economically beneficial to achieve ETCS onboard subsystem fitment so that the conformity assessment needed for authorisation is limited to conformity with the basic parameters applicable to the ETCS onboard subsystem and its interfaces.

G 2.1.6.4 'Grandfather rights' relates to the operation of rolling stock:

a) Built before current regulations or standards were issued; or
b) That do not comply with current regulations or standards; or
c) For which specific derogations have been issued.

G 2.1.6.5 There is benefit in not invalidating the grandfather rights due to the retrofitment of the ETCS onboard subsystem.

G 2.1.6.6 Although Interoperability authorisations are not required for existing rolling stock that predate the interoperability regulations, there is still the need for the operator of these trains to comply with The Railways and Other Guided Transport Systems (Safety) Regulations 2006 and apply the relevant Common Safety Methods.

G 2.1.6.7 Exemptions from parts of applicable NTSNs that an older vehicle does not need to comply with may be granted by the Department for Transport (DfT) - see Regulation 14 of the Rail Interoperability Regulations 2011 (as amended).

G 2.1.6.8 The Office of Rail and Road (ORR) can be consulted for guidance on authorisation of rolling stock designed to earlier standards.

G 2.1.6.9 The supplier can discuss this requirement with the relevant conformity assessment body before design takes place.

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### 2.1.7 ETCS onboard subsystem: Reliability and availability targets

2.1.7.1 The ETCS onboard subsystem shall, as a minimum, meet the Mean Time Between Service Affecting Failure (MTBSAF) and Mean Time Between Mission Failure (MTBMF) targets for the onboard subsystem as set out in the ERTMS Reliability Specification NR/AM/SA/SPE/00147. (Normative)

**Rationale**

G 2.1.7.2 Reliability & Availability: The MTBSAF and MTBMF achieved by the ETCS onboard subsystem influences the overall reliability and availability of the ETCS.

G 2.1.7.3 Integration with train operations: An unreliable ETCS onboard subsystem is a potential hazard, which would need to be managed as part of the process of safe integration of an ETCS fitted rail vehicle into the GB mainline railway.

**Guidance**

G 2.1.7.4 This requirement addresses the open point in the CCS NTSN on the mean time of hours of operation between failures of a CCS on-board subsystem requiring the isolation of the train protection functions.

G 2.1.7.5 NR/AM/SA/SPE/00147 sets out reliability and availability targets for the ETCS, which are then apportioned to the respective elements of the onboard and trackside subsystems.

G 2.1.7.6 Meeting the MTBSAF and MTBMF targets specified in NR/AM/SA/SPE/00147 means that the ETCS onboard subsystem will be at least as reliable as the existing Class B systems used on the GB mainline railway. Any increase in failures associated with an ETCS onboard subsystem might result in overall performance losses in conventionally signalled or ETCS with signals areas.

G 2.1.7.7 Hours operating in Isolation (IS) will not be counted as contributing to the MTBSAF requirements.

G 2.1.7.8 NR/AM/SA/SPE/00147 is called up by the requirements in the GB Digital Rail generic requirements suite and is published as a supporting document on the SR&I webpage alongside that suite. The link to the SR&I webpage can be found on the standards landing page for this RIS on the RSSB's website (www.rssb.co.uk).

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### 2.1.8 ETCS onboard subsystem: Maximum time from No Power (NP) to Standby (SB)

2.1.8.1 The ETCS onboard subsystem shall take no more than 60 seconds to go from NP to being ready to accept data entry in SB (Status S0). (Normative)

**Rationale**

G 2.1.8.2 Availability: The time taken to initialise the ETCS onboard subsystem has operational implications, for example, it influences how long it takes to make a train ready to start a new journey when it reverses at a terminal station.

G 2.1.8.3 Performance: Significantly increasing the time taken to make trains ready to start could impact on the ability to deliver the train timetable.

**Guidance**

G 2.1.8.4 The 60 seconds limit includes all of the time needed to undertake any self-test functions when the ETCS onboard subsystem is operating correctly. It does not include additional time required for managing failure conditions identified during self-test functions or due to delays in receiving driver or other train inputs upon which the start up sequence depends.

G 2.1.8.5 This time value is applicable to the ETCS start of mission when the rail vehicle is being powered-up for the first time, and after an ETCS reset when the ETCS onboard

subsystem has been de-powered and re-powered manually as a result of system failure or otherwise.

G 2.1.8.6 Status S0 is defined within Subset-026 Chapter 5.

### 2.1.9 ETCS onboard subsystem: time from SB with the cab inactive to commencing a journey

**Guidance**

G 2.1.9.1 The time taken from opening a driving cab to the train being ready to commence the mission has operational implications, for example, it influences how long it takes to make a train ready to start a new journey when it reverses at a terminal station, or for a train to commence a journey after driver handover. Increasing the time taken to make trains ready to commence a journey could impact on the ability to deliver the train timetable.

G 2.1.9.2 A number of train driver tasks are currently required to ready a train for commencing a journey, including entry of the train driver identification for data recording and Global System for Mobile Communications - Railway (GSM-R) voice radio registration. The introduction of an ETCS onboard subsystem means that additional actions need to be completed between the driving cab being activated and the train being capable of commencing a journey. Some of these actions are imposed by the ETCS start of mission process, for example entry of train data and establishing a communications session with the radio block centre (RBC) for Level 2 or 3 operations. The completion of other actions may be necessary due to the level of integration between ETCS and other onboard subsystems, for example Class B or onboard traction systems, and may include:

a) The completion of automatic warning system/train protection and warning system (AWS/TPWS) power-up self test in accordance with RIS-0775-CCS where this constrains when the ETCS data entry menus are available.
b) Waiting for train data from other onboard systems, or for other train systems to start up before train data entered into the ETCS onboard subsystem can be sent to them.

G 2.1.9.3 It is good practice for the supplier and the operator to identify, during the early design phases of an implementation project, where additional start-up time impacts on train operations and to minimise that impact where required. Areas that could be considered to reduce the impact include:

a) Minimising the ETCS onboard subsystem response times for those additional actions imposed by the ETCS onboard subsystem itself, for example the time taken between the cab being activated and ETCS start of mission process state S0 being reached.
b) Simplifying manual tasks to reduce the time required for them to be completed correctly without placing undue time pressure on the train driver.
c) Modifying existing onboard subsystems to perform their normal start-up actions faster.

G 2.1.9.4 Clause *3.14.2* sets out a requirement on the ETCS DMI data entry process time.

#### 2.1.10 ETCS onboard subsystem: Level 2 and Level 3 capability

2.1.10.1 The ETCS onboard subsystem shall be configured with Levels 2 and 3. (Normative)

2.1.10.2 Provision shall be made within the ETCS onboard subsystem for an interface to a train integrity monitoring system (TIMS). (Application specific)

**Rationale**

G 2.1.10.3 Technical compatibility: So that the ETCS onboard considers Levels 2 and 3 available for use, subject to the other conditions, as set out in clause 5.10.2.4.1 of Subset-026.

G 2.1.10.4 Economic: The Digital Railway includes ETCS Level 3 within its future migration states. Making allowances to support future ETCS Level 3 capability when the ETCS onboard subsystem is fitted to a rail vehicle will provide efficiencies and simplify the migration path to ETCS Level 3 operations.

**Guidance**

G 2.1.10.5 The behaviour of an ETCS onboard in Levels 2 and 3 is the same. The ETCS Trackside changes behaviour based on the content of the train position reports.

G 2.1.10.6 Where a train is not to be authorised to operate in ETCS, the operator can choose to configure the ETCS onboard such that Level 2 and 3 are not available for use. Additionally, Level 0 or Level 1 is always available. The criteria whereby the ETCS onboard subsystem considers an ETCS level as available for use are set out in clause 5.10.2.4.1 of Subset-026.

G 2.1.10.7 It is expected that a future CCS NTSN will set out the integrity requirements for the TIMS.

G 2.1.10.8 Guidance for retrofit: Although developing a TIMS for freight trains is likely to pose a number of difficulties, including ETCS Level 3 capability on passenger units with electrical interworking is likely to be much simpler, and will not require additional inter-vehicle connections. Passenger rail vehicles that will not be operated as a unit could be considered under the same conditions as a freight train. Therefore, the expectation is that a train integrity proving capability can credibly be included on passenger stock without affecting interworking capabilities.

G 2.1.10.9 Guidance for new train fitment: Whilst developing a TIMS for mixed formation trains might be difficult, it is expected that locomotives fitted with an ETCS onboard subsystem that are used for mixed formation trains will facilitate simple connection of TIMS at a later date.

## 2.2 Configuration management

#### 2.2.1 ETCS onboard subsystem: LRU labelling

2.2.1.1 All line-replaceable units (LRUs) shall be labelled externally with their part number, serial number and modification version. (Normative)

2.2.1.2 The label shall be positioned so that the information is easily acccessible to read. (Normative)

**Rationale**

G 2.2.1.3 Asset management: Maintenance and faulting staff read the label to understand the modification version of the LRU installed in the rail vehicle.

**Guidance**

G 2.2.1.4 The modification version of an LRU will relate to its software, firmware, hardware and parameter versions, as appropriate. Recording this modification version on LRUs also assists in distinguishing between LRUs during replacement activities or during storage.

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### 2.2.2 ETCS onboard subsystem: LRU identification

2.2.2.1 The installed software versions of all software driven LRUs shall be available to be viewed electronically. (Normative)

2.2.2.2 The part number, serial number and modification version of all software driven LRUs shall be available to be viewed electronically. (Preferred)

**Rationale**

G 2.2.2.3 Asset management: The ability to display the configuration of the LRUs allows for rapid verification of the modification state; this is particularly useful during a modification programme.

**Guidance**

G 2.2.2.4 Such functionality could be provided using either:

a) The ETCS onboard system
b) An integrated solution using an onboard train management system
c) A portable maintenance terminal
d) Remote interrogation.

G 2.2.2.5 'Software driven' LRUs includes the ETCS Driver Machine Interface (DMI), European Vital Computer (EVC), and Balise Transmission Module (BTM), and other ETCS equipment that can feasibly report its configuration to the systems providing the functionality, but excludes 'hardware-only' LRUs without such intelligence, for example antennas or speed probes.

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### 2.2.3 ETCS onboard subsystem: configurable data

2.2.3.1 The ETCS onboard subsystem shall be implemented so that an authorised person can modify the configurable data that describes the performance and dimensions of the rail vehicle or train. (Normative)

2.2.3.2 It shall be possible to configure a range within which a configurable data parameter value can be modified by an authorised person. (Normative).

**Rationale**

G 2.2.3.3 Integration with train operations: The ability to modify configurable data is necessary as rail vehicles or trains can be modified, and their operations can be amended, over the course of their life.

G 2.2.3.4 Integration with train operations: The inclusion of constraints on acceptable values protects against human error during data entry.

G 2.2.3.5 Safe integration: This is to prevent hazards caused by an authorised person misentering data, for example an extra digit or an incorrect decimal point position.

G 2.2.3.6 The requirement to configure the range of values is used to control *Hazard OB-H008*.

**Guidance**

G 2.2.3.7 An authorised person, including for example a railway undertaking staff member, maintainer, or a representative of the ETCS onboard equipment supplier working under contract, needs a facility to amend relevant parameters within the train data and within train types. This requirement relates to the modification of data configured within the ETCS onboard subsystem - it does not apply to data amended by the train driver using the ETCS DMI.

G 2.2.3.8 Whilst flexibility to modify configuration data is needed, freedom to enter values which are outside of realistic or safe bounds is prevented, to avoid problems caused by misentered data.

G 2.2.3.9 This requirement does not apply to the determination of the configuration data modifications required - this complex work is likely undertaken by the supplier or another competent person. The requirement applies to the configuration of the ETCS onboard subsystem with that data by authorised personnel of appropriate competence.

G 2.2.3.10 Permanent vehicle or train modifications that might require a change to parameters within the configurable data and train types include:

a) Re-gearing a locomotive, which can change its maximum design speed
b) Adding extra equipment, which might affect axle loadings
c) Altering the consist of fixed formation units.

G 2.2.3.11 Some train operations might require a temporary modification of parameters within the configurable data, for example, adjusting the front end position of the train to account for a snow plough, or an officer's saloon being propelled.

G 2.2.3.12 Other modifications may be required in response to vehicle maintenance or calibration activities, for example configuring new wheel diameters following wheel grinding.

# Part 3 ETCS Onboard Subsystem Functionality

## 3.1 Braking

### 3.1.1 ETCS onboard subsystem: Service brake application

3.1.1.1 The "service brake command" interface set out in Subset-034 shall be implemented. (Normative)

**Rationale**

G 3.1.1.2 Integration with train operations: A brake application can be invoked as part of trackside braking reactions (for example, M_NVCONTACT). Non-provision of the service brake command interface would result in an emergency brake application, which is an excessive response that the train driver cannot avoid. The service brake command interface avoids such scenarios.

**Guidance**

G 3.1.1.3 The ETCS onboard subsystem can be interfaced with the rail vehicle service brake, so that the ETCS can command its application when required. This interface is optional as set out in clause 3.13.2.2.7.1 of Subset-026; however, it is beneficial to train operations on the GB mainline railway and will be implemented.

G 3.1.1.4 The conditions under which the ETCS can command a service brake application can be configured using national values. Default values for national values are specified in the CCS NTSN.

G 3.1.1.5 The GB implementation of ETCS will inhibit the service brake application for target speed monitoring, but allow it for ceiling speed monitoring. In doing so, the first line of intervention in target speed monitoring will be enforced by the emergency brake and will occur later than if the service brake is enabled. This mitigates the potential performance loss associated with the service brake intervention curve being more restrictive than the emergency brake.

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### 3.1.2 ETCS onboard subsystem: service brake application rate

3.1.2.1 The braking rate resulting from an ETCS onboard subsystem service brake command shall be equivalent to that resulting from a train driver initiated full service brake demand. (Normative)

3.1.2.2 The train braking system shall have the same response time from initiation of the service brake command until the full service application of the brakes irrespective of whether the command originates from the ETCS onboard subsystem or the train driver's control device. (Normative)

**Rationale**

G 3.1.2.3 Integration with train operations: Applying the service brake too abruptly may result in passenger and staff injury, buffer locking and damage to on-train equipment or freight payloads.

G 3.1.2.4 Safe integration: The braking response time and application rate influences the total train stopping distance (and time).

**Guidance**

G 3.1.2.5 The ETCS brake model and parameters are defined within the CCS NTSN requirements; however, the method of interfacing the ETCS to the rail vehicle or train is specific to the type or class.

G 3.1.2.6 The rate chosen will take into account the effects of any enhanced service braking, where that system provides a guaranteed application under full service brake applications.

G 3.1.2.7 The method of providing the interface is appropriately designed so that it does not compromise, or adversely affect, the ETCS brake application. Potential issues include:

a) Introduction of excessive delay between the ETCS brake application and the train brake system reaction; and
b) Excessively slow/fast brake application compared to a train driver initiated application.

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### 3.1.3 ETCS onboard subsystem: emergency brake application rate

3.1.3.1 The train braking system response time to, and the braking rate resulting from, an ETCS emergency brake command shall be determined by risk assessment. (Normative)

**Rationale**

G 3.1.3.2 Integration with train operations: Applying the emergency brake too abruptly may result in passenger and staff injury, buffer locking and damage to on-train equipment or freight payloads.

G 3.1.3.3 Safe integration: The braking response time and application rate influences the total train stopping distance (and time).

G 3.1.3.4 Safe integration: This requirement is used to control *Hazards OB-H016a and OB-H016b*.

**Guidance**

G 3.1.3.5 The ETCS brake model and parameters are defined within the CCS NTSN requirements; however, the method of interfacing the ETCS to the rail vehicle or train is specific to the type or class.

G 3.1.3.6 The response time and braking rate determine the speed with which brakes are applied and the net deceleration achieved in response to the ETCS emergency brake command.

G 3.1.3.7 The risk assessment is used to determine an optimised train interface that balances the safety risk in all situations for the vehicle /trailing load concerned. Safety risk is not limited to the time or distance taken to bring a train to a stand, it also includes any negative impact on the train itself as a result of the brake application. For example, choosing the most extreme emergency brake rate/response time might

reduce the extent of the supervised brake curves in target speed monitoring, but for freight trains with many vehicles and slow acting brakes an emergency brake application at that rate/response time could result in braking shocks (leading to broken couplings, shifted loads, locked buffers) and wheel flats. Requiring the most extreme brake application possible in response to an ETCS emergency brake command may invite the worst outcome whatever the actual context, and initiating a more modest brake application (as with the Class B systems, and other cab systems such as vigilance & DSD) can allow the Driver the option to escalate via, for example, the brake controller or emergency plunger, where necessary.

G 3.1.3.8 The rate chosen will take into account the effects of any enhanced emergency braking where that system provides a guaranteed application under emergency brake applications.

G 3.1.3.9 Verification that the calculated ETCS braking curves align with the braking rate and response times achieved with the particular train interface forms part of train fitment activities.

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### 3.1.4 ETCS onboard subsystem: braking reliability and performance

3.1.4.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the performance and reliability of the brake shall not be compromised by the presence and operation of the ETCS onboard subsystem. (Normative)

**Rationale**

G 3.1.4.2 Safe integration: A poorly performing or unreliable train brake would compromise the train protection capability of the ETCS and the capability of the train to stop.

G 3.1.4.3 Safe integration: This requirement is used to control *Hazard OB-H015*.

**Guidance**

G 3.1.4.4 Performance of the brake relates to, for example, brake force, retardation rate, and tolerance to rail conditions.

G 3.1.4.5 Reliability of the brake refers to the ability of the brake to be applied when commanded.

G 3.1.4.6 This requirement applies to all the braking levels available to the rail vehicle (brake off, through to full service brake and emergency brake applications).

G 3.1.4.7 This requirement is not intended to preclude the reliability and performance of the train braking system being improved.

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### 3.1.5 ETCS onboard subsystem: train brake applications

3.1.5.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the ability of the train driver or existing safety systems to apply the brakes shall not be compromised by the presence and operation of the ETCS onboard subsystem. (Normative)

**Rationale**

G 3.1.5.2 Integration with train operations: The train driver is responsible for controlling the movement of the train, including the application of train brakes. ETCS fitted trains can be operated on ERTMS/ETCS fitted lines and on lines where the train protection function is provided using a Class B system.

G 3.1.5.3 Safe integration: This requirement is used to control *Hazard OB-H015*.

**Guidance**

G 3.1.5.4 The ETCS onboard subsystem is implemented so that existing brake controls and safety systems (when unsuppressed) are able to demand a brake application as per their current operations.

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### 3.1.6 ETCS onboard subsystem: derivation of service and emergency braking rates

3.1.6.1 The service and emergency braking rates used within the ETCS brake model shall be modified automatically from detection of the operational status of any special brake systems used. (Preferred)

**Rationale**

G 3.1.6.2 Integration with train operations: To enable the most accurate braking rate input to the ETCS brake model.

**Guidance**

G 3.1.6.3 Special brakes include any regenerative, eddy current or magnetic shoe brakes that will operate on the rail vehicle.

G 3.1.6.4 The ETCS onboard subsystem can utilise available track condition information to determine the availability of special brake systems and will automatically incorporate the appropriate deceleration profiles in the calculation of the supervision curves.

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### 3.1.7 ETCS onboard subsystem: ETCS Kdry value

3.1.7.1 For new trains, the train brake system shall have an ETCS Kdry (99 %) value in excess of 0.95 at all speeds. (Preferred)

**Rationale**

G 3.1.7.2 Performance: A higher value of Kdry results in better performance under the ETCS.

**Guidance**

G 3.1.7.3 The tolerance and reliability of the brake system is captured within the ETCS parameter Kdry, which has a direct impact on the assumed deceleration of the train.

G 3.1.7.4 The means to determine the Kdry_rst correction factor for the nominal emergency brake deceleration values are set out in Subset-040, clauses 4.4.1.4 and 4.4.1.5. Subset 026 section 3.1.3 defines how the correction factor is used by the ETCS onboard subsystem to determine the safe emergency brake deceleration.

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#### 3.1.8 ETCS onboard subsystem: ETCS Kwet value

3.1.8.1 For new trains, the train brake system shall have an ETCS Kwet value in excess of 0.85 at all speeds. (Preferred)

**Rationale**

G 3.1.8.2 Performance: A higher Kwet value results in better performance under the ETCS.

**Guidance**

G 3.1.8.3 The braking performance of the train under representative wet rail conditions (as prescribed by BS EN15595:2018) has a direct impact on the assumed deceleration of the train.

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### 3.2 Traction power cut-off

#### 3.2.1 ETCS traction power cut-off command

3.2.1.1 The "Traction Cut-Off " interface set out in Subset-034 shall be implemented. (Normative)

**Rationale**

G 3.2.1.2 Performance: Implementing the traction power cut-off command and interface is intended to mitigate the performance impact that would arise from delays in cutting off traction after an ETCS intervention.

**Guidance**

G 3.2.1.3 The ETCS onboard subsystem can be interfaced with the rail vehicle traction system, so that the ETCS can command traction to be cut-off when required. This interface is optional as set out in clause 3.13.2.2.8.1 of Subset-026; however, it is beneficial to train operations on the GB mainline railway and will be implemented.

G 3.2.1.4 The ETCS onboard subsystem may be directly interfaced with the traction system, or via an onboard train management system provided this has an appropriate safety and security integrity level, and that minimal delay is introduced.

G 3.2.1.5 It is good practice to consider the consequences of a sudden removal of traction demand on the traction system when configuring the response of the traction system to the receipt of the cut-off command from the ETCS.

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#### 3.2.2 ETCS traction power cut-off when operating in multiple

3.2.2.1 The traction power cut-off command shall cut power to all traction units operating in multiple within the train. (Normative)

**Rationale**

G 3.2.2.2 Integration with train operations: So that, if the braking curves are calculated on the basis of a traction power cut-off being implemented, they are correct for the train when traction units are operating in multiple.

**Guidance**

G 3.2.2.3 In the same way as for a train driver-initiated removal of traction power, the cut-off command removes traction power from all rail vehicles operating in multiple under the control of a single train driver within the train. This is expected to be achieved through standard rail vehicle functionality.

### 3.2.3 ETCS traction power cut-off rate

3.2.3.1 Rail vehicle traction shall be cut in response to the traction cut-off command from the ETCS onboard subsystem at a rate equivalent to a train driver-initiated command. (Normative)

**Rationale**

G 3.2.3.2 Integration with train operations: Cutting the traction power from full effort to zero quickly will assist train performance; however doing so abruptly, when the train passes the ETCS warning limit, might result in personal injury, power unit overspeed trips, buffer locking, or damage to on-train equipment or freight payloads.

**Guidance**

G 3.2.3.3 The equivalent rate of traction cut-off achieved by train drivers can depend upon the traction type and human reaction delays. The time taken to initiate a traction cut-off will ignore any train driver reaction delays.

G 3.2.3.4 It is envisaged that conformity with this requirement will be achieved through design of the ETCS interface to the rail vehicle braking systems, not via bespoke onboard commands.

## 3.3 ETCS onboard isolation

### 3.3.1 ETCS isolation control

3.3.1.1 An ETCS isolation control shall be provided for the train driver to place the ETCS onboard subsystem into IS. (Normative)

**Rationale**

G 3.3.1.2 Integration with train operations: The ETCS onboard subsystem will sometimes need to be physically isolated from other rail vehicle equipment and systems (for example, the braking system).

**Guidance**

G 3.3.1.3 The isolation control may be a switch, button, train management system function, or another facility of the appropriate safety and security integrity level.

G 3.3.1.4 The requirements for the ETCS isolation control are set out in section 4.4.3 of Subset-026 and RIS-2761-RST, Part 6.

G 3.3.1.5 Some trains use a 'Safety Systems Isolated' indicator, provided in the cab, to comply with the requirements set out in RIS-2761-RST for visibility of isolation status.

Isolation of the ETCS onboard subsystem should be indicated to the train driver, but not in such a way as to make the train unfit for service.

G 3.3.1.6 Ideally, an ETCS isolation control is provided within each driving cab; this avoids the need for the driver to leave the driving cab to isolate the ETCS onboard subsystem. However, ETCS isolation controls can be provided in other locations within the rail vehicle or unit if it is acceptable for the train driver to leave the driving cab to access these controls.

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### 3.3.2 ETCS isolation control function

3.3.2.1 An ETCS isolation control shall only act upon one ETCS onboard subsystem. (Normative)

**Rationale**

G 3.3.2.2 Performance: This is to retain the ability for ETCS operation from a non-isolated cab on trains that have more than one ETCS onboard subsystem. This allows normal operation for certain recovery moves following failure (that is, if one ETCS onboard subsystem fails and a second is available in a different cab, then any recovery moves performed from that cab can still be done under ETCS control).

**Guidance**

G 3.3.2.3 Where a rail vehicle is fitted with more than one EVC (for example, on long trains where the economics dictate that to be the most effective option), then operation of the isolation control only acts upon a single ETCS onboard subsystem. This retains the ability for ETCS operation from the remaining non-isolated cab.

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### 3.3.3 ETCS isolation control location

3.3.3.1 The ETCS isolation control shall be located so that it is out of reach of the train driver when in the normal driving position. (Normative)

**Rationale**

G 3.3.3.2 Safe integration: Locating the isolation control so that it is out of reach of the train driver in the normal driving position is a method commonly employed to prevent system isolation whilst the train is moving.

G 3.3.3.3 Safe integration: This requirement is used to control *Hazard OB-H001*.

**Guidance**

G 3.3.3.4 None.

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### 3.3.4 ETCS isolation control and traction power

3.3.4.1 Putting the ETCS isolation control to the isolate position shall prevent the ETCS onboard subsystem from inhibiting traction power. (Normative)

**Rationale**

G 3.3.4.2 Integration with train operations: In some cases it is necessary to operate a train with the ETCS onboard subsystem isolated.

**Guidance**

G 3.3.4.3 GERT8000-TW5 sets out the requirements for moving a train when the ETCS onboard subsystem is isolated, for example, when an ETCS system failure results in the loss of the ETCS DMI.

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### 3.3.5 ETCS de-isolation controlled method

3.3.5.1 A controlled method shall be used to de-isolate the ETCS onboard subsystem. (Normative)

**Rationale**

G 3.3.5.2 Integration with train operations: After the ETCS onboard subsystem has been isolated from the other rail vehicle equipment and systems, the controlled method ensures that ETCS de-isolation is only performed by an authorised person.

G 3.3.5.3 Integration with train operations: Clause 4.4.3.1.3 of Subset-026 requires that to leave IS, a special operating procedure is needed which ensures that the ETCS onboard subsystem is only de-isolated when it has been proven that this is safe for normal operation.

G 3.3.5.4 Safe integration: This requirement is used to control *Hazard OB-H002*.

**Guidance**

G 3.3.5.5 In this context, a controlled method is one whose application can be restricted to only those authorised to use it by the railway undertaking. Examples of controlled methods include the use of a mechanical key, an electronic key, or a one-time reset code. A 'T' key or a train driver's key does not meet the criteria of a controlled method.

G 3.3.5.6 The railway undertaking determines who is authorised to de-isolate the ETCS, and is subsequently issued with the means to do so.

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### 3.3.6 ETCS isolation and data recording functionality

3.3.6.1 Isolation or loss of power to the ETCS onboard subsystem shall not affect the recording of onboard driving data from non-ETCS systems. (Normative)

**Rationale**

G 3.3.6.2 Integration with train operations: On-train data recording functionality needs to be maintained at all times to meet the requirements for recording the information set out in RIS-2472-RST.

**Guidance**

G 3.3.6.3 If the juridical recording unit (JRU) and on-train monitoring recorder (OTMR) are combined into one data recorder, then it needs to remain powered in order to record the full range of OTMR data requirements specified in RIS-2472-RST and the Rolling Stock - Locomotive and Passenger (LOC & PAS) NTSN.

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### 3.3.7 Train operation in IS

3.3.7.1 It shall be technically possible to operate the train indefinitely in revenue-earning service with the ETCS onboard subsystem in IS on ETCS with signals and non-ETCS fitted lines. (Application specific)

**Rationale**

G 3.3.7.2 Integration with train operations: In some cases, it is necessary to operate a train with the ETCS onboard subsystem isolated.

**Guidance**

G 3.3.7.3 To facilitate or support continued service operation in IS, on infrastructure equipped with lineside signals and alternative train protection systems, Class B train protection systems need to remain available when the ETCS onboard subsystem is isolated.

G 3.3.7.4 Revenue earning service covers normal operation of freight or passenger services with little or no impact on performance on ETCS with signals and non-ETCS fitted lines where the vehicle is authorised to operate.

G 3.3.7.5 Considerations include:

a) How conformity with this requirement can be achieved when the Class B train protection system is integrated into the ETCS DMI
b) The positioning and size of the speedometer so that the train driver can use it for continuous operation
c) Any dependance on the ETCS onboard subsystem to provide information for normal operation on ETCS with signals or non-ETCS fitted lines that would not be available with the ETCS onboard subsystem isolated, for example, transferring packet 44 data to train systems for traction changeover or selective door opening. With the ETCS onboard subsystem isolated, it may not be possible to access packet 44 information required for normal operation, and it may not be possible to provide other functionality where this is supported by the ETCS DMI.

G 3.3.7.6 The decision to invoke this requirement is dependent upon the fleet to which the equipment is fitted, and the scope of operations.

G 3.3.7.7 This requirement does not imply that indefinite operation in IS is either commercially acceptable or the intended approach for operation on non-ETCS fitted lines.

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### 3.3.8 ETCS isolation indication - one ETCS onboard subsystem

3.3.8.1 Where one ETCS onboard subsystem is provided on a rail vehicle or unit, an indication shall be provided in the active cab so that the train driver can determine that the ETCS onboard subsystem has been isolated. (Normative)

3.3.8.2 Where multiple isolation controls can act on the single ETCS onboard subsystem, the indication shall support the driver in determining which isolation control has isolated the ETCS onboard subsystem. (Normative)

**Rationale**

G 3.3.8.3 Safe integration: The train driver needs to understand whether the ETCS onboard subsystems are capable of providing the required train protection functionality for the intended train operations.

G 3.3.8.4 Integration with train operations: The driver being able to determine where the isolation has been enacted from can support timely de-isolation or identification of necessary amendments to planned train operations.

G 3.3.8.5 Safe integration: This requirement is used to control *Hazard OB-H003*.

**Guidance**

G 3.3.8.6 This requirement is complementary to the requirement set out in ERA_ERTMS_015560 for the isolation of the ETCS onboard subsystem "to be indicated by any means", and may form part of the mitigation of hazardous situations DMI-02b, MMI-2b and DMI-04j listed in Subset-091.

G 3.3.8.7 On a vehicle or unit where there is only one ETCS onboard subsystem, it may have been isolated at multiple locations, or at a single centralised location.

G 3.3.8.8 The indication could be displayed on the ETCS DMI in each driving cab. Other examples of an isolation indication include the Additional Speed Display (ASD) becoming functional or an isolation indication being provided on the ASD itself. Ideally the form of the isolation status indication is standardised across train fleets operated by the same railway undertaking.

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### 3.3.9 ETCS isolation indication - two ETCS onboard subsystems

3.3.9.1 Where two ETCS onboard subsystems are provided on a single rail vehicle or unit, an indication shall be provided in the active cab so that the train driver can determine that the ETCS onboard subsystem associated with that cab has been isolated. (Normative)

3.3.9.2 Where two ETCS onboard subsystems are provided on a single rail vehicle or unit, an indication shall be provided in the active cab of the status of the ETCS onboard subsystem associated with the other driving cab. (Application specific)

**Rationale**

G 3.3.9.3 Safe integration: The train driver needs to understand whether the ETCS onboard subsystems are, or will be, capable of providing the required train protection functionality for the intended train operations.

G 3.3.9.4 Safe integration: The requirement for indication of the isolation status is used to control *Hazard OB-H003*.

**Guidance**

G 3.3.9.5 A single rail vehicle or unit may be fitted with more than one EVC where technical constraints, for example train length, or economics dictate that to be the most effective option.

G 3.3.9.6 This requirement is complementary to the requirement set out in ERA_ERTMS_015560 for the isolation of the ETCS onboard subsystem to be indicated by any means, and may form part of the mitigation of hazardous situations DMI-02b, MMI-2b and DMI-04j listed in Subset-091.

G 3.3.9.7 The status of the ETCS onboard subsystem associated with the other driving cab can be limited to its isolation status on retrofit implementations. For new trains, the status can also include whether the ETCS onboard subsystem is in NP or System Failure (SF).

G 3.3.9.8 The indication can be displayed using the ETCS DMI in each driving cab. Other examples of an isolation indication include the ASD becoming functional or an isolation indication being provided on the ASD itself. Ideally the form of the isolation status indication is standardised across train fleets operated by the same railway undertaking.

## 3.4 ETCS reset

### 3.4.1 ETCS reset control

3.4.1.1 The ETCS onboard subsystem shall include a reset control that allows authorised personnel to remove and reinstate power to the ETCS in order to force the system to transition to NP and then SB. (Normative)

**Rationale**

G 3.4.1.2 Performance: The reset function is intended to provide an efficient means for the train driver to reset the ETCS onboard subsystem in the event of a failure which, if successful in clearing the failure, would allow continued normal operation of the rail vehicle.

**Guidance**

G 3.4.1.3 It is envisaged that the reset control will remove the power for a short duration. The reset control will not remain in the 'off' position. A self-restoring switch could be used to provide this function.

G 3.4.1.4 The reset control might also support ETCS onboard subsystem maintenance interventions being undertaken.

### 3.4.2 ETCS reset method

3.4.2.1 Special tools or equipment shall not be necessary to reset the ETCS onboard subsystem. (Normative)

**Rationale**

G 3.4.2.2 Integration with train operations: The ETCS reset control is intended for use by the train driver to facilitate recovery from ETCS onboard subsystem failure. The use of special tools or equipment would not only increase the competency requirement for its use, but could prevent or prolong a reset being completed when required.

**Guidance**

G 3.4.2.3 This requirement applies to all ETCS onboard subsystem reset controls.

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### 3.4.3 ETCS reset control: other rail vehicle systems

3.4.3.1 Resetting the ETCS onboard subsystem shall not necessitate operation of any other rail vehicle systems. (Normative)

**Rationale**

G 3.4.3.2 Integration with train operations: Resetting the ETCS onboard subsystem using a single control that does not affect anything else avoids unnecessary performance implications. For example, use of other functions or operations that simultaneously remove power from the ETCS and other rail vehicle systems (for example, opening the battery switch or power master switch) could extend the time taken to restore the vehicle to a condition where it is ready to be moved or cause inconvenience to passengers.

G 3.4.3.3 Integration with train operations: Resetting the ETCS onboard subsystem using a single control that does not affect other on-train systems may support ETCS onboard subsystem maintenance interventions being undertaken without impacting other on-train systems.

**Guidance**

G 3.4.3.4 This requirement can be met by providing a dedicated ETCS onboard subsystem reset control, which could be a function that removes power from the ETCS onboard subsystem only (for example, a switch, button, or train management system option).

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### 3.4.4 ETCS reset control protection

3.4.4.1 The ETCS reset control shall be protected against accidental and unauthorised operation. (Normative)

**Rationale**

G 3.4.4.2 Integration with train operations: Resetting the ETCS onboard subsystem when the train is being driven could result in the train driver not being presented with information necessary for the train driving task, increasing the likelihood of error or hazardous situations.

G 3.4.4.3 Safe integration. Accidental or unauthorised reset of the ETCS onboard subsystem during the operation of a train would affect performance and increase risk.

G 3.4.4.4 Safe integration: This requirement is used to control *Hazard OB-H002*.

**Guidance**

G 3.4.4.5 Example design solutions to prevent accidental or unauthorised use include:

a) In the case of a physical switch, providing a lockable safety cover, or locating the switch in a lockable equipment cabinet or other location where unauthorised access is suitably controlled
b) In the case of a virtual control, incorporating a prompt for the train driver to confirm that a reset is needed.

### 3.4.5 ETCS reset control access and use

3.4.5.1 The ETCS reset control/s shall be readily accessible to the train driver. (Normative)

3.4.5.2 Where the reset control is provided in a driving cab, the reset control shall only be effective when the train systems consider the cab to be active. (Normative)

**Rationale**

G 3.4.5.3 Integration with train operations: Ready access to the reset control reduces the time required to perform a reset.

G 3.4.5.4 Integration with train operations: To prevent a reset in another cab being undertaken in error.

**Guidance**

G 3.4.5.5 Ideally, an ETCS reset control is located in each driving cab, however, the provision of the ETCS reset control/s in another location or locations on the rail vehicle may be appropriate if it is acceptable for the train driver to leave the driving cab to perform the reset.

G 3.4.5.6 In determining whether the ETCS reset control is to be somewhere other than in the driving cab/s the following are considered:

a) Any need for the train driver need to leave the vehicle or unit to move to the ETCS reset control location and whether this is possible and acceptable anywhere where the train may come to a stand
b) Accessing and operating the ETCS reset control in areas with excessive noise or other hazards
c) It being acceptable to walk through passenger areas to access the ETCS reset control
d) Controlling unauthorised access to the ETCS reset control/s located in passenger areas
e) The possibility of confusion over which ETCS onboard subsystem to reset if multiple reset controls are provided in the same location
f) Whether the ETCS reset control is used for ETCS onboard subsystem maintenance activities, and what requirements these activities impose on the location of the ETCS reset control/s.

G 3.4.5.7 The train configuration to generate a "Cab Active" status to the ETCS is application specific. The reset control is only active when the train is an equivalent state.

### 3.4.6 ETCS reset control accessibility

3.4.6.1 It shall not be possible for the ETCS onboard subsystem to be reset whilst the rail vehicle or train is in motion. (Normative)

**Rationale**

G 3.4.6.2 Integration with train operations. Resetting the ETCS onboard subsystem when a train is being driven could increase risk.

G 3.4.6.3 Integration with train operations. Inhibiting the ETCS reset function when the train is moving can also prevent improper use.

**Guidance**

G 3.4.6.4 Options for achieving this requirement include:

a) Inhibiting the ETCS reset function when the train is moving; and/or
b) Locating the ETCS reset control so that it is out of reach of the train driver in the normal driving position.

G 3.4.6.5 In identifying an option for achieving this requirement, consideration is given to the provision of an additional technical control to mitigate for a second person accessing and using the reset control while the train is in motion.

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### 3.4.7 ETCS reset action

3.4.7.1 Each ETCS onboard subsystem shall be reset independently. (Normative)

**Rationale**

G 3.4.7.2 Integration with train operations: The ETCS reset function is used to reset an ETCS onboard subsystem that has failed. In this case, there is no need to reset more than one subsystem at a time.

**Guidance**

G 3.4.7.3 Where a train is fitted with more than one ETCS onboard subsystem (for example, long trains where the economics dictate that to be the most effective option), operation of an ETCS reset control acts upon only one of the ETCS onboard subsystems.

G 3.4.7.4 Where a rail vehicle or unit is fitted with one ETCS onboard subsystem and a reset control is provided in each driving cab, operation of either control will reset the ETCS onboard subsystem.

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### 3.4.8 ETCS reset data recording

3.4.8.1 Operation of the ETCS reset control shall be recorded on the rail vehicle data recorder. (Normative)

**Rationale**

G 3.4.8.2 Integration with train operations: The use of the ETCS reset control is recorded to satisfy requirements set out in RIS-2472-RST.

**Guidance**

G 3.4.8.3 RIS-2472-RST sets out the requirements for the data to be recorded. In this context, ‘data recorder’ may be the JRU, existing OTMR equipment, or combined JRU/OTMR equipment.

## 3.5 Tandem working

### 3.5.1 ETCS interfaces when working in tandem

3.5.1.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the method of interfacing the ETCS onboard subsystem to the train control systems shall not affect the existing capability of the rail vehicle to work in tandem. (Normative)

**Rationale**

G 3.5.1.2 Integration with train operations: In some cases it is necessary to operate a train with traction units in tandem.

**Guidance**

G 3.5.1.3 None.

### 3.5.2 ETCS interface: 'allow non-leading mode'

3.5.2.1 The ETCS 'allow non-leading mode' rail vehicle interface shall be implemented. (Application specific)

**Rationale**

G 3.5.2.2 Integration with train operations: The 'allow non-leading mode' rail vehicle interface enables the non-leading (NL) function, which will be used for tandem working, banking and rescue operations.

**Guidance**

G 3.5.2.3 There are operational benefits in implementing the 'allow non-leading mode' rail vehicle interface on locomotives working in variable consist trains. Providing this interface on other types of rail vehicle might also be an advantage.

G 3.5.2.4 The functional definition of the non-leading interface is set out in section 2.2.3 of Subset-034.

### 3.5.3 ETCS interface: 'passive shunting permitted'

3.5.3.1 The ETCS ‘passive shunting permitted’ interface shall be implemented. (Application specific)

**Rationale**

G 3.5.3.2 Integration with train operations: The ‘passive shunting permitted’ interface enables the passive shunting (PS) function, which will be used for 'top and tail' working where the trailing locomotive is unmanned yet left running.

**Guidance**

G 3.5.3.3 There are operational benefits in implementing the ‘passive shunting permitted’ rail vehicle interface on locomotives working in variable consist trains. Providing this interface on other types of rail vehicle might also be an advantage.

G 3.5.3.4 The functional definition of the passive shunting interface is set out in section 2.2.2 of Subset-034.

## 3.6 Dead hauling

### 3.6.1 ETCS interfaces : dead hauling rail vehicles

3.6.1.1 It shall be possible to temporarily configure a rail vehicle so that it can be dead-hauled after the ETCS onboard subsystem has entered NP. (Normative)

3.6.1.2 When retrofitting a rail vehicle with an ETCS onboard subsystem, the method of interfacing the ETCS onboard subsystem to the train brakes so that it is possible to move the rail vehicle in NP shall not affect the existing arrangements for dead-hauling rail vehicles. (Normative)

**Rationale**

G 3.6.1.3 Integration with train operations: Dead hauling of rail vehicles is sometimes used to move a failed train, or to transit the rail vehicle over certain routes.

G 3.6.1.4 Integration with train operations: For retrofitted rail vehicles or trains, this requirement means that additional steps do not have to be taken to isolate systems when assisting the rail vehicle or train.

**Guidance**

G 3.6.1.5 Dead-hauling is referred to as cold movement in the ETCS specifications.

G 3.6.1.6 This requirement can be met if the brakes can be released and the rail vehicle can be moved without requiring power to the ETCS onboard subsystem, or isolation of the ETCS onboard subsystem.

G 3.6.1.7 GERT8000-TW1 sets out the operating requirements for trains that incorporate dead locomotives or units. Isolating the brakes so that they do not function is not an acceptable solution.

G 3.6.1.8 The application of this requirement to the rail vehicle is specific to the rolling stock type. Existing railway undertaking operating practices are considered when retrofitting a rail vehicle with an ETCS onboard subsystem.

G 3.6.1.9 Clause 4.4.4.3.3 of Subset-026 states: 'If it is required to move a loco in No Power (NP) as a wagon, ETCS brake command must be overridden by external means'.

## 3.7 Multiple working

### 3.7.1 ETCS interfaces: multiple working

3.7.1.1 The ETCS onboard subsystem shall not prevent or reduce the capability for multiple working between compatible rail vehicles or units. (Normative)

**Rationale**

G 3.7.1.2 Integration with train operations: Train operations on the mainline railway sometimes rely on working in multiple.

**Guidance**

G 3.7.1.3 Where the rail vehicle is capable of coupling electrically to another, the ETCS onboard subsystems in trailing units operate in Sleeping (SL) in order to move the train. The transition to SL is dependent upon the 'sleeping requested' signal being received.

G 3.7.1.4 Rail vehicles to be retrofitted and which are already capable of being operated in multiple have existing interfaces between compatible rail vehicles. Using these interfaces for ETCS input (such as 'sleeping requested'), rather than adding further interfaces, will retain inter-vehicle compatibility.

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### 3.7.2 ETCS interface: rail vehicle compatibility

3.7.2.1 Retrofitting a rail vehicle with an ETCS onboard subsystem shall maintain any existing compatibility for multiple working between ETCS-fitted rail vehicles or between ETCS-fitted rail vehicles and ETCS-unfitted rail vehicles. (Normative)

**Rationale**

G 3.7.2.2 Integration with train operations: Restricting compatibility to only certain rail vehicles would place unacceptable restrictions on train planning.

**Guidance**

G 3.7.2.3 Multiple unit working between compatible classes, and locomotive haulage of train sets, is not restricted by the presence of the ETCS onboard subsystem, regardless of the supplier of the ETCS onboard subsystem on the respective rail vehicles.

G 3.7.2.4 An ETCS-fitted multiple unit might be operated when coupled to ETCS-unfitted, compatible multiple units on ETCS-fitted and unfitted lines.

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### 3.7.3 Operation of trains when the ETCS is not operating in a trailing unit

3.7.3.1 An isolated or failed ETCS onboard subsystem in a trailing coupled unit shall not adversely impact on the operation of the train when it is driven from the leading unit. (Normative)

**Rationale**

G 3.7.3.2 Integration with train operations: It would be detrimental to service operation for a failed ETCS onboard subsystem in a trailing coupled unit to prevent the operation of

the train where the train is being supervised by the ETCS onboard subsystem in the leading rail vehicle.

**Guidance**

G 3.7.3.3 When the ETCS onboard subsystem in the leading unit is supervising the operation of the train, the fact that the trailing unit incorporates an isolated or failed ETCS onboard subsystem does not impact on the capability of the train to be safely operated. It should be possible for a unit with a failed ETCS onboard subsystem to provide traction power to the train if demanded by the leading unit, and not to interfere with the control from the leading unit.

## 3.8 Operations in possessions

### 3.8.1 ERTMS/ETCS Level 0

3.8.1.1 The ETCS onboard subsystem default list for supported levels shall be configured so that Level 0 is enabled. (Normative)

**Rationale**

G 3.8.1.2 Integration with train operations: This is necessary so that Level 0 can be selected by the train driver when the trackside supported level is not available onboard. The default list is configured onboard.

**Guidance**

G 3.8.1.3 The default list configured onboard is used when trackside supported levels are not available as set out in clause 11.3.2.8 in ERA_ERTMS_015560.

## 3.9 On-track machine (OTM) operation

### 3.9.1 ETCS functionality on OTMs: Sleeping

3.9.1.1 When an on-track machine (OTM) is changed into working mode, it shall cause the ETCS onboard subsystem to enter SL. (Normative)

**Rationale**

G 3.9.1.2 Efficiency: SL enables the OTM to be moved when in working mode, without the need to isolate the ETCS onboard subsystem.

**Guidance**

G 3.9.1.3 The ETCS onboard subsystem is not required to control movements when an engineering train is in working mode.

G 3.9.1.4 This requirement is in addition to the automatic transition to SL that is initiated when the ETCS onboard subsystem on the OTM detects that another driving desk in a coupled engineering train has been opened.

G 3.9.1.5 If the ETCS sub-system is put into SB, the OTM would be prevented from moving by the ETCS onboard subsystem.

G 3.9.1.6 'Working mode' in this context refers to OTM functionality; it is not an ETCS mode. When some OTMs are in working mode, within a possession, both driving cabs are closed and the OTM operator uses a separate workstation (for example, an unslung cab or platform), from which the OTM may be moved.

### 3.9.2 ETCS functionality on OTMs

3.9.2.1 It shall not be necessary to isolate the ETCS onboard subsystem when an OTM is performing its intended track maintenance functions. (Application specific)

**Rationale**

G 3.9.2.2 Integration with train operations: Some OTMs are authorised to work outside of a possession. Isolating the ETCS onboard subsystem for these operations could result in a train being operated without a functional train protection system and the train driver not being presented with information necessary for the train driving task, increasing the likelihood of error or hazardous situations.

G 3.9.2.3 Efficiency: Isolating the ETCS onboard subsystem when an OTM is performing its intended track maintenance functions within a possession, the requirement for an authorised person to be available to de-isolate the ETCS onboard subsystem and the additional time needed to restart the system might result in delays to the OTM being able to clear the line for traffic.

G 3.9.2.4 Safe integration: This requirement is used to control *Hazard OB-H003*.

**Guidance**

G 3.9.2.5 OTMs that work only within a possession might be operated with an active ETCS onboard subsystem (for example, in NL, or using Shunting (SH) and PS).

G 3.9.2.6 Also, OTMs may undertake reverse movements and operate automatically in working mode.

## 3.10 Power supply

### 3.10.1 ETCS onboard subsystem: power supply availability

3.10.1.1 The trainborne power supply systems shall be configured to maintain the operation of the ETCS onboard subsystem whilst the train is available for operation. (Normative)

**Rationale**

G 3.10.1.2 Availability: Failure of the power supply arrangements to the ETCS onboard subsystem has a direct impact on availability. The availability of the ETCS onboard subsystem influences the availability of the ETCS as a whole.

**Guidance**

G 3.10.1.3 When retrofitting a rail vehicle, existing train power systems might be inadequate for the ETCS onboard subsystem power requirements.

G 3.10.1.4 Options to achieve conformity with this requirement include either:

a) Cross-feeding of power from independent sources (for example, from other rail vehicles within a multiple unit); or
b) Provision of a backup power supply.

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### 3.10.2 ETCS onboard subsystem: temporary power supply interruptions

3.10.2.1 The ETCS onboard subsystem shall be tolerant of being de-energised before it has fully initialised. (Normative)

**Rationale**

G 3.10.2.2 Availability: The capability of the ETCS onboard subsystem to withstand temporary power supply interruptions during start-up/shut-down sequences has a direct impact on the availability of the ETCS onboard subsystem. The availability of the ETCS onboard subsystem influences the availability of the ETCS as a whole.

**Guidance**

G 3.10.2.3 It is feasible that electronic train systems will be energised temporarily during start-up/shutdown sequences or power supply disturbances, meaning that they do not go through their full power-up sequence.

G 3.10.2.4 Conformity with this requirement can be achieved by designing the ETCS onboard subsystem so that:

a) It will not be energised temporarily during start-up / shutdown sequences; or
b) it can tolerate such scenarios without being damaged or entering SF.

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### 3.10.3 ETCS onboard subsystem: power supply integration

3.10.3.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the power requirements of the ETCS onboard subsystem shall not affect the functionality of the existing rail vehicle power supply system. (Normative)

**Rationale**

G 3.10.3.2 Economic: It is economically beneficial to achieve ETCS onboard subsystem fitment so that the conformity assessment needed for authorisation is limited to conformity with the basic parameters applicable to the ETCS and its interfaces.

**Guidance**

G 3.10.3.3 None.

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### 3.10.4 ETCS onboard subsystem: rail vehicle power supply reliability

3.10.4.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the power requirements of the ETCS onboard subsystem shall not adversely affect the reliability of the existing rail vehicle power supply system. (Normative)

**Rationale**

G 3.10.4.2 Economic: It is economically beneficial to achieve ETCS onboard subsystem fitment so that the conformity assessment needed for authorisation is limited to conformity with the basic parameters applicable to the ETCS and its interfaces.

**Guidance**

G 3.10.4.3 Fitting the ETCS onboard to a rail vehicle adds a load to existing rail vehicle power systems, subjecting them to increased mechanical and/or electrical stresses which in turn may contribute to reducing their reliability. A reduction in reliability may occur if the rail vehicle power systems are normally operating at or near the maximum power output limits with the addition of the ETCS onboard subsystem electrical load.

G 3.10.4.4 A reliability assessment can be used to inform whether a modification to the rail vehicle power systems is required so that the additional electrical load of the ETCS onboard subsystem can be reliably supported. Modifications may include upgrades to power generation systems or additional back-up battery support being provided.

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### 3.10.5 ETCS onboard subsystem: power supply ranges

3.10.5.1 When retrofitting an ETCS onboard subsystem to a rail vehicle, the ETCS subsystem shall be able to operate over the full operating range of power supply voltages, surges and transients presented by the rail vehicle. (Normative)

**Rationale**

G 3.10.5.2 Availability: The capability to withstand power supply fluctuations has a direct impact on the availability of the ETCS onboard subsystem. The availability of the ETCS onboard subsystem influences the overall availability of the ETCS as a whole.

**Guidance**

G 3.10.5.3 Examples of power supply fluctuations that might impact on the ETCS onboard subsystem include:

a) Moments of significant demand (for example, when starting diesel engines). Severe voltage reductions occur when starting engines in diesel locomotives and multiple units.
b) Legacy power supplies on older rail vehicles might generate power supply perturbations, spikes and ripples well in excess of current standards. The present requirement, according to BS EN 50155:2021, is for a maximum of 5 % ripple on the nominal DC voltage. Legacy standards BS EN 50155:2007 and RIA12 place limits of 15 % and 30 % respectively, and even these limits may be exceeded on some older rail vehicles. An installation design that only meets current, or even legacy standards, might therefore not achieve conformity with this requirement.

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### 3.10.6 ETCS onboard subsystem: automatic energisation

3.10.6.1 The ETCS onboard subsystem shall energise automatically only when the primary source of power is available. (Normative)

**Rationale**

G 3.10.6.2 Reliability and Availability: Preventing the ETCS onboard subsystem from starting automatically when only battery power is available reduces the likelihood of the rail vehicle batteries becoming discharged.

G 3.10.6.3 Starting the ETCS automatically removes the need for a separate 'ETCS start' button.

**Guidance**

G 3.10.6.4 The specific trigger for this automatic energisation will be rail vehicle class-specific. In the context of this requirement, the primary source of power is a 25 kV AC / 750 V DC energy (ENE) subsystem supply, or when engines are running.

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### 3.10.7 ETCS onboard subsystem - manual energisation

3.10.7.1 It shall be possible to energise the ETCS onboard subsystem manually without the primary source of power being applied. (Normative)

**Rationale**

G 3.10.7.2 Asset management: This function provides the ability to energise parts of the ETCS onboard subsystem manually for some maintenance activities, as well as giving further scope for train rescue in the event of engine / electric failure.

**Guidance**

G 3.10.7.3 In the context of this requirement, the primary source of power is a 25 kV AC / 750 V DC ENE subsystem supply, or when engines are running. Conformity with this requirement implies that a back-up power supply is available (for example, a battery).

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### 3.10.8 ETCS onboard subsystem: maintaining essential services

3.10.8.1 In the event of a loss of primary power, the ETCS onboard subsystem shall be load shed before the rail vehicle's unsupported back-up power voltage becomes critically low. (Normative)

**Rationale**

G 3.10.8.2 Reliability and Availability: Maintaining only essential services reduces the likelihood of the rail vehicle batteries becoming discharged by the ETCS after loss of primary power.

**Guidance**

G 3.10.8.3 In the context of this requirement, the primary source of power on trains that are to be retrofitted with an ETCS onboard subsystem is expected to be 25 kV AC / 750 V DC supply, or when engines are running. For new trains, including new trains which are not delivered with an ETCS onboard subsystem but are subsequently retrofitted, other primary power sources may be provided.

G 3.10.8.4 In the context of this requirement critically low unsupported back-up power voltage means an inability to power other higher priority rail vehicle systems for the required

duration, for example, emergency lighting, voice radio, or the ability to re-start the vehicle engine.

G 3.10.8.5 'Critically low' is a rail vehicle-specific definition.

G 3.10.8.6 Retrofitted ETCS onboard subsystems are not expected to de-power as soon as primary power is lost (for example, during neutral sections, traction gaps, or overhead line equipment (OLE) trips). However, it would be undesirable for the ETCS onboard subsystem to consume the remaining battery power in order to remain energised if primary power is lost for a significant period. In doing so, other rail vehicle systems could be depowered and/or the batteries become too discharged to restart the engine. For retrofitted electric traction, a class-specific delay of 10 minutes or more is considered to be sufficient to mitigate the performance risk from the majority of unplanned interruptions in 25 kV / 750 V DC supply.

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### 3.10.9 ETCS onboard subsystem: resilience to loss of primary power supply

3.10.9.1 The ETCS onboard subsystem implementation on new trains shall support the ETCS onboard subsystem remaining active for at least ten minutes after loss of primary power. (Normative)

3.10.9.2 The ETCS onboard subsystem implementation on retrofit trains shall support the ETCS onboard subsystem remaining active for at least ten minutes after loss of primary power. (Preferred)

**Rationale**

G 3.10.9.3 Integration with train operations: 10 minutes provides time for:

a) The train driver to decide the train stopping position; and
b) The train to reach that location after the primary power is lost.

G 3.10.9.4 Performance: 10 minutes is intended to mitigate the performance risk from the majority of unplanned interruptions in electrical power supply or rail vehicle engine operation.

**Guidance**

G 3.10.9.5 Common causes of temporary power supply interruptions include:

a) Conductor rail system gaps
b) OLE neutral sections
c) ENE subsystem trips
d) Temporary shutdown of engines.

G 3.10.9.6 Failures of the primary source of power that last significantly longer than 10 minutes are expected to be infrequent and result in situations where the additional delay of restarting the ETCS onboard subsystem is less significant.

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## 3.11 Cab detection

### 3.11.1 ETCS 'cab active' signal derivation

3.11.1.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the ETCS ‘cab active’ signal shall be derived from existing rail vehicle controls. (Normative)

**Rationale**

G 3.11.1.2 Integration with train operations: Using existing cab controls is intended to avoid the cost and complexity of introducing additional controls. It is also intended to reduce any risk arising from human error in undertaking additional actions to provide the 'cab active' signal.

**Guidance**

G 3.11.1.3 This requirement is predicated on the existing rail vehicle controls being of sufficient reliability and integrity to meet the needs of providing the ETCS 'cab active' signal.

G 3.11.1.4 Existing cab controls that could be used to derive the ETCS 'cab active' signal include but are not limited to:

a) Cab open switch
b) Direction controller.

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### 3.11.2 ETCS 'sleeping requested' signal derivation

3.11.2.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the ETCS ‘sleeping requested’ signal shall be derived from existing rail vehicle controls. (Normative)

3.11.2.2 When retrofitting a rail vehicle with an ETCS onboard subsystem, and where existing rail vehicle controls cannot support the derivation of the ETCS 'sleeping requested' signal, the provision of new controls shall not affect any existing compatibility of the rail vehicle with other types of rail vehicles, or unfitted rail vehicles of the same type. (Normative)

**Rationale**

G 3.11.2.3 Integration with train operations: Additional controls or wiring might affect compatibility with other types of rail vehicles, or unfitted rail vehicles of the same type.

**Guidance**

G 3.11.2.4 None.

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### 3.11.3 Remote closing of a cab

3.11.3.1 For new trains, the ETCS onboard subsystem shall be configured so that an open desk can be closed from another cab within the same rail vehicle or train, subject to certain conditions being met. (Application specific)

**Rationale**

G 3.11.3.2 Integration with train operations: Remotely closing the desk means that a train driver does not need to access multiple driving cabs in order to close an open desk when opening the cab that will be used to drive the train.

**Guidance**

G 3.11.3.3 Examples of applicable conditions include:

a) The enabling of the cab active signal within another cab of the train
b) The operation of driving controls within another cab of the train.

G 3.11.3.4 Likewise, certain circumstances may prevent the active cab being remotely cancelled. For example:

a) The rail vehicle is moving; or
b) A direction is still selected in the original cab.

G 3.11.3.5 Such a method of remotely closing the desk means that the 'cab open' function might be better served by a push button or train management system option, rather than a physical switch or key that cannot be remotely reset.

G 3.11.3.6 If implementing this requirement, it is good practice to consider how this function may interact with any cab security functions implemented in response to clause *3.21.1*.

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### 3.11.4 Automatic cab closure

3.11.4.1 For new trains, the ETCS onboard subsystem shall be configured so that an open desk will automatically close after a configurable time delay, subject to certain conditions being met. (Application specific)

**Rationale**

G 3.11.4.2 Integration with train operations: The train driver might need to leave the cab for an unspecified time period to deal with an unplanned event. This facility allows a train operator to control the hazard of an open cab desk without the train driver being present.

**Guidance**

G 3.11.4.3 Whilst desk closure is beneficial for security, there are operational benefits to leaving it open in certain circumstances.

G 3.11.4.4 Applicable conditions include those that are consistent with the train driver having exited the cab, for example:

a) The rail vehicle is stationary
b) No direction is selected
c) There has been no human interaction with the DMI or controls for a predetermined time period.

G 3.11.4.5 The time delay will be determined by the train operator. For example, 30 minutes might be needed to account for the train driver leaving the cab to attend to an incident.

G 3.11.4.6 If implementing this requirement, it is good practice to consider:

a) How this function may interact with any cab security functions implemented in response to clause *3.21.1*.
b) How this function impacts on other in-cab systems, for example the GSM-R voice radio, where it may be beneficial not to have them affected by this automatic cab closure.

## 3.12 Self-test

### 3.12.1 ETCS onboard subsystem status indications

3.12.1.1 The ETCS onboard subsystem shall automatically indicate to the train driver whether the ETCS is functioning safely and correctly. (Normative)

**Rationale**

G 3.12.1.2 Integration with train operations: The train driver needs to confirm that the ETCS is functioning safely and correctly before it is used to control the rail vehicle or train movement.

G 3.12.1.3 Safe integration: An ETCS onboard subsystem that is not functioning safely and correctly could compromise the safety or performance of train operations.

G 3.12.1.4 Safe integration: This requirement is used to control *Hazard OB-H004*.

**Guidance**

G 3.12.1.5 This requirement applies to:

a) Initialisation self tests performed at power up and/or when a driving cab is made active. An indication that the ETCS is not functioning safely and correctly at this point could, for example, lead to the train not entering service or being restricted to operations on non-ETCS fitted lines.
b) Continuous in-service health monitoring routines. An indication that the ETCS is not functioning safely and correctly could, for example, lead to the train already in service being turned back before entering an ETCS fitted line.

G 3.12.1.6 Initialisation self-tests or in-service health monitoring routines include checking the following:

a) That the ETCS DMI connection is working
b) That the relevant balise reader is verified
c) That other relevant ERTMS/ETCS onboard subsystem equipment is confirmed healthy by the system check.

G 3.12.1.7 'Safely and correctly' means that the ETCS onboard subsystem is healthy and fit for purpose.

G 3.12.1.8 The indication can be displayed using the ETCS DMI.

### 3.12.2 ETCS onboard subsystem self-test and health monitoring routines

3.12.2.1 The ETCS onboard subsystem shall be capable of performing any initialisation self-test and continuous in-service health monitoring routines without the presence of specific ETCS trackside infrastructure. (Normative)

**Rationale**

G 3.12.2.2 Integration with train operations: In some cases, it will be necessary to initialise the ETCS onboard subsystem, or run the in-service health monitoring routines when the rail vehicle is located away from infrastructure fitted with the ETCS.

**Guidance**

G 3.12.2.3 None.

### 3.12.3 ETCS onboard subsystem self-test routine - remote vehicle starting

3.12.3.1 The ETCS onboard subsystem shall be capable of performing any initialisation self-test routines without an operator being present during the course of the test. (Normative)

**Rationale**

G 3.12.3.2 Integration with train operations: In some cases, the ETCS onboard subsystem, or initialisation self-test routine, will use remote vehicle starting, allowing the unit to be prepared for ETCS start of mission before the train driver is present in the cab.

**Guidance**

G 3.12.3.3 Although the initialisation self test is performed without an operator present, there is no industry requirement for the rectification of detected faults or failures to be undertaken remotely.

### 3.12.4 ETCS onboard subsystem: self-test and in-service health monitoring result indications

3.12.4.1 The results of any ETCS onboard subsystem initialisation self-test and in-service health monitoring routines shall be displayed in a succinct, intuitive form. (Normative)

**Rationale**

G 3.12.4.2 Integration with train operations: The appearance of the presented information impacts on the ability of the train driver to interpret the results of the tests. A display that is difficult to interpret might adversely affect safety or performance.

**Guidance**

G 3.12.4.3 Displaying information using concise plain English text will support train drivers' understanding of the test results. Displaying information using non-English languages

or as a series of fault codes which need to be translated or interpreted would not meet the requirement.

## 3.13 ETCS DMI

### 3.13.1 ETCS default level list: Level NTC, NID_NTC=20 and 21

3.13.1.1 Where a train is fitted with AWS/TPWS onboard equipment, Level NTC, NID_NTC=20 and Level NTC, NID_NTC=21 shall be included in the default list configured in the ETCS onboard subsystem. (Normative)

**Rationale**

G 3.13.1.2 Integration with train operations: This is necessary so that Level NTC, NID_NTC=20 and 21 can be selected by the train driver when the trackside supported level is not available onboard. The default list is configured in the ETCS onboard subsystem.

G 3.13.1.3 Integration with train operations: Levels NTC, NID_NTC=20 and 21, are required as part of the GB system solution to manage drivers not authorised to operate under Levels 1, 2 or 3.

**Guidance**

G 3.13.1.4 Level NTC, NID_NTC=20 and 21, is described in clause *4.2*.

### 3.13.2 ETCS DMI indications: Level NTC, NID_NTC=20

3.13.2.1 Level NTC, NID_NTC=20, shall be displayed as 'TPWS>' on the ETCS DMI.(Normative)

3.13.2.2 The height of the chevron symbol '>' shall be the same as the height of the 'TPWS' characters. (Normative)

**Rationale**

G 3.13.2.3 Integration with train operations: Displaying distinctive, consistent, informative indications supports train driver knowledge retention and learning.

**Guidance**

G 3.13.2.4 Level NTC, NID_NTC=20 is described in clause *4.2*.

G 3.13.2.5 These requirements apply to symbols LE02, LE08 and LE09 as set out in section 13.2 of ERA_ERTMS_015560.

G 3.13.2.6 The chevron symbol '>' is based on the greater-than sign (U+003E) in accordance with the ISO/IEC 8859-1:1998 character set.

### 3.13.3 ETCS DMI indications: Level NTC, NID_NTC=21

3.13.3.1 Level NTC, NID_NTC=21, shall be displayed as 'TPWS Fixed' on the ETCS DMI. (Normative)

3.13.3.2 Symbol number LE02 for NID_NTC = 21 shall be displayed with the background colour Grey (Red:195; Green: 195; Blue: 195) and the text colour Dark Blue (Red: 3; Green: 17; Blue: 34). (Normative)

**Rationale**

G 3.13.3.3 Integration with train operations: Displaying distinctive, consistent, informative indications support train driver knowledge retention and learning.

G 3.13.3.4 Integration with train operations: The use of the inverse colours for symbol LE02 further supports the train driver in differentiating Level NTC, NID_NTC=20 ('TPWS>') and Level NTC, NID_NTC=21 ('TPWS Fixed').

**Guidance**

G 3.13.3.5 Level NTC, NID_NTC=21 is set out in clause *3.24*. This requirement applies only when Level NTC, NID_NTC=21 is implemented.

G 3.13.3.6 This requirement applies to symbols LE02, LE08 and LE09 as set out in section 13.1 of ERA_ERTMS_015560, and only when Level NTC, NID_NTC=21 is implemented.

G 3.13.3.7 Display of the 'TPWS Fixed' text within the relevant symbols can be achieved with all the text in one line ('TPWS Fixed') or in two separate lines ( 'TPWS' above 'Fixed'). The latter might permit the text to be slightly larger within the constraints of the symbol and button sizes and to make the text more readable.

G 3.13.3.8 Symbols number LE08 and LE09 for Level NTC, NID_NTC=21 are displayed with the background colour Dark Blue (Red: 3; Green: 17; Blue: 34) and the text colour Grey (Red:195; Green: 195; Blue: 195) or Yellow (Red: 223; Green: 223; Blue: 0) as set out in sections 13.1 and 13.2 of ERA_ERTMS_015560.

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### 3.13.4 ETCS DMI indications: Level NTC, NID_NTC=14

3.13.4.1 Level NTC, NID_NTC=14 shall be displayed as 'TVM' on the ETCS DMI. (Application specific)

**Rationale**

G 3.13.4.2 Integration with train operations: Displaying distinctive, consistent, informative indications support train driver knowledge retention and learning.

**Guidance**

G 3.13.4.3 The integration of ETCS with Transmission Voie-Machine (TVM) is described in clause *4.5*.

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### 3.13.5 ETCS DMI indications: Level NTC (CBTC)

3.13.5.1 Level NTC (CBTC) shall be displayed as 'CBTC' on the ETCS DMI. (Application specific)

**Rationale**

G 3.13.5.2 Integration with train operations: Displaying distinctive, consistent, informative indications support train driver knowledge retention and learning.

**Guidance**

G 3.13.5.3 The integration of ETCS with Communication-based Train Control (CBTC) systems is described in clause *4.5*.

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### 3.13.6 ETCS DMI indications: Level NTC level selection buttons

3.13.6.1 Where Level NTC, NID_NTC=20 is implemented onboard: (Normative)

a) Button 7 on the ERTMS/ETCS level window shall be used for the selection of Level NTC, NID_NTC=20; and
b) The button 7 label shall be 'TPWS>; and
c) The height of the '>' symbol shall be the same as the height of the 'TPWS' characters.

3.13.6.2 Where Level NTC, NID_NTC=21 is implemented onboard: (Normative)

a) Button 9 on the ERTMS/ETCS level window shall be used for the selection of Level NTC, NID_NTC=21; and
b) The button 9 label shall be 'TPWS Fixed'.

**Rationale**

G 3.13.6.3 Integration with train operations: Providing a consistent layout of the level selection buttons, and separation (of one button) between the two AWS/TPWS levels where both are implemented onboard, minimises the impact of incorrect level selection by the train driver.

**Guidance**

G 3.13.6.4 The level buttons displayed on the DMI ETCS level window will only be those which the train supports – the availability of the buttons is dependent on the onboard-configured default list and the status of the stored priority table of the trackside supported levels.

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### 3.13.7 ETCS DMI displays and controls: location and arrangement

3.13.7.1 The ETCS DMI shall comply with the principles set out in BS EN 894-1:1997 Chapter 4. (Preferred)

**Rationale**

G 3.13.7.2 Integration with train operations: The location and arrangement of DMI displays and controls influences the likelihood of human error during train operations.

**Guidance**

G 3.13.7.3 BS EN 894-1:1997 Chapter 4 sets out ergonomic requirements for the location and arrangement of displays and control actuators in order to avoid hazards associated with their use from poor design.

G 3.13.7.4 The requirements in BS EN 894-1:1997 are complementary to the ERTMS/ETCS specifications published by the ERA, including ERA_ERTMS_015560, and are applicable when integrating other onboard system displays and control actuators with those defined for display on the ETCS DMI within the ERTMS/ETCS specifications,. The requirements are also applicable when locating ETCS controls or indications that do not utilise the ETCS DMI in the driving cab, for example the location and appearance of separate ETCS acknowledgement controls, ETCS reset controls, or ETCS isolation indications. Conformity with the ERA specifications takes precedence.

G 3.13.7.5 The ETCS DMI is the primary train driver control and speedometer as set out in GMRT2161.

G 3.13.7.6 Consultation on the proposed design with end-users is essential in reaching a conclusion that the ETCS DMI can be integrated with train operations.

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### 3.13.8 ETCS DMI: physical input devices

3.13.8.1 ETCS related input devices shall comply with BS EN ISO 9241-400:2007 section 4.2. (Preferred).

**Rationale**

G 3.13.8.2 Integration with train operations: The design of ETCS DMI displays and controls influences the likelihood of human error during train operations.

**Guidance**

G 3.13.8.3 ETCS-related input devices may include those that do not utilise the ETCS DMI touchscreen or softkey devices, such as separate ETCS acknowledgement controls, ETCS reset controls, or set speed value input devices.

G 3.13.8.4 BS EN ISO 9241-400:2007 section 4.2 sets out design requirements for physical input devices. The requirements are complementary to the ERTMS/ETCS specifications published by the ERA, including ERA_ERTMS_015560.

G 3.13.8.5 Conformity with the ERA specifications takes precedence.

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### 3.13.9 ETCS DMI: legibility

3.13.9.1 The ETCS DMI installation shall meet the requirements for legibility in the cab environment set out in BS EN 894-2:1997. (Preferred)

**Rationale**

G 3.13.9.2 Integration with train operations: The legibility of ETCS DMI displays and controls influences the likelihood of human error during train operations.

**Guidance**

G 3.13.9.3 BS EN 894-2:1997 refers to the clarity of the artefacts on the display compared with the display background once factors such as lighting, backlighting, reflections and vibration are taken into account.

G 3.13.9.4 Compliance with this requirement includes demonstration of acceptable legibility in the cab environment of display artefacts not specified in ERA_ERTMS_015560, for example those related to a Class B system where this has been integrated with the ETCS DMI.

G 3.13.9.5 Legibility of display artefacts may be affected by a number of installation factors, including:

a) The ratio of foreground to background luminance
b) The possibility of reflection of other light sources, both inside and outside the driving cab
c) The distance from the train driver's eye to, and the size of, the display artefacts.

G 3.13.9.6 The requirements are complementary to the ERTMS/ETCS specifications published by the ERA, including ERA_ERTMS_015560. Conformity with the ERA specifications takes precedence.

G 3.13.9.7 Requirements for train driver's visual acuity are set out in RIS-3451-TOM.

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### 3.13.10 Position of ETCS DMI displays and controls

3.13.10.1 The position of the ETCS DMI and ETCS-related controls in the driving cab shall meet the requirements for the positioning of displays as set out in BS EN 16186-2:2017 section 7.2. (Preferred)

**Rationale**

G 3.13.10.2 Integration with train operations: The position of ETCS DMI displays and controls relative to the train driver influences the likelihood of human error during train operations.

**Guidance**

G 3.13.10.3 The requirements are complementary to the ERTMS/ETCS specifications published by the ERA, including ERA_ERTMS_015560. Conformity with the ERA specifications takes precedence.

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### 3.13.11 ETCS DMI: response time

3.13.11.1 The ETCS DMI shall respond to any manual input within a time that will not be perceived by the driver as requiring further action. (Normative)

**Rationale**

G 3.13.11.2 Integration with train operations: The ETCS DMI response time influences the likelihood of human error during train operations. A response time that is too long

might be perceived as requiring further action by the train driver and cause a distraction.

**Guidance**

G 3.13.11.3 Typically available touch screen displays offer feedback times of around 100 ms. BS EN ISO 9241-420:2011 Table H.131 recommends feedback in under 20 ms for an action with a touch screen display; this represents the ultimate target to limit the perception of delay.

G 3.13.11.4 While it is accepted that response times for different ETCS DMI interactions might vary due to delays in DMI to EVC data exchange or EVC processing delays due to safety critical touch operations needing to be validated and checked before a response, these variations are minimised as far as possible.

G 3.13.11.5 ERA_ERTMS_015560 defines some of the DMI controls to be of the delay type. A delay type control requires the button to be pressed and held for 2 seconds before the required action is taken. These delays do not need to be considered when demonstrating compliance with this requirement.

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### 3.13.12 ETCS DMI: display rendering

3.13.12.1 Graphical objects on the ETCS DMI shall be fully rendered and displayed within 20 ms of new DMI display data being received by the DMI display. (Normative)

**Rationale**

G 3.13.12.2 Integration with train operations: The rendering and display time influences the likelihood of human error during train operations. A response time greater than 20 ms might be distracting to the train driver and could result in the train driver acting on an incorrect DMI state.

**Guidance**

G 3.13.12.3 A typical liquid crystal display (LCD) panel has a response time of less than 20 ms for the pixels of the screen to change to the required state once commanded to do so.

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### 3.13.13 ETCS DMI: cab position

3.13.13.1 The ETCS DMI shall be positioned in the cab so that the train driver can interact with the ETCS DMI display area from the normal driving position, without being impeded by other cab equipment, controls or structures. (Preferred)

**Rationale**

G 3.13.13.2 Integration with train operations: The train driving task includes train driver interaction with the ETCS DMI at any time. Any driving cab features that obscure the DMI screen or make interaction more difficult would influence the likelihood of human error during train operations.

**Guidance**

G 3.13.13.3 Potential train driver errors include:

a) Misreading or misinterpreting a display presented on the DMI; and
b) Accidental operation of the DMI while using adjacent vehicle controls.

G 3.13.13.4 Further guidance on cab layouts is set out in BS EN 16186-2:2017.

### 3.13.14 ETCS DMI: luminance

3.13.14.1 The ETCS DMI luminance shall adjust automatically in response to changing cab lighting levels. (Normative)

**Rationale**

G 3.13.14.2 Integration with train operations: ETCS DMI luminance is one of the factors that supports and influences readability of the presented displays. Cab lighting level changes are influenced by ambient and environmental conditions. It is not practical to expect the train driver to be able to adjust the ETCS DMI brightness manually for quickly changing cab lighting levels (for example, on entering a tunnel).

**Guidance**

G 3.13.14.3 Readability of the ETCS DMI can be managed by tailoring the automatic luminance settings to the rail vehicle cab environment.

### 3.13.15 ETCS DMI: manual luminance adjustment

3.13.15.1 Manual ETCS DMI luminance adjustment shall be simple to achieve whilst the rail vehicle is being driven. (Normative)

**Rationale**

G 3.13.15.2 Integration with train operations: The train driver uses the manual luminance adjustment to fine tune the brightness around the automatic set point. Easy adjustment minimises the impact on the train driving task.

**Guidance**

G 3.13.15.3 Simple external controls (set out as options in ERA_ERTMS_015560), or minimal menu navigation can support the train driving task. Adjusting the luminance using multiple DMI menus would be a distraction to the train driving task.

### 3.13.16 ETCS DMI: minimum luminance setting

3.13.16.1 It shall be possible for an authorised person to preconfigure limits within which the train driver can manually adjust the luminance of the ETCS DMI display. (Normative)

3.13.16.2 The minimum limit to which the luminance of the ETCS DMI display can be reduced shall provide sufficient luminance so that the visual information displayed on the ETCS DMI can be reliably read. (Normative)

**Rationale**

G 3.13.16.3 Integration with train operations: The train driving task includes reading and interpreting the information visually presented on the ETCS DMI and the train driver's ability to do this is dependent upon the luminance settings.

G 3.13.16.4 Safe integration: This requirement is used to control *Hazard OB-H007*.

**Guidance**

G 3.13.16.5 The process for assessing, determining, setting and adjusting the minimum ETCS DMI display luminance that a train driver can select includes:

a) Competent personnel assessing and setting the range within which luminance of the ETCS DMI display can be adjusted.
b) Restricting permissions to adjust the luminance range to authorised personnel via a controlled method. Authorised personnel could include railway undertaking staff, train maintenance staff, or a representative of the ETCS onboard equipment supplier working under contract. In this context, a controlled method is one whose application can be restricted to only those authorised to use it. Examples of controlled methods include the use of a mechanical key, an electronic key, or a one-time reset code. A 'T' key or a train driver's key does not meet the criteria of a controlled method.

G 3.13.16.6 Human factors assessment can be used to determine the suitability of methods of brightness adjustment. Natural and artificial lighting conditions, including incidental lighting, are considered in processes for determining the full range of ambient cab lighting levels under which the brightness can be adjusted.

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### 3.13.17 ETCS DMI: manual volume adjustment

3.13.17.1 Manual ETCS DMI loudspeaker volume adjustment shall be simple to achieve whilst the rail vehicle is being driven. (Normative)

**Rationale**

G 3.13.17.2 Integration with train operations: Easy ETCS DMI loudspeaker volume adjustment minimises the impact on the train driving task.

**Guidance**

G 3.13.17.3 Simple external controls (set out as options in ERA_ERTMS_015560) or minimal menu navigation mitigates the risk of train driver distraction.

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### 3.13.18 ETCS DMI: minimum volume setting

3.13.18.1 It shall be possible for an authorised person to preconfigure limits within which the train driver can manually adjust the ETCS DMI loudspeaker volume. (Normative)

3.13.18.2 The preconfigured limits shall be determined such that the train driver can reliably interpret ETCS audible information above the ambient noise in the driving cab at all speeds throughout the operational context applicable to the rail vehicle. (Normative)

3.13.18.3 The minimum limit to which the train driver can reduce the ETCS DMI loudspeaker volume shall provide sufficient volume so that the audible information presented by the ETCS DMI can be reliably interpreted. (Normative)

**Rationale**

G 3.13.18.4 Safe integration: The train driving task includes hearing and interpreting the information audibly presented by the ETCS DMI and the train driver's ability to do this is dependent upon the loudspeaker volume settings.

G 3.13.18.5 Safe integration: This requirement is used to control *Hazard OB-H005*.

**Guidance**

G 3.13.18.6 Information audibility in the operational context is supported and influenced by the position and alignment of the loudspeaker and the volume settings. Audibility can be adversely affected by ambient noise, including that generated by:

a) The wheel/rail interface
b) External environmental conditions, for example wind and rain
c) Reflected sound from tunnels.

G 3.13.18.7 Section 14 of ERA_ERTMS_015560 sets out the audible information requirements for the ETCS DMI.

G 3.13.18.8 The process for assessing, determining, setting and adjusting the minimum loudspeaker volume that a train driver can select includes:

a) Competent personnel assessing and setting the range within which volume of the ETCS DMI loudspeaker volume can be adjusted. The assessment identifies and considers background noise in the driving cab at all speeds throughout the operational context applicable to the rail vehicle.
b) Restricting permissions to adjust the volume range to authorised personnel via a controlled method. Authorised personnel could include railway undertaking staff, train maintenance staff, or a representative of the ETCS onboard equipment supplier working under contract. In this context, a controlled method is one whose whose application can be restricted to only those authorised to use it. Examples of controlled methods include the use of a mechanical key, an electronic key, or a one-time reset code. A 'T' key or a train driver's key does not meet the criteria of a controlled method.

G 3.13.18.9 The LOC & PAS NTSN clause 4.2.9.3.4 (5) requires that 'audible information generated by on-board equipment inside the cab for the driver shall be at least 6 dB(A) above the noise level in the cab (this noise level taken as reference being measured under conditions specified in the NTSN Noise).' However,

a) This requirement may not apply when retrofitting a vehicle with an ETCS onboard subsystem; and
b) Setting the minimum volume to 6dB above the minimum cab noise levels may not be sufficient to guarantee that audible information can be reliably interpreted.

G 3.13.18.10 Requirements for train driver's hearing are set out in RIS-3451-TOM.

### 3.13.19 ETCS display and indications luminance

3.13.19.1 The brightness of the ETCS DMI shall be adjustable to be viewed comfortably over the full range of ambient cab lighting levels. (Normative)

3.13.19.2 The brightness of ETCS cab indications shall be adjustable to be viewed comfortably over the full range of ambient cab lighting levels. (Normative)

**Rationale**

G 3.13.19.3 Integration with train operations: ETCS DMI and ETCS cab indication brightness are factors that support and influence readability of the presented displays. The range of adjustment is needed to accommodate the range of ambient light levels.

**Guidance**

G 3.13.19.4 Previous experience of ETCS onboard subsystems has shown that the brightness of the cab indications and ETCS DMI needs to be sufficiently variable to accommodate a wide range of ambient lighting levels, as well as train driver preference. This is especially important for dark conditions where excessive luminance can affect the train driver's night vision.

G 3.13.19.5 Good practice is to undertake an analysis of suitable display screens before a type is selected because technology is frequently improving. Evidence from experience suggests that a display using light-emitting diode (LED) backlit technology provides benefits including:

a) Low maintenance cost
b) Low heat emission
c) A suitable range of luminance.

### 3.13.20 ETCS DMI: failure indication

3.13.20.1 The ETCS DMI shall not freeze or otherwise fail without the train driver being made aware. (Normative)

**Rationale**

G 3.13.20.2 Safe integration: The train driver needs to be aware that the ETCS DMI information can no longer be relied upon.

G 3.13.20.3 Safe integration: This requirement is used to control *Hazard OB-H006*.

**Guidance**

G 3.13.20.4 Should the DMI freeze during operation or start-up, it might not be immediately apparent to the train driver. Delays in recognising this failure could adversely affect train operations. Conformity with this requirement can be achieved by either eradicating failure modes that result in a DMI freeze and hidden failure, or by

providing a positive and obvious indication of the DMI function at all times, for example a heartbeat indication or rotating icons.

## 3.14 Data entry and interaction

### 3.14.1 ETCS DMI: data entry process

3.14.1.1 The ETCS DMI data entry process shall minimise the likelihood of train driver error when selecting the train type or entering parameters. (Normative)

**Rationale**

G 3.14.1.2 Safe integration: The train driver is responsible for selecting train type and parameters. Correct data entry is essential for safe and optimal performance.

G 3.14.1.3 Safe integration: This requirement is used to control *Hazard OB-H008*.

**Guidance**

G 3.14.1.4 Clear and intuitive labelling of train types and range-checking of flexible data entry parameters can contribute to meeting this requirement.

G 3.14.1.5 Section 10.3.4 of ERA_ERTMS_015560 sets out requirements for data checks to verify correct entry of data.

### 3.14.2 ETCS DMI: data entry completion time

3.14.2.1 The ETCS DMI data entry process shall be configured to enable data entry to be completed within 60 seconds of the ETCS onboard subsystem being ready to accept data entry in SB (Status S0). (Preferred)

**Rationale**

G 3.14.2.2 Efficiency: Minimising the time taken to complete ETCS data entry reduces the overall time taken to prepare the train to start a journey.

**Guidance**

G 3.14.2.3 ERA_ERTMS_015560 specifies the DMI data entry process; however, there are certain elements which can be configured to minimise train driver workload, including:

a) Rationalisation of train types to an easily interpreted set
b) Auto-population of some aspects of train data where it is fixed or known from other systems
c) Non-display of data options that are not appropriate to that installation of the ETCS onboard subsystem.

### 3.14.3 ETCS DMI: fixed, variable or switchable data entry

3.14.3.1 It shall be possible for an authorised person to re-configure the ETCS DMI for fixed, variable or switchable data entry. (Normative).

**Rationale**

G 3.14.3.2 Integration with train operations: This capability has operational benefit because it enables a rail vehicle fitted with an ETCS onboard subsystem to be transferred to a different train operator or be used for different operational contexts during its life cycle.

**Guidance**

G 3.14.3.3 ERA_ERTMS_015560 permits fixed, flexible and switchable train data entry.

G 3.14.3.4 An authorised person may include a railway undertaking staff member, train maintainer, or a representative of the ETCS onboard equipment supplier working under contract.

G 3.14.3.5 This requirement assumes that train data is entered via an ETCS DMI, rather than automatically populated from onboard systems.

G 3.14.3.6 ERA_ERTMS_015560 only specifies data entry in metric units. This includes data relating to speed and distance.

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### 3.14.4 ETCS DMI: definition of train types

3.14.4.1 Railway undertakings shall define the train types required for regular train formations. (Normative)

3.14.4.2 The ETCS onboard shall be configured with the train types defined by the railway undertaking. (Normative)

**Rationale**

G 3.14.4.3 Integration with train operations: The use of train types, and the associated train data, reduces the likelihood of data transcription errors.

**Guidance**

G 3.14.4.4 Train types are configured in the ETCS onboard subsystem and represent a combination of the train data applicable to that train type. Train type can be selected by the driver during data entry activities instead of the driver entering individual train data values. Train types may be referred to colloquially as 'presets'.

G 3.14.4.5 It is beneficial to define train types for multiple unit, fixed formation trains and regularly used formations. Train types for regular train formations can include those for predictable degraded operations and other train formations.

G 3.14.4.6 The number of train types displayed at any time is limited as set out in sections 10.3.5 and 10.3.6 of ERA_ERTMS_015560.

G 3.14.4.7 Consultation with other railway undertakings may be appropriate where the train class is used by multiple railway undertakings.

G 3.14.4.8 The railway undertaking may determine that no train types are necessary and only variable data entry will used.

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### 3.14.5 ETCS DMI: quantity and naming of train type options

3.14.5.1 In defining train types, railway undertakings shall determine the quantity and naming of the options on the ETCS DMI. (Normative)

**Rationale**

G 3.14.5.2 Integration with train operations: Train drivers need to be able to reliably read and interpret the train type information to decide what train type to select. Reducing the number of train type options reduces the risks associated with selection of an incorrect train type.

**Guidance**

G 3.14.5.3 The number of train types displayed at any time is limited and the amount of text which can be displayed (and be readable) is also limited as set out in sections 10.3.5 and 10.3.6 of ERA_ERTMS_015560. Train driver frustration or misreading may lead to errors.

G 3.14.5.4 The onboard supplier uses the information provided by the railway undertaking to configure the ETCS onboard subsystem.

G 3.14.5.5 Consultation with other railway undertakings may be appropriate where the train class is used by multiple railway undertakings.

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### 3.14.6 ETCS DMI: single data entry

3.14.6.1 The need for multiple entry of any particular item of data shall be avoided through the linkage of cab systems by appropriate interfaces. (Application Specific)

3.14.6.2 There shall be a single, unified point of data entry for entering the train running number (TRN) into onboard systems. (Normative)

3.14.6.3 There shall be a single, unified point of data entry for entering the train driver identification number into onboard systems. (Application Specific)

**Rationale**

G 3.14.6.4 Efficiency: Entering the same data manually into multiple systems would extend the start of mission time, reducing route capacity and driving efficiency, and could result in an increase in data entry errors and data mismatch.

**Guidance**

G 3.14.6.5 The ETCS data within scope of this requirement is dependent on which data is required to be entered into multiple systems on a particular train. For example, it may only apply to the TRN and train driver identification number on trains where the only systems that require the same data are the ETCS onboard subsystem and the GSM-R voice radio system.

G 3.14.6.6 The ETCS specifications permit the population of the GSM-R voice radio TRN and train driver identification number from the ETCS data entry process. As a minimum, the GB application of ETCS implements this functionality. Furthermore, it is possible

that the train driver will enter the TRN and train driver identification number into other train systems, for example a train management system.

G 3.14.6.7 Data will be entered using one system and transmitted to other systems for subsequent train driver validation. The primary system used for the entry of data is specific to the rail vehicle and its proposed operations.

G 3.14.6.8 External systems that provide data to the ETCS onboard subsystem are of a high enough integrity to meet the ETCS data requirements. External systems might include onboard driving data recording systems and public address systems.

G 3.14.6.9 Where an interface between the ETCS onboard subsystem and the GSM-R voice radio is provided for the exchange of TRN and train driver identification number, it is operationally beneficial for this interface to be bidirectional to allow all data and any subsequent failure messages to be displayed in the same location. GERT8402 provides additional guidance on the design of this interface.

G 3.14.6.10 The exact specification for the design of any interface to the GSM-R voice radio will need to be confirmed with the cab radio supplier and Network Rail Telecoms (NRT) before implementing a solution.

G 3.14.6.11 The TRN may be transmitted between onboard systems in an all-numeric format. TRN entered in alphanumeric format can be converted to numeric using the algorithm in GERT8402 for transmission to other systems. These systems can then use the algorithm defined in GERT8402 to convert back to alphanumeric format for display.

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### 3.14.7 ETCS DMI: Alphanumeric entry of the Train Running Number

3.14.7.1 The ETCS onboard subsystem shall support alphanumeric entry of the TRN. (Normative)

**Rationale**

G 3.14.7.2 Integration with train operations: The CCS NTSN includes the GB specific case permitting the use of alphanumeric entry of the TRN on the GB mainline railway.

**Guidance**

G 3.14.7.3 The GB mainline railway currently uses an alphanumeric TRN to describe a train, unlike the standard numeric method employed within the ETCS. For as long as alphanumeric TRNs are required, and in order to retain operational consistency between ETCS-fitted and non ETCS-fitted trains, the ETCS will allow acceptance of alphanumeric TRN (which are convertible to numeric TRN via defined algorithms) in addition to numeric TRN.

G 3.14.7.4 GERT8402 sets out the requirements for implementing the specific case. The CCS NTSN requires the ability to enter a numeric TRN.

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### 3.14.8 ETCS train type data label configuration

3.14.8.1 ETCS train type data set labels shall be a configurable part of the data set. (Normative)

**Rationale**

G 3.14.8.2 Integration with train operations: A rail vehicle fitted with an ETCS onboard subsystem can be transferred to a different train operator or be used for different operational contexts during its life cycle. Changes to train type data labels may be necessary to support the train data entry task.

**Guidance**

G 3.14.8.3 The process of modifying train type data labels includes restricting permissions to authorised personnel.

G 3.14.8.4 An authorised person may include a railway undertaking staff member, train maintainer, or a representative of the ETCS onboard equipment supplier working under contract.

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### 3.14.9 ETCS data entry menu levels

3.14.9.1 The ETCS train type data entry process shall use no more than five menu levels. (Preferred)

**Rationale**

G 3.14.9.2 Integration with train operations: An excessive number of menu levels increases the likelihood of human error during the train type data entry process.

**Guidance**

G 3.14.9.3 Train type menus can be presented as a series of nested lists, that is where selection of one train type on the first list presents a second list of sub-types.

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### 3.14.10 ETCS train data range limits

3.14.10.1 It shall be possible for an authorised person to preconfigure limits within the ETCS onboard subsystem on the range of values for the ETCS train data. (Normative)

**Rationale**

G 3.14.10.2 Integration with train operations: The inclusion of constraints on acceptable values protects against human error during data entry.

**Guidance**

G 3.14.10.3 Where the train driver enters data (for example flexible data entry) rather than selecting a train type, restricting the range of values that the train driver can select or enter to realistic values controls the likelihood of human error. Examples of limits that could be specified include upper and lower limits for train length or lambda value.

G 3.14.10.4 This restriction on data entry may be placed within the ETCS onboard subsystem or an external system, for example the train management system, depending upon which is the primary train data entry system.

G 3.14.10.5 An authorised person, including for example railway undertaking staff, train maintenance staff, or a representative of the ETCS onboard equipment supplier

working under contract, needs a facility to amend the acceptable ranges for train data entered by the train driver.

### 3.14.11 ETCS DMI: data entry timeout

3.14.11.1 The ETCS onboard subsystem shall not impose a timeout limit on the data entry task. (Normative)

**Rationale**

G 3.14.11.2 Integration with train operations: Timeout restrictions on this task would create an unnecessary distraction that may lead to erroneous data entry.

**Guidance**

G 3.14.11.3 None.

### 3.14.12 ETCS DMI: remote data entry

3.14.12.1 The ETCS DMI interface shall support the future provision of a remote train data entry system. (Application specific)

**Rationale**

G 3.14.12.2 Economic: This provides for future system upgrade.

**Guidance**

G 3.14.12.3 Manual entry of train data (particularly lambda data entry) introduces the likelihood of incorrect braking data being used to populate the ETCS, thereby rendering the ETCS braking curves unsafe. Automatic data entry is believed to reduce some of the risk of error.

G 3.14.12.4 Clause *5.4.2* requires provision for a data connection to support remote population of train data. The ETCS DMI design needs to have corresponding functionality to make use of this.

G 3.14.12.5 The term ‘remote’, in this context, means a data source external to the ETCS DMI or EVC. This may be other train systems, or a source external to the train.

### 3.14.13 ETCS DMI: automatic population of train data

3.14.13.1 At start of mission, where the ETCS data is available from an external system, the ETCS onboard subsystem shall populate the ETCS data automatically for the train driver to accept or modify. (Application specific)

**Rationale**

G 3.14.13.2 Integration with train operations: Automatic data population reduces the likelihood of human error during manual data input.

**Guidance**

G 3.14.13.3 None.

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### 3.14.14 ETCS DMI: train driver vigilance interface

3.14.14.1 The vigilance timer in the cab shall be reset whenever the train driver presses any valid button on the ETCS DMI, or an external ETCS control, associated with a positive response to an ETCS generated request. (Preferred)

**Rationale**

G 3.14.14.2 Integration with train operations: This facilitates the safety purpose of the timer whilst minimising the train driving task in resetting the vigilance timer.

**Guidance**

G 3.14.14.3 Positive responses to an ETCS generated request include mode and level transition acknowledgements.

G 3.14.14.4 ERA_ERTMS_015560 permits the provision of external ETCS controls positioned in an ergonomic location on the train driver's desk.

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## 3.15 Set Speed function

### 3.15.1 Set speed system guidance

**Guidance**

G 3.15.1.1 In the context of the following requirements, a 'set speed' system is:

a) An onboard "cruise control" function that, when active, controls the train speed to, and maintains the train speed at, a set speed limit by automatically applying and removing traction demand. It includes, but is not limited to, cruise control equipment allowing for a wide range of speed limits to be set, for example as found on Class 90 and Class 91 locomotives, and slow speed controls (usually up to 5 mph) for continuous loading or unloading operations at terminals.
b) An onboard "speed limiter" function that, when active, requires the driver to manually control train speed but prevents the train speed exceeding a set speed limit.

G 3.15.1.2 In the requirements below a distinction is made between these two types of set speed systems where necessary.

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### 3.15.2 ETCS DMI: display of set speed

3.15.2.1 When a set speed function is active, the speed set point shall be displayed on the ETCS DMI speed dial. (Application specific)

**Rationale**

G 3.15.2.2 Integration with train operations: The set speed indication reminds the train driver that set speed is active during the train driving task.

**Guidance**

G 3.15.2.3 The functional requirements for the exchange of set speed information between the vehicle and the ETCS onboard subsystem are set out in Subset-034, and require that the set speed value information be transmitted in km/h to a resolution of 1 km/h. ERA_ERTMS_015560 sets out the display requirements for a set speed indication around the speed dial on the ETCS DMI. GERT8402 defines the requirements for the configuration of the ETCS DMI speed dial for indicating speed information in mph.

G 3.15.2.4 In meeting this requirement, consideration is given to the ETCS DMI being capable of displaying speed in mph and km/h, and how the display of the set speed indication at an appropriate set speed value is achieved for both km/h and mph display.

G 3.15.2.5 If the set speed input control is configured in discrete steps, consideration is given to the suitability of the step interval for the units of measurement in use. For example, a set speed input control configured only in 5 mph steps will not generally align to commonly used speed limit values on lines operated in km/h, and vice versa.

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### 3.15.3 Set speed disengagement

3.15.3.1 An active set speed function that controls train speed to, and maintains the train speed at a set speed limit by automatically applying and removing traction demand shall be disengaged immediately when the ETCS commands a brake intervention. (Application specific)

**Rationale**

G 3.15.3.2 Safe integration: It is possible that, on entering target speed monitoring, a set speed function that can automatically apply traction could cause an intervention. This requirement is intended to eliminate the possibility that, when ETCS stops the intervention (because the train speed is below the permitted speed), the set speed function does not try and increase speed to the previous level.

G 3.15.3.3 Safe integration: This requirement is used to control *Hazard OB-H018*.

**Guidance**

G 3.15.3.4 This requirement is only applicable to rail vehicles fitted with a set speed system, and only to those set speed systems that when active can automatically, i.e., without driver input , demand traction be applied to maintain train speed at the set speed limit. It does not apply to set speed functions that only limit the train speed to the set speed value.

G 3.15.3.5 Disengaging removes the ability for the set speed function to automatically demand traction be applied in an attempt to reach the set speed limit until this ability is re-enabled by the driver or other means.

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### 3.15.4 Set speed units

3.15.4.1 Where the set speed value is entered via, or displayed numerically on, the ETCS DMI then the same units as those used for the ETCS DMI speed dial shall be used. (Application specific)

3.15.4.2 Where the set speed value is entered via an external set speed system, the units of the set speed displayed on the ETCS DMI shall be consistent with the units shown on the external 'Set Speed' system. (Application specific)

**Rationale**

G 3.15.4.3 Safe integration: Showing different or inconsistent units of measurement on the set speed device and the speedometer increases the likelihood that a train driver will select an incorrect speed.

G 3.15.4.4 Safe integration: This requirement is used to control *Hazard OB-H009*.

**Guidance**

G 3.15.4.5 This requirement is only applicable to rail vehicles fitted with a set speed system.

G 3.15.4.6 Where an ETCS onboard subsystem is being retrofitted to a rail vehicle with an existing external set speed system, and noting that the ETCS DMI may be configured to display speeds in both mph and km/h, getting consistency between the units shown on the external set speed system and the ETCS DMI may not be possible without changes to the set speed system. Where changes to the external set speed system are not possible, examples of how conformity with this requirement can be achieved include:

a) Obscuring the existing external set speed system display
b) Using unitless values.

G 3.15.4.7 If the set speed input control is configured in discrete steps, consideration should be given to the suitability of the step interval for the units of measurement in use. For example, a set speed input control configured only in 5mph steps will not generally align to commonly used speed limit values on lines operated in km/h, and vice versa.

## 3.16 Speed display

### 3.16.1 Consistency of speed displays

3.16.1.1 Where multiple speedometers are active simultaneously within a cab, the speed displayed shall be consistent on all displays visible to the train driver in the normal driving position. (Normative)

**Rationale**

G 3.16.1.2 Safe integration: Providing multiple speedometers showing inconsistent speed values could adversely impact on the safe operation of the train.

G 3.16.1.3 Safe integration: This requirement is used to control *Hazard OB-H026*.

**Guidance**

G 3.16.1.4 The preferred methods of achieving compliance with this requirement are:

a) Concealing or deactivating all but the primary speed display in normal operation; or
b) Providing consistent displays on multiple speed displays.

G 3.16.1.5 Active means that the speed display is dynamically displaying the current train speed. A speed display that always displays zero speed is not considered active even though it will be consistent with the active speed display when the train is at a stand.

G 3.16.1.6 Risks which may arise with multiple active speed displays include:

a) Train driver distraction
b) Train driver confusion over the correct speed where inconsistent speed values are displayed, including where these speed values are displayed in different units.

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### 3.16.2 Displaying speed information when the ETCS onboard subsystem is isolated

3.16.2.1 Current train speed information shall be presented to the train driver whilst the ETCS onboard subsystem is in IS. (Normative)

**Rationale**

G 3.16.2.2 Safe integration: The train driver needs current train speed information to inform the train driving task, which may include operating the train when the ETCS onboard subsystem is isolated.

G 3.16.2.3 Safe integration: This requirement is used to control *Hazard OB-H026*.

**Guidance**

G 3.16.2.4 A current train speed display being available to the train driver when the ETCS onboard subsystem is in IS mitigates risks associated with having no ETCS speedometer due to ETCS failure; it also assists the train driver training programme in being able to run trains on unfitted lines, irrespective of ETCS train driver training.

G 3.16.2.5 Conformity with this requirement can be achieved by either:

a) Using the ETCS DMI to provide current train speed information, if a speed source can be provided when the broader ETCS functionality is isolated. This solution may be the more practical option (due to space / packaging constraints); or
b) Using an additional speed display (ASD) that is independent of the ETCS onboard subsystem. This option is non-preferred.

G 3.16.2.6 RIS-2004-RST sets out requirements for the accuracy of speed indicating systems.

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### 3.16.3 ETCS DMI: displayed speed units in Isolation

3.16.3.1 The current train speed displayed to the train driver while the ETCS onboard subsystem is in IS shall be in the correct units for the operating location. (Normative)

**Rationale**

G 3.16.3.2 Integration with train operations: Presenting speed information using units that are different to those usually used for that location would adversely impact on the train driving task.

G 3.16.3.3 Integration with train operations: Speed information, including that on lineside signage and in operating publications, may be provided in mph or km/h on different parts of the network as ETCS is rolled out.

**Guidance**

G 3.16.3.4 GERT8402 specifies how the ETCS onboard subsystem automatically determines the speed units to be used for the display of current train speed information on the ETCS DMI. When the ETCS onboard subsystem is in IS then this will not be available.

G 3.16.3.5 Where the speed display in IS is provided via the ETCS DMI, conformity with this requirement can be achieved by:

a) Dual marking (mph and km/h) of the ETCS DMI speed display when operating in IS, or
b) Train driver selection of the correct units (by an ETCS DMI option within IS, or an external switch), or
c) Other means.

G 3.16.3.6 Where the speed display in IS is provided via an ASD, for example a retained speedometer on retrofit trains or a speed display on the train management system, conformity with this requirement can be achieved by:

a) Dual marking (mph and km/h) of the ASD; or
b) Train driver selection of the correct units; or
c) Other means.

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### 3.16.4 ETCS DMI: dual marked speed display

3.16.4.1 Where the provision of speed information to the train driver while the ETCS onboard subsystem is in IS is via a dual marked speed display, the dominant scale shall be determined by the railway undertaking. (Normative)

**Rationale**

G 3.16.4.2 Integration with train operations: When operating in isolation, the train driver might need to refer to lineside speed signage that provides information in either mph or km/h.

**Guidance**

G 3.16.4.3 A dual marked speed display is one which displays a mph and km/h scale at the same time.

G 3.16.4.4 The dominant scale is the one which is the most visually obvious to the driver.

G 3.16.4.5 A dual marked speed display for use with the ETCS onboard subsystem in IS can be provided on the ETCS DMI, or as an ASD. Examples of an ASD include a retained

speedometer on retrofit trains or a speed display provided via a train management system.

G 3.16.4.6 Considerations for risk assessments carried out to support determining the dominant scale include:

a) The speed units predominantly in use in the train's intended area/s of operation; and
b) Where applicable, the impact of similar fleets having different dominant scales.

G 3.16.4.7 It may be appropriate for the dominant scale on a dual marked speed display to be configurable to allow for future changes in the train's area/s of operation.

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#### 3.16.5 ETCS DMI: ASD illumination

3.16.5.1 An ASD that is visible to the train driver while the ETCS onboard subsystem is not in IS, shall be illuminated in IS only, both in a colour, and with a luminance that matches existing cab instrumentation. (Normative)

**Rationale**

G 3.16.5.2 Integration with train operations: The train driver does not need to use the ASD when the speed information is presented on the ETCS DMI. When the ETCS DMI is not displaying the speed information, illuminating the ASD so that it has a similar appearance to other cab instrumentation helps the train driver identify the speed information and recognise that it is applicable.

**Guidance**

G 3.16.5.3 None.

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### 3.17 Odometry and tachometry system

#### 3.17.1 ETCS odometry system: calibration

3.17.1.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, calibration of the odometry system shall not require additional or more complex measurement of the wheels beyond that already performed on the rail vehicle for conventional purposes. (Normative)

**Rationale**

G 3.17.1.2 Economic: An odometry system that required enhanced measurement would adversely impact on the cost of rail vehicle maintenance operations and therefore the economics of railway operations.

**Guidance**

G 3.17.1.3 Rail vehicle wheelset maintenance includes routine, periodic measurement and recording of wheel sizes and tyre thicknesses at periodic intervals. These parameters are also accurately recorded whenever wheel tyres are 'turned'.

G 3.17.1.4 Conformity with this requirement means that:

a) Wheelset maintenance can continue using the existing skill level
b) The required frequency of wheel measurements does not increase
c) The wheel measurement process does not become more complicated
d) The required measurement accuracy will be no more difficult to achieve than it is for the current wheel measurement accuracy and method.

G 3.17.1.5 Automatic odometry calibration, needing no maintainer intervention at all for routine odometry calibration, is a method of meeting this requirement. Clause *3.17.3* sets out a further requirement on automatic odometery calibration.

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### 3.17.2 ETCS odometry system: rail vehicle maintenance

3.17.2.1 When retrofitting a rail vehicle with an ETCS onboard subsystem: (Normative)

a) The odometry system shall not require additional wheel turning or renewal to maintain accuracy in addition to that necessary for the physical wheel / rail interface; and
b) Tighter tolerances for wheel profiles than would otherwise be maintained shall not be specified.

**Rationale**

G 3.17.2.2 Economic: An odometry system that required additional wheel turning or renewal, compared with current asset management regimes, or tighter tolerances for wheel profiles would adversely impact on availability, the cost of rail vehicle maintenance operations, and therefore the economics of railway operations.

**Guidance**

G 3.17.2.3 Variations in distance measurement will occur as track and wheel profiles change with wear.

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### 3.17.3 ETCS odometry calibration: infrastructure constraints

3.17.3.1 ETCS odometry calibration shall not require specific additions or changes to the railway infrastructure on the GB mainline railway network. (Normative)

**Rationale**

G 3.17.3.2 Economic: An odometry system that required enhanced infrastructure provision could adversely impact on the cost of railway infrastructure provision and maintenance operations.

**Guidance**

G 3.17.3.3 The infrastructure manager for the GB mainline railway is not currently intending to make any special provision to facilitate an automatic calibration system for the ETCS onboard subsystem, including more accurate location of balise groups. Automatic calibration systems can rely only upon the ETCS infrastructure that would otherwise be available.

G 3.17.3.4 ETCS odometry calibration may include the automatic update of wheel diameters following wheel turning.

G 3.17.3.5 Infrastructure contained wholly within the confines of a train maintenance facility is excluded from this requirement.

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#### 3.17.4 Odometry error limit

3.17.4.1 The ETCS onboard subsystem shall determine its position with an error of no more that 1 % of distance travelled from the last relevant balise group when operating at constant speed. (Preferred)

**Rationale**

G 3.17.4.2 Performance: Excessive positional error within the odometry system results in a reduction in train performance.

**Guidance**

G 3.17.4.3 Whilst the positional error might increase to 5 % +/-5m over the range of train conditions (acceleration, braking, slip, slide), it is reasonable to expect better performance in steady state conditions.

G 3.17.4.4 In the context of this requirement, 'constant speed' means movement without acceleration.

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#### 3.17.5 Automatic odometry recalibration

3.17.5.1 The ETCS Odometry shall automatically recalibrate in response to wheel wear. (Preferred)

**Rationale**

G 3.17.5.2 Asset management: Automatic calibration avoids the potential for human error, is more efficient and can be effected more frequently, with a consequential train performance benefit.

**Guidance**

G 3.17.5.3 While manual measurement and entry of wheel diameter data can be supported, automatic calibration is preferred.

G 3.17.5.4 The infrastructure manager for the GB mainline railway is not currently intending to make any special provision to facilitate an automatic calibration system for the ETCS onboard subsystem, including more accurate location of balise groups.

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### 3.18 Eurobalise reader

#### 3.18.1 Eurobalise reader system: adjustment

3.18.1.1 The Eurobalise reader system shall not require adjustment during periodic maintenance in order to operate on the train to which it is fitted. (Normative)

**Rationale**

G 3.18.1.2 Economic: Manual re-calibration or re-positioning of the Eurobalise reader system or other intrusive maintenance would adversely impact on the cost of rail vehicle maintenance operations and therefore the economics of railway operations.

**Guidance**

G 3.18.1.3 Conformity with this requirement means that manual re-calibration or re-positioning of the Eurobalise reader system, or other intrusive maintenance, is not necessary during the life of the equipment on any given rail vehicle. Other intrusive maintenance includes: adjustment to accommodate wheel turning, wheelset change, and ride height change.

G 3.18.1.4 This requirement does not preclude adjustments necessary where the balise antenna and/or its mounting arrangements are reinstalled following removal to facilitate access to other maintained equipment.

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### 3.18.2 Eurobalise reader system: ETCS onboard subsystem start-up

3.18.2.1 The ETCS onboard subsystem shall be tolerant of the Eurobalise reader being positioned directly over a balise during its initialisation self-test. (Normative)

**Rationale**

G 3.18.2.2 Performance: It is not practicable to stop trains so that one or both Eurobalise readers are never located directly above a balise.

**Guidance**

G 3.18.2.3 This requirement applies to the situation where the initialisation self test is undertaken when powering up the ETCS onboard subsystem and/or a cab is made active, and one or both Eurobalise readers is located directly above a balise.

G 3.18.2.4 This requirement is not related to avoiding the specified ETCS onboard subsystem reaction to the incomplete reading of a balise group - the ETCS trackside implementation will use packet 145 where necessary to manage this scenario.

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## 3.19 Cold Movement Detection

### 3.19.1 Cold Movement Detection system

3.19.1.1 The ETCS onboard subsystem shall include a Cold Movement Detection system. (Normative)

**Rationale**

G 3.19.1.2 Integration with train operations: Cold Movement Detection serves to revalidate the train position upon leaving NP, subject to the train not having moved.

G 3.19.1.3 Maintenance of a valid position helps to reduce the dependency on operational procedures that result from degraded operation when starting with an invalid position.

G 3.19.1.4 Hazards associated with operational procedures are likely to increase if multiple trains are affected, for example when resuming service after a major infrastructure failure.

**Guidance**

G 3.19.1.5 72 hours operation is the minimum duration set out in Subset-026.

G 3.19.1.6 The period for which external rail vehicle power may be lost will be dependent upon the power supply system to the train and the anticipated duty cycle. It is customary in diesel-powered rail vehicles to shut down engines at terminating stations, during turnarounds and layovers. Unplanned shutdowns can also occur. Electric traction can be subject to loss of power from the ENE subsystem.

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### 3.19.2 Cold Movement Detection: stored information validation

3.19.2.1 The ETCS Cold Movement Detection function shall only be used to validate stored information if the information was known to be correct upon entry to NP. (Normative)

**Rationale**

G 3.19.2.2 Safe integration: The ETCS onboard subsystem might not correctly record changes to the rail vehicle position when in IS. If the ETCS onboard subsystem subsequently transitioned from IS to NP, and then back to SB, the stored position data might be invalid.

G 3.19.2.3 Safe integration: This requirement is used to control *Hazard OB-H019*.

**Guidance**

G 3.19.2.4 Cold Movement Detection is only active when the ETCS onboard subsystem is in NP.

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### 3.19.3 Cold Movement Detection: maximum distance for train position remaining invalid

3.19.3.1 ETCS train position information set to invalid on entry to NP shall remain invalid on exiting NP if the ETCS Cold Movement Detection function has detected cold movement in excess of 5 metres. (Normative)

**Rationale**

G 3.19.3.2 Integration with train operations: Moving a rail vehicle up to 5 metres is considered to be the maximum acceptable distance allowance for revalidating train position upon leaving NP.

**Guidance**

G 3.19.3.3 The train position information is stored in the EVC.

G 3.19.3.4 This requirement specifies the sensitivity of the Cold Movement Detection system, which is used to guarantee that the train position information is not revalidated if the rail vehicle moves by 5 metres or more.

G 3.19.3.5 The response of the ETCS Cold Movement Detection function to movement of between 1 metre and 5 metres is not specified; this response is supplier-specific.

### 3.19.4 Cold Movement Detection: minimum distance for validating train position

3.19.4.1 ETCS train position information set to invalid on entry to NP shall be set to valid on exiting NP if the ETCS Cold Movement Detection function has detected a cold movement of less than 1 metre. (Normative)

**Rationale**

G 3.19.4.2 Performance: Coupling/uncoupling operations or buffering can move a stationary rail vehicle by up to 1 metre. This minimum tolerance is applied so that these normal, expected operations do not result in the ETCS train position information stored onboard remaining invalid on exiting NP.

**Guidance**

G 3.19.4.3 The train position information is stored in the EVC.

G 3.19.4.4 This requirement specifies the sensitivity of the Cold Movement Detection system, which is used to guarantee that the train position information does not remain invalid if the rail vehicle moves by less than 1 metre.

G 3.19.4.5 The response of the ETCS Cold Movement Detection function to movement of between 1 metre and 5 metres is not specified; this response is supplier-specific.

### 3.19.5 Cold Movement Detection: detection of absolute movement

3.19.5.1 The ETCS Cold Movement Detection function shall monitor and summate incremental movements of the rail vehicle. (Normative)

**Rationale**

G 3.19.5.2 Integration with train operations: Moving a rail vehicle onto an adjacent line or turning it around and returning it to the original location means that the rail vehicle position report held in the EVC remains invalid.

**Guidance**

G 3.19.5.3 Rail vehicles can be shunted onto adjacent tracks, or be returned to the same position but facing the opposite direction.

## 3.20 Data radio

### 3.20.1 Data radio

**Guidance**

G 3.20.1.1 The main applications of the current radio system, as defined in the CCS NTSN, are considered as reference and co-existence with these applications is necessary. However, the radio system may need to consider the capability for supporting future

changes and extensions of the applications covered by the CCS NTSN and other NTSNs, as well as railway-related applications outside the NTSNs.

### 3.20.2 Data radio antenna position

3.20.2.1 The data radio antenna installation shall not compromise the performance of other communication and data systems. (Normative)

**Rationale**

G 3.20.2.2 Rail vehicle integration: The safety and performance targets for the rail vehicle are supported and influenced by the performance of all the individual communication and data systems incorporated into the rail vehicle.

**Guidance**

G 3.20.2.3 Other communication and data systems include, but are not limited to, Wi-Fi, global navigation satellite systems (GNSS), GSM-R, and antenna installations. GKGN0602 provides further guidance on positioning a train rooftop antenna.

G 3.20.2.4 The radio signal losses between the train antenna and antenna socket of the ETCS Data Only Radio (EDOR) will be 3dB (maximum), and typically 1dB.

### 3.20.3 Future migration of EDOR functionality into communication gateways

3.20.3.1 Provision shall be made to cater for future migration of EDOR functionality into communication gateways where such gateways already exist on trains, or where they are planned. (Application specific)

**Rationale**

G 3.20.3.2 Economic: This provides for future system upgrade associated with the transition from EIRENE GSM-R to the future railway mobile communication system (FRMCS).

**Guidance**

G 3.20.3.3 The GB preference would be for the migration of EDOR functionality into communication gateways to be based on the "$OB_{APP}$" interface requirements that will be defined in the telecoms onboard architecture (TOBA) reference model.

## 3.21 Cab security

### 3.21.1 Securing the train - ETCS mission data

3.21.1.1 It shall be possible to secure the rail vehicle or train from unauthorised operation whilst retaining the cab active signal. (Normative)

**Rationale**

G 3.21.1.2 Efficiency: Losing the ETCS mission data if the train driver has to secure the driving cab against unauthorised operation in order to leave it, would result in delays from any subsequent need to complete the ETCS start of mission process.

**Guidance**

G 3.21.1.3 The train driver is, on occasion, required to leave the cab to perform other duties (for example, reset a passenger alarm, or operate safety systems), which can require removal of the train driver's key from the cab desk. It is also standard practice to remove the train driver's key from the cab desk in order to prevent unauthorised operation when the train driver is not present.

G 3.21.1.4 Examples of how such 'cab security' functionality could be provided include:

a) Applying the brakes and inhibiting the driving controls when the cab is unoccupied, or through application of standstill supervision via a train driver-enabled setting; and
b) Retaining the ETCS cab active signal even though the train driver's key has been removed (cab closed). This may require another train driver control to be operated.

G 3.21.1.5 Retention of the cab active signal could introduce additional operational hazards related to the retention of train data and the driver not being prompted to check and validate train data as part of a start of mission process when the cab is subsequently opened. These hazards are identified and addressed as part of the implementation of a 'cab security' function that retains the ETCS cab active signal even though the train driver's key has been removed.

### 3.21.2 Cab security - data recording

3.21.2.1 The operation of the ‘cab security’ function shall be recorded on the onboard driving data recording system. (Normative)

**Rationale**

G 3.21.2.2 Integration with train operations: Recording this information supports systematic safety monitoring and investigation of incidents and accidents.

**Guidance**

G 3.21.2.3 Conformity with this requirement is only applicable where a cab security function is implemented.

## 3.22 Key management

### 3.22.1 Key management solution

3.22.1.1 The ETCS on-line key management solution shall not normally require any maintenance staff intervention. (Normative)

**Rationale**

G 3.22.1.2 Economic: Requiring maintenance staff intervention would adversely impact on the cost of key management and therefore the economics of railway operations.

**Guidance**

G 3.22.1.3 Maintenance staff intervention to be avoided includes distribution, deletion or updating of any key entry.

G 3.22.1.4 RIS-0743-CCS sets out the requirements for the key management process.

G 3.22.1.5 This requirement applies once the initial configuration of the ETCS onboard subsystem has been completed and the digital certificates have been installed.

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### 3.22.2 Key management: key relation storage capacity

**Guidance**

G 3.22.2.1 It is good practice to allow onboard storage capacity for one current and one future key relation per RBC - ETCS onboard subsystem relationship. Clause 4.3.4.9 of Subset-114 sets out that the ETCS onboard subsystem be able to store 2000 key relations; the expectation is that the GB domain will contain up to 500 RBCs so meeting the Subset-114 requirement is considered to be sufficient for GB operations. However, if a vehicle is expected to operate in other ETCS domains in addition to the GB domain, guidance on the number of RBCs expected to be contained within the other ETCS domains can be sought from the relevant infrastructure managers.

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### 3.22.3 Key management: periodicity for online update requests

3.22.3.1 The ETCS onboard subsystem shall enable the rail vehicle maintainer to configure the periodicity for online update requests as specified by the KMC manager. (Normative)

**Rationale**

G 3.22.3.2 Asset management: The periodicity of online update requests needs to be modifiable by an authorised person.

**Guidance**

G 3.22.3.3 The Home KMC establishes the ETCS key-checking periodicity and the ETCS onboard subsystem is configured to apply this as set out in clause 4.2.6.2b of Subset-137.

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### 3.22.4 Key management: logging access to the configuration settings and data

3.22.4.1 The ETCS onboard subsystem shall maintain a log of access to the key management configuration settings and data. (Normative)

**Rationale**

G 3.22.4.2 Safe integration: To enable access to the system data to be monitored.

**Guidance**

G 3.22.4.3 The ETCS onboard subsystem records when an attempt is made to access the secure data, whether successful or not.

G 3.22.4.4 The ETCS onboard subsystem is able to record information including: the date, time, user identity and type of access.

G 3.22.4.5 The minimum number of events to be stored is specified contractually.

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### 3.22.5 Key management: provision of maintenance and error information

3.22.5.1 Key management maintenance and error information shall be available to ETCS onboard subsystem maintainers. (Normative)

**Rationale**

G 3.22.5.2 Asset management: To allow ETCS onboard subsystem maintainers to carry out their duties efficiently.

**Guidance**

G 3.22.5.3 Maintenance and error information includes the status of updates and error reports related to ETCS cryptographic keys, digital certificates and public/private keys.

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### 3.22.6 Key management: accepting digital certificates

3.22.6.1 The ETCS onboard subsystem shall be configured only to accept digital certificates distributed utilising Public Key Infrastructure (PKI). (Normative)

**Rationale**

G 3.22.6.2 Safe integration: To reduce the security risks by minimising staff intervention in the distribution of certificates.

**Guidance**

G 3.22.6.3 The use of pre-shared keys (PSK) is an option with Subset-137 but this involves more staff intervention.

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### 3.22.7 Key Management: Use of Hyper Text Transfer Protocol

3.22.7.1 The ETCS onboard subsystem shall use Hyper Text Transfer Protocol (HTTP) for the transfer of Certificate Management Protocol (CMP) and Online Certificate Status Protocol (OCSP) messages, and for the download of Certificate Revocation Lists (CRLs). (Normative)

**Rationale**

G 3.22.7.2 This requirement removes ambiguity in Subset-137 version 1.0.0 around the key management system being capable of handling multiple transport mechanism protocols, and aligns with the solution to ERA change request CR1415 as will be set out in the future Subset-146. Compliance with this requirement avoids a mismatch between the transport mechanisms used by the onboard and trackside online KMS functions.

**Guidance**

G 3.22.7.3 RFC-6712 sets out information on how to layer the CMP over HTTP.

G 3.22.7.4 RFC-6960 sets out information relevant to the transfer of OCSP messages.

## 3.23 Ancillary systems

### 3.23.1 ETCS onboard subsystem: Integration with ancillary rail vehicle systems

3.23.1.1 Rail vehicle ancilliary systems shall be capable of processing ETCS track condition data exported by the ETCS onboard subsystem. (Application Specific)

**Rationale**

G 3.23.1.2 Integration with train operations: Integrating the operation of ancilliary rail vehicle systems with the ETCS could provide train performance benefits and reduce the workload associated with the train driving task.

**Guidance**

G 3.23.1.3 The ETCS track conditions are provided in case it is deemed useful to utilise them.

G 3.23.1.4 ETCS track condition information intended to be provided by the ETCS trackside that can be passed to ancillary vehicle systems includes:

a) Pantograph raising or lowering
b) Traction circuit breakers opening or closing
c) Change of traction power supply source
d) Change of allowed traction current consumption
e) Station platform information for door control.

G 3.23.1.5 The ETCS onboard subsystem is capable of receiving such information, and will either action the track condition function directly or export the data to other rail vehicle systems, as appropriate.

G 3.23.1.6 Packet 44 applications that support certain track condition functions on the GB mainline railway are available on the RSSB website (www.rssb.co.uk), and include:

a) Automatic power change-over (APCO)
b) Fully automatic and automatic selective door opening (FASDO/ASDO) and correct side door enable (CSDE).
c) Automatic control of tractive effort at neutral sections.

G 3.23.1.7 These packet 44 applications have been developed to provide equivalent ETCS track condition functionality, but without the constraints on transmission media, operating level or operating mode. The use of the packet 44 applications on rail vehicles is dependent on the necessary packets being available from the trackside in the area/s in which the rail vehicle will operate.

### 3.23.2 ETCS DMI: displayed symbols

3.23.2.1 The ETCS DMI shall only display track condition order and announcement and associated planning information symbols that are relevant to the traction type and braking systems available for use on, or currently in use by, the train. (Application specific)

**Rationale**

G 3.23.2.2 Integration with train operations: Presenting information on the ETCS DMI that is unnecessary or irrelevant to the train driving task would increase train driver workload.

**Guidance**

G 3.23.2.3 The ETCS onboard subsystem has the capability of displaying all specified track condition symbols.

G 3.23.2.4 ERA_ERTMS_015560 contains symbols that are displayed to the train driver when track conditions change, for example for the lowering of pantographs, change of traction system, and inhibition of regenerative brake. These symbols are listed in ERA_ERTMS_015560 with a "TC" and, in some instances a "PL" prefix. Displaying these symbols is needed only when they are applicable to the operational context at that location and time.

G 3.23.2.5 Some trains are capable of operating with multiple traction sources, for example, 750 V DC and 25 kV AC, or 25 kV AC and diesel.

G 3.23.2.6 Examples of track condition order and announcement symbols that are not suitable for display for a particular train include:

a) Symbols TC01 to TC09, TC25, TC26, PL01 to PL08, PL27 and PL28 on trains not equipped with traction collection equipment for an overhead line
b) Symbols TC33, TC34, PL35 and PL36 on trains not equipped with traction collection equipment for third rail
c) Symbols TC23, TC24, PL25 and PL26 on trains not equipped with any traction collection equipment (overhead or third rail).

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### 3.23.3 Facility for authorised person to control ETCS track condition information

3.23.3.1 The ETCS onboard subsystem shall include a facility for an authorised person to inhibit and enable the defined response to ETCS track condition information. (Normative)

**Rationale**

G 3.23.3.2 Integration with train operations: The operational context may include specific restrictions or requirements on which track condition facilities will be used, and this may change during the life of the vehicle.

**Guidance**

G 3.23.3.3 If a certain track condition needs to be implemented, a competent authorised person will be able to enable the facility.

G 3.23.3.4 This requirement applies:

a) To the defined response by ancillary rail vehicle systems to ETCS track condition information; and
b) Where the ETCS DMI is configured to only display track condition order and announcement and associated planning information symbols relevant to the traction type and braking systems available for use on, or currently in use by, the train.

G 3.23.3.5 An authorised person can include railway undertaking staff, train maintenance staff, or a representative of the ETCS onboard equipment supplier working under contract.

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### 3.23.4 Change of traction system announcement

3.23.4.1 For manual traction changeover systems, the ETCS onboard subsystem shall be configured with the time required for a train driver to complete the task of switching over to the correct traction system. (Application specific)

**Rationale**

G 3.23.4.2 Integration with train operations: The train driver needs enough time to complete the traction changeover task before the train reaches the changeover boundary.

**Guidance**

G 3.23.4.3 This time is utilised by the ETCS onboard to determine where the announcement of traction symbol is displayed in ETCS DMI display area B3/4/5, that is the determination of the point 'C' as set out in section 5.18.10 of Subset-026 when the track condition packet 68 is used.

G 3.23.4.4 The timing of the announcement takes account of the train driving task, including:

a) The time needed for the train driver to complete any traction changeover functions in the operational context; and
b) The traction power equipment switchover requirements.

G 3.23.4.5 This requirement implies a site specific assessment because the time needed by the train driver is influenced by the operational context.

G 3.23.4.6 The time required is provided to the infrastructure manager to determine compatibility with the trackside design constraints imposed by Subset-040.

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### 3.23.5 ETCS onboard subsystem: indicating automatic control of the rail vehicle in-feed circuit breakers

3.23.5.1 The ETCS onboard subsystem shall be configured so that when neutral section symbols are displayed on the ETCS DMI, the symbols indicating automatic control of the rail vehicle in-feed circuit breakers are used. (Application specific)

**Rationale**

G 3.23.5.2 Integration with train operations: The train driver interprets the DMI symbol for automatic control of the in-feed circuit breakers to understand that action is needed to reduce traction power demand prior to reaching the neutral section.

**Guidance**

G 3.23.5.3 Rail vehicle in-feed circuit breakers in the UK will continue to be controlled automatically by the automatic power control (APC) system; train drivers are not responsible for opening/closing rail vehicle in-feed circuit breakers.

G 3.23.5.4 The symbols indicating automatic execution of vehicle in-feed circuit breakers (main power switch) are PL05 and PL07 for display on the planning area, and TC06 and TC08 for display in area B3/4/5, as set out in ERA_ERTMS_015560.

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### 3.23.6 ETCS onboard subsystem: displaying the neutral section announcement symbol

3.23.6.1 The ETCS onboard subsystem shall be configured so that the neutral section announcement symbol is displayed in ETCS DMI display areas B3, B4 or B5 a minimum of 10 seconds before the maximum safe front end of the train reaches the start of the neutral section, as defined in the packet 68 information received from the ETCS trackside subsystem. (Application specific)

**Rationale**

G 3.23.6.2 Safe integration: The train driver needs enough time to complete the associated train driving task. Ten seconds is considered to be the minimum time necessary for the driving task and aligns with the Subset-040 requirement for the packet 68 information to be provided at least 11 seconds at line speed before the neutral section start location.

G 3.23.6.3 Safe integration: This requirement is used to control *Hazard M1-H001*.

**Guidance**

G 3.23.6.4 This relates to the determination of the point C by the ETCS onboard subsystem as set out in section 5.18.3 of Subset-026.

G 3.23.6.5 Rail vehicle in-feed circuit breakers will continue to be controlled automatically by the APC system on the GB mainline railway, Train drivers are not responsible for opening/ closing rail vehicle in-feed circuit breakers.

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### 3.23.7 ETCS track condition symbols to support manual pantograph management

3.23.7.1 The ETCS onboard subsystem shall display the ERTMS/ETCS track condition symbols related to pantograph management to support manual pantograph management. (Application specific)

**Rationale**

G 3.23.7.2 Integration with train operations: Train drivers use pantograph management information to understand the need to command the lowering or raising of pantographs at the correct locations.

**Guidance**

G 3.23.7.3 The symbols indicating manual pantograph lowering and raising are PL02 and PL04 for display on the planning area, and TC03 and TC05 for display in ETCS DMI display areas B3, B4 or B5 as set out in ERA_ERTMS_015560.

## 3.24 Driver training

### 3.24.1 Configured to include Level NTC, NID_NTC = 20 and 21

3.24.1.1 The ETCS onboard subsystem shall be configured to include Level NTC, NID_NTC=20 and NID_NTC = 21. (Application-Specific)

**Rationale**

G 3.24.1.2 Integration with train operations: The system needs to be able to support all ETCS Levels.

G 3.24.1.3 Train driver learning: Level NTC, NID_NTC=21 will be used in ETCS with signals areas during the driver training process.

**Guidance**

G 3.24.1.4 The NID_NTC value 21 has been assigned by the European Agency for Rail (ERA) for this purpose and is recorded in ERA_ERTMS_040001. Where a train driver is not trained in the use of the ETCS beyond Level NTC, the intention is to select this level during the ETCS start of mission process.

G 3.24.1.5 Conditional Level Transition Order balises will be used at the border between AWS/TPWS areas and ETCS with signals areas. These balises will be programmed so that only rail vehicles in Level NTC, NID_NTC=20 transition to Level 1, 2 or 3; rail vehicles in Level NTC, NID_NTC=21 will remain in Level NTC throughout the transition.

G 3.24.1.6 This requirement only applies if the train is fitted with AWS/TPWS onboard equipment - trains that will only ever be required to operate under ETCS (Levels 1, 2 or 3) for the life of the vehicle may not be fitted with AWS/TPWS onboard equipment. Compliance with this requirement is likely to be appropriate until ETCS becomes more extensively deployed across the GB mainline network.

G 3.24.1.7 It is permissible for trains fitted with AWS/TPWS onboard equipment, and which will only ever be operated by train drivers trained in the use of ETCS beyond Level NTC, not to be configured with Level NTC, NID_NTC = 21. However, this may impact on the ability for the future cascade of these trains to other routes or train operators if NID_NTC=21 is not configured.

### 3.24.2 Level NTC, NID_NTC=21: functionality

3.24.2.1 Level NTC, NID_NTC=21, shall be functionally identical to Level NTC, NID_NTC=20. (Application specific)

**Rationale**

G 3.24.2.2 Integration with train operations: The consistent appearance and functionality of the AWS/TPWS supports operational consistency where the same Class B CCS system is required to be active in different operating levels.

**Guidance**

G 3.24.2.3 This applies only where Level NTC, NID_NTC=20 and NID_NTC = 21 are implemented.

G 3.24.2.4 With the exception of the level indication, the operation and train driver interface for AWS/TPWS are the same in Levels NTC, NID_NTC= 20 and 21 (that is, functionally and visually identical, apart from the indication on the ETCS DMI of which level is selected).

G 3.24.2.5 The AWS/TPWS onboard functionality is set out in GERT8075 and RIS-0775-CCS.

# Part 4 National systems

## 4.1 General

### 4.1.1 Introduction to national systems

**Guidance**

G 4.1.1.1 The requirements in section 4 related to Class B systems only apply if the rail vehicle will be fitted with the ETCS alongside Class B systems in order to operate in both an ETCS environment and a conventionally-signalled environment. This excludes the Tilt Authorisation and Speed Supervision (TASS) requirements in section 4.6.

G 4.1.1.2 Where a rail vehicle will be constrained to operate on railway that is only fitted with ETCS and where operation under Class B systems is not required, the requirements within Section 4 related to Class B systems are not applicable.

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### 4.1.2 Guidance on integration of ETCS and Class B systems

**Guidance**

G 4.1.2.1 The safe integration of the ETCS onboard with Class B systems is reliant on assessing the technical implementation in the operational context of the rail vehicle. Areas to consider when assessing safe integration include:

a) The likelihood of train driver distraction and error where multiple system train driver interfaces are provided.
b) Transitions between ETCS and Class B systems, and the switch between different DMIs
c) Where multiple train protection systems can be active at the same time, how are multiple interventions to be managed
d) Indications provided, including alarms and alerts.

G 4.1.2.2 Requirements and guidance on safe integration of CCS and signalling systems to support transitions is provided in RIS-0036-CCS.

G 4.1.2.3 While the railway undertaking remains responsible for safe integration, the necessary work to achieve this can form part of a contractual arrangement with the supplier or other party.

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### 4.1.3 Class B system operation on non-ETCS fitted infrastructure

4.1.3.1 The ETCS onboard subsystem shall work in conjunction with any applicable Class B protection systems on routes over which the train operates. (Application specific)

**Rationale**

G 4.1.3.2 Integration with train operations: To allow the rail vehicle to operate correctly on lines not fitted with ETCS, or fitted with both ETCS and class B systems.

**Guidance**

G 4.1.3.3 Trains fitted with ETCS onboard subsystems are likely to be required to operate in train management and control environments based on lineside signalling and the AWS/TPWS Class B train protection system. However, the train may be required to operate in environments where other signalling and train protection systems are in use. Applicable class B protection systems are defined in ETCS onboard system fitment contracts.

G 4.1.3.4 The CCS NTSN lists the Class B systems in use on the GB mainline railway.

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### 4.1.4 Class B system: status indications

4.1.4.1 The train driver shall be provided with the information needed to understand the availability / non-availability of the Class B systems fitted to the rail vehicle. (Normative)

**Rationale**

G 4.1.4.2 Integration with train operations: The train driver needs to know which Class B systems are operational in order to conform with the operating rules.

**Guidance**

G 4.1.4.3 This requirement could be satisfied on a traction-specific basis.

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## 4.2 AWS/TPWS

### 4.2.1 Background to AWS/TPWS

**Guidance**

G 4.2.1.1 The CCS NTSN section 2.2 lists the Class B Systems applicable to the GB mainline network. The Class B system recorded as 'TPWS' is applicable to the whole network. In this context, ‘TPWS’ includes AWS.

G 4.2.1.2 The CCS NTSN section 3.1 states that ‘The requirements for Class B systems are the responsibility of the Competent Authority’. GERT8075 and RIS-0775-CCS, fulfil that responsibility by setting out the GB industry agreed requirements for ‘TPWS’ on the GB mainline railway.

G 4.2.1.3 AWS is provided to give train drivers in-cab warnings of the approach to signals, reductions in permissible speed, some level crossing warning signs, and temporary / emergency speed restrictions, and to apply the brakes in the event that a train driver does not acknowledge cautionary warnings given by the system within the specified time.

G 4.2.1.4 TPWS is a train protection system compliant with the train protection requirements of the Railway Safety Regulations 1999. The primary purpose of TPWS is to minimise the consequence of a train passing a TPWS fitted signal at danger and a train overspeeding at certain other locations.

G 4.2.1.5 AWS and TPWS are the principal warning and train protection systems which are installed on most Network Rail lines and on most rolling stock operating over them. The only exceptions are certain lines which are fitted with mechanical trainstops, lines fitted with ETCS, and trains which operate only over those lines.

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**Guidance: AWS/TPWS integration with the ETCS onboard subsystem**

G 4.2.1.6 AWS/TPWS can be integrated as follows:

a) As a standalone system, with rudimentary interfaces to the ETCS for suppression
b) Partially or fully integrated into the ETCS DMI
c) Integrated as a fully compliant specific transmission module (STM).

G 4.2.1.7 Operationally, all of these configurations are ETCS Level NTC (AWS/TPWS).

G 4.2.1.8 The ERTMS/ETCS reference architecture set out in section 2.5.3 of Subset-026 allows for national systems to be integrated with the ETCS onboard subsystem using a compliant STM or another solution. The principle of an STM is that it allows the national system to access some of the functions controlled by the ETCS onboard subsystem and information from onboard. The ETCS controls whether the STM is active or not, based on level and, in some cases, mode. The most common STM application is to interface an automatic train protection (ATP) system to the ETCS where similar principles of supervision (distance to go and speed profile) are applied.

G 4.2.1.9 AWS/TPWS is not an ATP system; it operates by detecting intermittent transmissions from trackside objects – there is no requirement for information from the ETCS onboard subsystem, such as odometry.

G 4.2.1.10 When operating in Level NTC (NID_NTC=20 or 21), trains on GB mainline passenger lines have active AWS/TPWS onboard equipment in all modes in which the train may operate, as set out in clause *4.2.4*.

G 4.2.1.11 Integrating AWS/TPWS as a fully compliant STM will result in the AWS/TPWS onboard subsystem being suppressed when the onboard enters SH. If, in normal operation, a train does not have an active train protection system, the railway undertaking and infrastructure manager are not compliant with the Railway Safety Regulations 1999 if operated on passenger lines.

G 4.2.1.12 For new trains, the option to integrate the AWS/TPWS DMI with the ETCS DMI might be preferable in order to optimise the cab layout. However, the AWS/ TPWS may ultimately be withdrawn, so the economics of integrating it into the ETCS DMI is an important consideration.

G 4.2.1.13 Conformity with the requirements in this document may require an upgrade to the AWS/TPWS onboard subsystem in order to provide the specified functionality. These requirements assume conformity with GERT8075 and RIS-0775-CCS.

### 4.2.2 AWS/TPWS in-service monitoring

4.2.2.1 The ETCS onboard subsystem shall not prevent any continuous AWS / TPWS in-service monitoring from being undertaken. (Normative)

**Rationale**

G 4.2.2.2 Safe integration: The train driver needs to understand when the AWS/TPWS is not operating correctly in order to conform with the rules for operating the train.

G 4.2.2.3 Safe integration: This requirement is used to control *Hazard OB-H023*.

**Guidance**

G 4.2.2.4 AWS/TPWS self-tests and monitoring are needed irrespective of ETCS use. Consideration should be given to how this is achieved when the AWS/TPWS is suppressed for operation outside Level NTC (AWS/TPWS) areas.

G 4.2.2.5 This requirement also applies when the AWS/TPWS is integrated into the ETCS DMI, or when interfaced through an STM.

G 4.2.2.6 RIS-0775-CCS sets out further requirements for AWS and TPWS onboard subsystem monitoring and self-testing.

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### 4.2.3 AWS/TPWS onboard subsystem suppression

4.2.3.1 The AWS/TPWS shall be suppressed when the ETCS onboard subsystem is operating in all levels other than Levels NTC, NID_NTC=20 or 21. (Normative)

**Rationale**

G 4.2.3.2 Integration with Class B CCS systems: When the ETCS is operating in a level other than Level NTC, NID_NTC=20 or 21, the train protection function is provided by the ETCS or another Class B system. In this case, the AWS/TPWS train protection function is suppressed.

G 4.2.3.3 Safe integration: This requirement is used to control *Hazard OB-H020*.

**Guidance**

G 4.2.3.4 In accordance with the strict definition of the ETCS Levels, only Level NTC, NID_NTC=20 or 21 requires that the AWS/TPWS is energised. Whilst AWS/TPWS could be energised in Level 0, suppression aligns more correctly with the intent of the CCS NTSN.

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### 4.2.4 AWS/TPWS onboard subsystem unsuppression

4.2.4.1 The AWS/TPWS shall be unsuppressed when the ETCS onboard subsystem is operating in Levels NTC, NID_NTC=20 and 21. (Normative)

**Rationale**

G 4.2.4.2 Integration with Class B CCS systems: The Class A train protection functionality provided by the ETCS is not available when the train is operated in Level NTC. The Class B system AWS/TPWS provides the train protection functionality when operating in Levels NTC, NID_NTC=20 or 21.

G 4.2.4.3 Safe integration: This requirement is used to control *Hazard OB-H021*.

**Guidance**

G 4.2.4.4 This requirement also applies while the ETCS onboard subsystem is operating in SH in Levels NTC, NID_NTC=20 and 21. Subset-035 sets out requirements for the ETCS onboard subsystem to command the suppression (entry to the Cold Standby state) of the active Class B system when entering SH, but delivering this requirement introduces a non-compliance with the Railway Safety Regulations 1999 if SH is selected during normal operation on a passenger line. A solution is therefore required that delivers compliance with the regulation and also the operational needs of the user. Examples of possible solutions include:

a) Preventing the selection of SH mode via the ETCS DMI in Level NTC, NID_NTC=20 and 21 is a solution that has been implemented on some fleets. By preventing selection of, and therefore entry into, SH the suppression of AWS/TPWS on entry to SH will not occur. However, this solution is non-complaint with the requirements in ERA_ERTMS_015560 for the enabling of the 'Shunting' button, and also means that neither SH nor PS are available for use in Level NTC, NID_NTC=20 and 21. This solution may be appropriate for multiple unit passenger trains where scenarios where SH could be used are rare and could be managed using other ETCS modes. On freight trains, this solution is non-preferred due to the need for the ETCS start of mission process, including train data entry, to be completed every time the driver changes driving cabs during a sequence of shunting movements.
b) Amending the relevant parts of the ETCS onboard subsystem STM state transition order conditions so that the issuing of a suppression command on entry to SH does not happen while the ETCS onboard subsystem is in Level NTC, NID_NTC=20 and 21. This solution would be non-compliant with the state transition order requirements set out in section 10.3 of Subset-035, but both SH and PS would remain available for use and the need for repeated data entry when changing driving cabs is eliminated.
c) Utilising a completely bespoke control interface between the ETCS and AWS/TPWS onboard subsystem that does not follow all of the state transition order requirements set out in section 10.3 of Subset-035. This solution allows for the AWS/TPWS onboard subsystem to remain active in SH, and both SH and PS would remain available for use.

### 4.2.5 AWS/TPWS in NL

4.2.5.1 The AWS/TPWS shall be suppressed when the ETCS onboard subsystem is operating in NL. (Normative)

**Rationale**

G 4.2.5.2 Safe integration: Not suppressing the AWS/TPWS system when operating in NL could result in unnecessary brake applications.

G 4.2.5.3 Safe integration: This requirement is used to control *Hazard OB-H020*.

**Guidance**

G 4.2.5.4 This is an exception to clause *4.2.4*. When tandem working on conventional lines, the TPWS onboard functionality is temporarily isolated (the temporary isolation control is operated) in non leading driving cabs, therefore it is beneficial for the ETCS to suppress it automatically for such operations.

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### 4.2.6 AWS/TPWS in IS

4.2.6.1 The AWS/TPWS shall be unsuppressed when the ETCS onboard subsystem is operating in IS. (Normative)

**Rationale**

G 4.2.6.2 Safe integration: When the ETCS onboard subsystem is isolated, the AWS/TPWS provides the train protection functionality necessary for the train to continue to operate on ETCS with signals and conventionally signalled lines.

G 4.2.6.3 Safe integration: This requirement is used to control *Hazard OB-H022*.

**Guidance**

G 4.2.6.4 None.

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### 4.2.7 AWS/TPWS suppression timing

4.2.7.1 The AWS/TPWS shall be suppressed no later than 5 seconds after the point of level transition from Level NTC, NID_NTC=20 or 21. (Normative)

**Rationale**

G 4.2.7.2 Technical compatibility with the ETCS trackside subsystem: No AWS/TPWS trackside equipment will be positioned within 5 seconds of the transition border at the permissible speed.

G 4.2.7.3 Safe integration: This requirement is used to control *Hazard N-H051*.

**Guidance**

G 4.2.7.4 The AWS/TPWS is expected to be suppressed at the transition border from Level NTC, NID_NTC=20 or 21. To ensure that the train is not inadvertently tripped, no AWS/TPWS trackside equipment is positioned within 5 seconds (at permissible speed) of the border in ETCS with signals areas.

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### 4.2.8 AWS/TPWS 'Operational Ready' state timing

4.2.8.1 The AWS/TPWS system shall be in the 'Operational Ready' state no later than 5 seconds after the point of level transition to Level NTC, NID_NTC=20 or 21. (Normative)

**Rationale**

G 4.2.8.2 Technical compatibility with the ETCS trackside subsystem: No AWS/TPWS trackside equipment will be positioned within 5 seconds of the border at the permissible speed.

**Guidance**

G 4.2.8.3 RIS-0775-CCS specifies the 'Operational Ready' state. The 'Operational Ready' state is equivalent to the ‘Data Available’ state in Subset-035.

G 4.2.8.4 RIS-0775-CCS requires that AWS/TPWS system transitions be configured so that trains moving at the permissible speed will not reach an interface with the AWS trackside subsystem within 5 seconds of passing the point of level transition to Level NTC, NID_NTC=20 or 21.

G 4.2.8.5 It is expected that an ETCS System Compatibility Check (ESC) will be defined for any line that has a location which requires the AWS/TPWS to be in the 'Operational Ready' state in a shorter time than 5 seconds. This is to check the technical compatibility between the ETCS onboard subsystem and the ETCS trackside. Potentially a specific ESC might not be available when the ETCS onboard is specified due to rollout of ETCS onto the GB network. On this basis, to reduce the likelihood of an upgrade, it might be beneficial to design the system to switch to the AWS/TPWS 'Operational Ready' state in time as short as possible

### 4.2.9 Temporary isolation of the AWS/TPWS

4.2.9.1 Selection of and operation in Level NTC, NID_NTC=20 and 21 shall be possible with the TPWS temporary isolated. (Normative)

**Rationale**

G 4.2.9.2 Integration with train operations: It is sometimes necessary to temporarily isolate the AWS/TPWS to pass a failed signal or to operate the train within a possession.

**Guidance**

G 4.2.9.3 Further requirements for the AWS visual indications are set out in RIS-0775-CCS.

### 4.2.10 AWS visual indicator display

4.2.10.1 During operation in levels other than Level NTC, NID_NTC=20 or 21, any AWS visual indicator still visible to the train driver shall display 'all black'. (Normative)

**Rationale**

G 4.2.10.2 Integration with train operations: The information provided by the AWS black and yellow visual indication is only relevant to the train driving task when the train is being operated in Level NTC, NID_NTC=20 or 21.

**Guidance**

G 4.2.10.3 The AWS visual indicator can be independent of the ETCS DMI, and so could still be visible when the ETCS is not in Level NTC, NID_NTC=20 or 21.

## 4.3 AWS/TPWS DMI integration

### 4.3.1 Train driver interaction with AWS/TPWS

4.3.1.1 Placing any AWS/TPWS indications or controls onto the ETCS DMI shall not require any additional train driver interaction with AWS/TPWS compared with a stand-alone AWS/TPWS. (Normative)

**Rationale**

G 4.3.1.2 Integration with train operations: Additional interactions would increase the workload associated with the train driving task.

**Guidance**

G 4.3.1.3 There is no requirement for AWS/TPWS indications or controls to be integrated within the ETCS DMI.

G 4.3.1.4 GERT8075 and RIS-0775-CCS set out further requirements for AWS/TPWS interfaces.

## 4.4 GW ATP

### 4.4.1 GW-ATP/ETCS control device functionality

4.4.1.1 The Great Western Automatic Train Protection (GW-ATP)/ETCS control device shall enable the appropriate train protection system (GW-ATP or ETCS) and disconnect the other system. (Application specific)

**Rationale**

G 4.4.1.2 Integration with train operations: Train operations on the GB mainline railway requires one of the ATP systems provided on the rail vehicle to be activated at any time. Activating the ETCS and the GW-ATP at the same time might result in unnecessary brake applications or other unwanted effects.

**Guidance**

G 4.4.1.3 It is not expected that suppliers will integrate GW-ATP with the ETCS onboard subsystem. The current trackside design proposal does not include the facility for running transitions between GW-ATP and ETCS.

## 4.5 TVM, KVB, Crocodile, and CBTC

### 4.5.1 Integration requirements for TVM, KVB, Crocodile, and CBTC systems

**Guidance**

G 4.5.1.1 There are no GB standards or trackside reference design for transitions between KVB, TVM430, Crocodile or CBTC, and ETCS. Projects that are implementing an ETCS onboard subsystem that would be required to manage transitions between different Class B systems could potentially make the train incompatible with those Class B systems in existing areas where the vehicle is used unless additional trackside

provision to support those transitions is provided at the relevant transition locations. Projects that would like to interface these systems with the ETCS can approach the Network Rail System Authority.

G 4.5.1.2 RIS-0036-CCS contains generic requirements and guidance that can be used to inform the integration design between KVB, TVM-430, Crocodile or CBTC, and ETCS to support transitions between them.

G 4.5.1.3 Requirements for the Level NTC label to be displayed for TVM (NID_NTC = 14) and CBTC are set out in *3.13.4* and *3.13.5*. The ETCS Level NTC label for KVB and Crocodile are not yet specified. A well designed ETCS Level NTC label for these systems will:

a) Address the specification set out in ERA_ERTMS_015560
b) Consider the existing ETCS DMI level labels in use on the train; and
c) Minimise the risk of train driver error leading to incorrect level selection.

G 4.5.1.4 If the ETCS DMI is considered to be a SIL 0 component of the ETCS onboard subsystem, its applicability for use within other Class B systems needs to be considered.

## 4.6 Tilt Authorisation and Speed Supervision (TASS)

### 4.6.1 Guidance for TASS

**Guidance**

G 4.6.1.1 The ETCS integration requirements for TASS systems are not defined in the CCS NTSN, there are limited national standards for TASS with those in place covering the basic principles of the system. When TASS was originally introduced, it followed the draft ETCS standards for track train interface in place at the time; the finalised ETCS track train interface standards now in place have deviated from those used for TASS. For this reason, there is no simple integration path for ETCS and TASS on existing TASS fitted fleets operating on existing TASS fitted infrastructure.

G 4.6.1.2 Options for integrating TASS with ETCS include:

a) Stand-alone - no integration between the two systems; TASS remains a stand-alone system with no interface to ETCS
b) Connected - partially integrated into the ETCS, with a minimum requirement to integrate 'TASS Healthy' status to drive cant deficiency ETCS train data; and
c) Integrated - fully integrated with all TASS functionality included within ETCS.

G 4.6.1.3 The implications of the integration options include:

a) For stand-alone, TASS may be using a different most restrictive speed profile (MRSP) when degraded to that used by ETCS with the change of cant deficiency data only taking place when the train driver changes the ETCS train data.
b) For connected and integrated, when the 'TASS Healthy' status changes, the train is braked to a stand to allow the train driver to validate the updated cant deficiency ETCS train data.

G 4.6.1.4 Whichever level of integration of TASS and ETCS is selected, a full risk assessment and operational review is carried out to identify all issues and apply mitigations as required.

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### 4.6.2 Transmitting tilt authorisation command where tilting functionality is integrated into the ETCS onboard subsystem

4.6.2.1 Where tilt authorisation is integrated into the ETCS, the ETCS onboard subsystem shall transmit the tilt authorisation command to the tilt system. (Application-Specific)

**Rationale**

G 4.6.2.2 Integration with train operations: The TASS system provides tilt authorisation commands to the train tilting system based on data received from the trackside which is configured to ensure that the train only tilts where tilting can be supported without gauge infringement. An integrated tilt function is required to mimic this functionality. Integrating tilt authorisation with the ETCS onboard subsystem allows for the TASS system to be replaced.

**Guidance**

G 4.6.2.3 An option is for tilt authorisation data received from either the RBC or balises to be processed / interpreted by the ETCS onboard subsystem which will control the tilt mechanism. When operating in Level NTC, the ETCS onboard subsystem will need to be able to undertake the full functionality of the current TASS system (speed supervision and tilt authorisation) using the balise reader provided for the ETCS. When operating in ETCS Levels 2 or 3, the ETCS onboard subsystem will only need to utilise the packet 44 data sent by the RBC.

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### 4.6.3 Integrating 'tilt healthy' signal monitoring into the ETCS onboard subsystem

4.6.3.1 On trains with integrated or connected TASS when tilt is selectively authorised, the ETCS onboard subsystem shall monitor and correctly interpret a 'tilt healthy' signal from the tilt system. (Application specific)

**Rationale**

G 4.6.3.2 Integration with train operations: Using the ETCS onboard subsystem to select the appropriate speed profile can provide train performance benefits if the tilt system is healthy. If the system is unhealthy, the train speed supervision reflects the lower permissible speed.

**Guidance**

G 4.6.3.3 The availability of the tilt system enables the ETCS onboard subsystem to supervise the train to the correct speed in ETCS Levels 2/3 by selecting the appropriate speed profile. If the system is unavailable due to a fault or isolation, then the speed of the train will be restricted by the ETCS.

G 4.6.3.4 Changes in the 'tilt healthy' signal will be managed as a change in train category from a source other than the train driver, in accordance with section 5.17 of

Subset-026. A change in state requires the train to be at a stand or be brought to a stand.

G 4.6.3.5 On trains where TASS is a standalone system to ETCS, other controls will be required to manage a mismatch of the tilt health and cant deficiency train data as the only input method for the availability of tilt will be as part of train driver data input.

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### 4.6.4 Managing TASS data where the tilting functionality is not integrated into the ETCS onboard subsystem

4.6.4.1 On trains where connected TASS has no ability to receive packet 44 data directly from the TASS trackside equipment and tilting functionality is not integrated into the ETCS onboard subsystem, the ETCS onboard subsystem shall pass all packet 44 data relating to TASS received from an RBC or balise to the external TASS. (Application specific)

**Rationale**

G 4.6.4.2 Integration with train operations: In order to retain the performance benefits of tilting trains.

**Guidance**

G 4.6.4.3 TASS is currently implemented using a simplified ETCS architecture with a balise reader and restricted functionality EVC.

---

### 4.6.5 Speed supervision in ETCS Levels 2/3

4.6.5.1 In ETCS Levels 1, 2 and 3, speed supervision shall be undertaken solely by the ETCS onboard subsystem when ETCS and TASS are integrated or connected. (Normative)

**Rationale**

G 4.6.5.2 Integration with train operations: Supervision by ETCS and TASS at the same time might result in unnecessary brake applications or other unwanted effects.

**Guidance**

G 4.6.5.3 The ETCS onboard subsystem will select the appropriate speed profile based on whether the tilt system is healthy or not.

G 4.6.5.4 The RBC will transmit a set of speed profiles relevant to trains which are able to operate with different amounts of cant deficiency. To avoid two systems attempting to manage the traction and the brake, a connected TASS will have its speed supervision isolated from the train system when the train is operating using the ETCS Levels 1, 2 and 3.

G 4.6.5.5 On trains where TASS is a standalone system to ETCS, other controls will be required to manage occasions when TASS may make a brake application.

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### 4.6.6 Indicating the health status of the tilt system

4.6.6.1 The train driver shall be provided with information about the health status of the tilt system in all levels. (Application specific)

**Rationale**

G 4.6.6.2 Integration with train operations: The train driver needs to know whether the tilt system is available for use.

**Guidance**

G 4.6.6.3 The information could be provided via a separate indicator or combined within the ETCS DMI.

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### 4.6.7 Indicating tilt authorisation

4.6.7.1 The train driver shall be provided with information about the authorisation of tilt in all levels. (Application specific)

**Rationale**

G 4.6.7.2 Integration with train operations: The train driver needs to know when tilting is authorised, primarily, in Level NTC.

**Guidance**

G 4.6.7.3 The indication could be a separate indicator or combined within the ETCS DMI.

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### 4.6.8 Isolating the tilt system

4.6.8.1 The train driver shall be able to isolate the tilt system independently of ETCS. (Application-Specific)

**Rationale**

G 4.6.8.2 Integration with train operations: This control provides a means of isolating a tilt system that has a fault, thus enabling continued train operations without tilt.

**Guidance**

G 4.6.8.3 Ideally this control is separate to the ETCS DMI and applies to the whole train, and operation of the control in one cab results in a loss of tilt system health indications in both cabs.

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# Part 5 Rail Vehicle Interface Requirements

## 5.1 Safety integrity requirement

### 5.1.1 Safety integrity of existing train systems

5.1.1.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the ETCS onboard subsystem interface with the train shall not compromise the safety integrity of existing train systems. (Normative)

**Rationale**

G 5.1.1.2 Safe integration: This requirement is used to control *Hazards OB-H011 and OB-H018*.

**Guidance**

G 5.1.1.3 None.

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## 5.2 Circuit protection

### 5.2.1 ETCS onboard subsystem: short-circuit protection

5.2.1.1 The ETCS onboard subsystem shall be protected from fault currents caused by short-circuits in the interfacing train wiring. (Normative)

**Rationale**

G 5.2.1.2 Reliability and availability: The objective is to protect the ETCS onboard subsystem from damage caused by high currents.

**Guidance**

G 5.2.1.3 The ETCS onboard subsystem performance in the operational context could be adversely affected by the rail vehicle electrical environment.

G 5.2.1.4 When retrofitting a vehicle, the protection provided considers fault currents that might be presented before the existing rail vehicle circuit protection devices operate.

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### 5.2.2 ETCS onboard subsystem: overcurrent protection

5.2.2.1 The ETCS onboard subsystem shall be protected by correctly rated protective devices. (Normative)

**Rationale**

G 5.2.2.2 Reliability and availability: The design of the ETCS onboard electrical protection system influences how effective it will be in protecting the ETCS onboard subsystem from damage.

**Guidance**

G 5.2.2.3 Appropriate grouping of protective devices minimises the number of locations where they are fitted within the rail vehicle.

G 5.2.2.4 The design and combination of circuits on protective devices considers the impact on rail vehicle reliability. Resettable protective devices are preferred if they are able to provide the level of protection required.

### 5.2.3 ETCS onboard subsystem: rail vehicle overcurrent protection

5.2.3.1 The ETCS onboard subsystem shall not compromise the hierarchy of protection of the rail vehicle electrical systems. (Normative)

**Rationale**

G 5.2.3.2 Reliability and availability: It is economically beneficial to achieve ETCS onboard subsystem fitment so that the conformity assessment needed for authorisation is limited to conformity with the basic parameters applicable to the ETCS system and its interfaces.

**Guidance**

G 5.2.3.3 None.

### 5.2.4 ETCS onboard subsystem: overcurrent protection testing

5.2.4.1 Where more than one switch or contact is fitted serially in a circuit, it shall be possible to test each switched output independently. (Normative)

**Rationale**

G 5.2.4.2 Reliability and availability: The ability to test each switched output independently reduces the likelihood that hidden failures go undetected when supported by maintenance activity at suitable periodicity.

**Guidance**

G 5.2.4.3 This functionality may be built into the train interface design. It is common practice to use serial switches and contacts in safety braking circuits to reduce the chance of a single switch failure causing a hazard to the train.

## 5.3 Fault tolerance

### 5.3.1 ETCS onboard subsystem: input error tolerance

5.3.1.1 The ETCS onboard subsystem shall not enter SF or NP as a result of any erroneous ETCS input that might reasonably occur on the rail vehicle. (Normative)

**Rationale**

G 5.3.1.2 Reliability and availability: System availability is supported and influenced by its capability to tolerate erroneous input.

**Guidance**

G 5.3.1.3 Examples of likely erroneous input includes: closure of a cab desk whilst it is running a self-test; rapid opening and closing of cabs.

## 5.4 Future provisions

### 5.4.1 Provision for future upgrade

**Guidance**

G 5.4.1.1 For the procurement of ETCS onboard subsystems, it is good practice to consider whether to provide additional provision to support future systems that interface with ETCS. The decision on additional provision is likely to be influenced by factors including cost, space, product availability, future systems, and the remaining life expectancy of the vehicle. It is likely to be more economic to provide additional provisions if the vehicle being fitted is new or has a long life remaining.

G 5.4.1.2 Future systems could include: ATO, systems that use packet 44, future communications equipment and positioning systems.

G 5.4.1.3 Examples of additional provisions that can be considered include:

a) External data connections to interface with future train systems
b) Spare wiring capacity in inter-vehicle jumper cables - EN 50343:2014 sets out requirements for the provision of spare wiring capacity for interface cables
c) Spare input and output card slots that can accommodate a variety of interface cards, or an interface based on a railway-compatible data standard.

### 5.4.2 Provision for remote population of train data

5.4.2.1 Provision shall be made for an external data connection to be used for the remote population of train data. (Application specific)

**Rationale**

G 5.4.2.2 Economic: Provision for future system upgrade to populate the ETCS onboard subsystem with data from other remote systems through the addition of further equipment at a later date.

**Guidance**

G 5.4.2.3 The term ‘remote’, in this context, means a data source external to the DMI or EVC. This may be from other train systems, or from a source external to the train.

G 5.4.2.4 Examples of remote systems from which train data might be received include Over the Air (OTA) or via a swipe card.

G 5.4.2.5 Subset-119 provides details of how such an external data interface might be specified. Although not formally issued, the principles within it provide a solid foundation.

### 5.4.3 Forwarding packet 44 data

5.4.3.1 The ETCS onboard subsystem shall be capable of forwarding recognised packet 44 data to the relevant trainborne system. (Application-Specific)

**Rationale**

G 5.4.3.2 To enable the ETCS onboard subsystem to manage packet 44 data correctly.

**Guidance**

G 5.4.3.3 Packet 44 is intended for non-ETCS application. To enable the intended external function to be fulfilled, the ETCS onboard subsystem routes the packet 44 data received from the ETCS trackside subsystem to the relevant trainborne system. Some non-ETCS systems use packet 44 to perform safety-related functions; the ETCS onboard subsystem transfers packet 44 data to the relevant trainborne system in a safe manner.

G 5.4.3.4 Packet 44-based applications for the management of certain track condition functions have been agreed for use on the GB mainline railway, and are available on the RSSB website (www.rssb.co.uk).

## 5.5 Additional (driver training) display

### 5.5.1 Facility for connecting an additional or portable display unit

5.5.1.1 Provision shall be made for an additional display unit to be temporarily fitted and viewed from a non-driving seat in the cab unless the ETCS DMI indications can be read by the occupant of a non-driving seat in the cab. (Application specific)

**Rationale**

G 5.5.1.2 Train driver learning: The additional display unit will be used by a train driver instructor to observe movement authorities and other ETCS DMI data, when monitoring train driver performance during training and service conditions.

G 5.5.1.3 Integration with train operations: The additional display unit may also be used by conductor drivers in support of meeting their responsibilities as per GERT8000 module TW1.

**Guidance**

G 5.5.1.4 The additional display unit will show indications only.

G 5.5.1.5 The facility for connecting an additional or portable display unit will be used if the ETCS DMI cannot be reliably observed from a non-driving seat.

G 5.5.1.6 Provision includes the appropriate power and signal connections, and a mounting bracket or suitable facility where the additional display can be placed while in use.

### 5.5.2 Additional display unit functionality

5.5.2.1 The additional display shall have no ETCS functionality. (Normative)

**Rationale**

G 5.5.2.2 Integration with train operations: The train driver is responsible for controlling the train and operating the ETCS. The additional display is provided for monitoring purposes only and might be used by someone who is not authorised to operate the train.

**Guidance**

G 5.5.2.3 This requirement will only apply where an additional display is provided.

### 5.5.3 Additional display unit image recording

5.5.3.1 It shall be possible to record the images provided from the ETCS DMI to the additional display (where provided) in order to facilitate post-journey analysis (Normative).

**Rationale**

G 5.5.3.2 Train driver learning: The recorded information will be used to inform train driver competence.

**Guidance**

G 5.5.3.3 None.

## 5.6 Automatic Train operation (ATO)

### 5.6.1 Guidance for ATO

**Guidance**

G 5.6.1.1 Specifications for an interoperable ATO system have been developed and are expected to be published in the CCS TSI in 2023. The GB rail industry intends to request the inclusion of these specifications in the subsequent update of the CCS NTSN. These specifications include changes to the specifications of the ETCS onboard and trackside sub-systems in order to:

a) Create an interface between the ETCS and ATO onboard sub-systems (documented in Subset-130); and
b) Modify the behaviour of the ETCS onboard and trackside sub-systems to accommodate ATO usage.

G 5.6.1.2 The 2023 CCS TSI is expected to introduce a new Baseline 4 of the ETCS, which will incorporate these changes. Any projects seeking to implement an ATO solution on vehicles or infrastructure otherwise configured to an earlier baseline of ETCS by using draft versions of the ATO specifications (including Subset-130 and the solution to CR1238) are encouraged to make a detailed assessment of the compatibility implications of doing so and consider the future migration path to Baseline 4. Guidance on these issues can be sought from the Network Rail System Authority.

G 5.6.1.3 The ATO onboard sub-system can be implemented at the same time as a compatible ETCS onboard sub-system, or at a later date, for example to align with an upgrade of an ETCS onboard sub-system to Baseline 4.

### 5.6.2 Provision for ATO controls on the train driver's desk

5.6.2.1 Provision shall be made for an ATO selector replicating the ETCS DMI ATO selector window functionality. (Normative)

**Rationale**

G 5.6.2.2 To enable the train driver to enable/disable automatic driving using a control external to the DMI from their normal driving position.

G 5.6.2.3 Economic: Providing this capability as part of an initial ETCS onboard sub-system fitment project reduces the impact on critical areas of the rail vehicle, such as the driving desk, when the ATO onboard sub-system is subsequently fitted.

**Guidance**

G 5.6.2.4 The ATO control is described CR1238, which is expected to be included in ERA_ERTMS_015560 for the 2023 CCS TSI.

# Part 6 Installation Design

## 6.1 General requirements

### 6.1.1 ETCS onboard subsystem: existing system redundancy

6.1.1.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the incorporation of the ETCS onboard subsystem shall not compromise existing provision of redundancy within other rail vehicle systems. (Normative)

**Rationale**

G 6.1.1.2 Reliability and availability: Compromising the redundancy of other rail vehicle systems can influence / adversely affect the reliability and availability of the rail vehicle.

**Guidance**

G 6.1.1.3 Trains may have redundant systems that provide system resilience to faults and failures (for example, operation on a single engine or a defective battery charger). ETCS application should not have an adverse effect on these existing arrangements.

## 6.2 Environmental

### 6.2.1 ETCS onboard subsystem: tolerance to the railway environment

6.2.1.1 The ETCS onboard subsystem shall meet its reliability requirement in the environmental conditions in which it will operate. (Normative).

**Rationale**

G 6.2.1.2 Reliability: The environment in which trains are operated will expose the ETCS onboard subsystem to conditions that could adversely affect system reliability.

**Guidance**

G 6.2.1.3 The operating environment includes:

a) Internal and external temperature
b) Solar and electromagnetic radiation
c) Humidity.

G 6.2.1.4 Temperature can be influenced by heat emitted by the ETCS onboard subsystem, heat given off by other equipment, and ambient conditions.

G 6.2.1.5 BS EN 50125-1:2014 sets out further requirements and guidance on the environmental conditions for rail vehicle onboard equipment. Class T1 is appropriate for GB.

### 6.2.2 ETCS onboard subsystem: system and component durability

6.2.2.1 The ETCS onboard subsystem shall meet its predicted service life in the environmental conditions in which it will operate. (Normative)

**Rationale**

G 6.2.2.2 Reliability and availability: The environment in which trains are operated will expose the ETCS onboard subsystem to conditions that could adversely affect system, and component durability.

**Guidance**

G 6.2.2.3 BS EN 50125-1:2014 sets out further requirements and guidance on the environmental conditions for rail vehicle onboard equipment. Class T1 is appropriate for GB.

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### 6.2.3 ETCS onboard subsystem: impact on train system performance

6.2.3.1 The ETCS onboard subsystem shall not reduce the reliability or performance of other systems on the train. (Normative).

**Rationale**

G 6.2.3.2 Integration with train operations: Adversely influencing the reliability or performance of other trainborne systems could negatively impact on train performance.

**Guidance**

G 6.2.3.3 None.

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### 6.2.4 ETCS onboard subsystem: impact on passenger comfort

6.2.4.1 The ETCS onboard subsystem shall not cause discomfort to passengers or train crew. (Normative)

**Rationale**

G 6.2.4.2 Integration with train operations: Discomfort would increase train crew fatigue and could adversely impact on the customer experience of travelling by train.

**Guidance**

G 6.2.4.3 Potential causes of discomfort include:

a) Conducted, convected or radiated heat
b) Draughts
c) Noise
d) Vibration.

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### 6.2.5 ETCS onboard subsystem: tolerance to ultraviolet and infrared radiation

6.2.5.1 The ETCS onboard subsystem equipment shall not be damaged or degraded in appearance due to exposure to ultraviolet and infrared radiation during its lifetime. (Normative)

**Rationale**

G 6.2.5.2 Reliability and availability: The environmental conditions in which trains are operated will expose the ETCS onboard subsystem to radiation that could adversely affect system equipment.

**Guidance**

G 6.2.5.3 Sources of ultraviolet and infrared radiation include sunlight and radiant depot roof heaters.

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### 6.2.6 ETCS onboard subsystem: readability

6.2.6.1 The cab layout shall not adversely affect the readability of the cab controls and indications over the full range of ambient lighting levels and incidence angles when the train driver is positioned in the normal driving position. (Normative)

**Rationale**

G 6.2.6.2 Safe integration: Poor readability of cab controls and indications is a hazard.

G 6.2.6.3 Safe integration: This requirement is used to control *Hazards OB-H001, OB-H002, OB-H003, OB-H004, OB-H005, OB-H006 and OB-H007.*

**Guidance**

G 6.2.6.4 Train driver controls and indications are readable when a train driver, who meets the minimum eyesight and competence requirement for their role, is able to reliably read each item, throughout the range of operational and ambient conditions applicable to that equipment, within the operational context and while performing their required duties. Previous experience of ETCS fitment has shown that 'washout' of the ETCS DMI and cab indications is a problem, particularly on retrofitment where it may not be possible to optimise the cab layout for in-cab signalling.

G 6.2.6.5 Readability is supported and influenced by:

a) The cab environment
b) Screen position
c) Light sources, including sunlight
d) The position of the train driver (which affects viewing angles)
e) Cab lighting levels, including maximum night-time cab illumination levels
f) Reflections and glare, including reflected glare from train driver clothing (for example, white shirts, high visibility vests).

G 6.2.6.6 Potential mitigation measures include DMI viewing angles, and diffuse coating on display screen.

G 6.2.6.7 Requirements for train drivers' visual acuity are set out in RIS-3451-TOM.

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## 6.3 Shock, vibration and noise

### 6.3.1 ETCS onboard subsystem: tolerance to shock and vibration

6.3.1.1 The ETCS onboard subsystem shall meet the reliability requirements and achieve its predicted service life in the shock and vibration environment encountered on the vehicle to which it is fitted. (Normative)

**Rationale**

G 6.3.1.2 Reliability and availability: The shock and vibration environmental conditions in which trains are operated could adversely affect system and component durability.

**Guidance**

G 6.3.1.3 RSSB research report T088 compares actual fatigue and shock levels measured on a vehicle with the requirements set out in BS EN 61373:2010 and GMRT2100.

G 6.3.1.4 Older rail vehicles were not designed to meet these standards and provide a more challenging environment.

G 6.3.1.5 Sources of vibration include:

a) Short periods of running with faulty equipment (for example, 'out of round' wheels, faulty damping)
b) Jointed track.

G 6.3.1.6 Rail vehicle bodies are prone to twisting during low frequency vibration.

G 6.3.1.7 Mitigation measures include:

a) Mounting equipment to prevent transmission of low frequency vibration to sensitive printed circuit board and backplane connections
b) Avoidance of possible resonance of equipment.

### 6.3.2 ETCS onboard subsystem: vibration and noise levels

6.3.2.1 The ETCS onboard subsystem shall not induce other equipment to vibrate or introduce noise which may cause discomfort or distraction to train crew or passengers. (Normative)

**Rationale**

G 6.3.2.2 Integration with train operations: Discomfort would increase train crew fatigue and could adversely impact on the customer experience of travelling by train.

**Guidance**

G 6.3.2.3 BS EN 15892:2011 sets out requirements and guidance for noise measurement in train driving cabs. The Noise NTSN (Rolling Stock) also sets out noise limits and measurement criteria for train drivers' cabs.

G 6.3.2.4 GMGN2460 provides guidance on compliance with noise and vibration legislation in the railway environment. Acceptable limits for passengers are not prescribed but can be assessed on the basis of avoiding any appreciable increase in noise (sound power

level) or vibration beyond the level experienced while the ETCS onboard subsystem is neither fitted, nor operating.

G 6.3.2.5 Acceptable limits for train crew can be assessed on a similar basis, whilst acknowledging that limiting criteria is governed by The Control of Vibration at Work Regulations 2005 and The Control of Noise at Work Regulations 2005.

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### 6.3.3 ETCS onboard subsystem: effect of vibration on readability

6.3.3.1 Vibration experienced by the rail vehicle in operation shall not prevent the readability of the cab controls and indications, including the ETCS DMI, when the train driver is positioned in the normal driving position. (Normative)

**Rationale**

G 6.3.3.2 Safe integration: The operational context will expose the ETCS onboard system to vibration that could prevent the readability of cab controls and indications.

G 6.3.3.3 Safe integration: This requirement is used to control *Hazard OB-H007*.

**Guidance**

G 6.3.3.4 Harmonics induced in the rail vehicle structure could cause the DMI to become unreadable. On-track machines are particularly susceptible to vibration during operation.

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## 6.4 Electromagnetic Compatibility

### 6.4.1 ETCS onboard subsystem: Electromagnetic and electrostatic interference emissions

6.4.1.1 Any electromagnetic and electrostatic interference emitted by the ETCS onboard subsystem shall not degrade any other system or component on the rail vehicle. (Normative)

**Rationale**

G 6.4.1.2 Safe integration: Excessive electromagnetic and electrostatic interference could adversely affect other rail vehicle systems.

G 6.4.1.3 Safe integration: This requirement is used to control *Hazard OB-H011*.

**Guidance**

G 6.4.1.4 Electromagnetic and electrostatic interference is one of the potential hazards that is managed to achieve safe integration of changes to the railway. Before a change to the rail vehicle is put into use, the proposer identifies whether the hazard of electromagnetic and electrostatic interference is present and, if it is, undertakes an electromagnetic compatibility assessment.

G 6.4.1.5 If the rail vehicle includes electronic systems that do not have documented electromagnetic and electrostatic interference susceptibility levels, electromagnetic

compatibility testing confirms that the electromagnetic and electrostatic interference emitted by the ETCS onboard subsystem will not degrade these systems.

G 6.4.1.6 Susceptibility to interference might be influenced by the proximity of radiating equipment and cables.

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### 6.4.2 ETCS onboard subsystem: Electromagnetic and electrostatic interference susceptibility

6.4.2.1 The ETCS onboard subsystem shall behave in a controlled and predictable manner when subjected to electromagnetic and electrostatic interference and input, and power supply perturbations, outside its design capability. (Normative)

**Rationale**

G 6.4.2.2 Safe integration: Failing to a safe condition protects against wrong-side failure or inappropriate activation.

G 6.4.2.3 Safe integration: This requirement is used to control *Hazard OB-H011*.

**Guidance**

G 6.4.2.4 Electromagnetic and electrostatic interference is one of the potential hazards that is managed to achieve safe integration of changes to the railway. Before a change to the rail vehicle is put into use, the proposer identifies whether the hazard of electromagnetic and electrostatic interference is present and, if it is, undertakes an electromagnetic compatibility assessment.

G 6.4.2.5 Older rail vehicles were not designed to meet these standards and provide a more challenging environment.

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## 6.5 Contamination

### 6.5.1 ETCS onboard subsystem: moisture protection

6.5.1.1 Underframe and roof-mounted equipment shall be appropriately sealed against moisture ingress. (Normative)

**Rationale**

G 6.5.1.2 Reliability and availability: The environmental conditions in which trains are operated will expose the externally mounted parts of the ETCS onboard subsystem to sources of moisture that could adversely affect system reliability and availability.

**Guidance**

G 6.5.1.3 IP (or 'Ingress Protection') ratings are defined in BS EN 60529:1992 and IEC 60529:1989. They are used to define levels of sealing effectiveness of electrical enclosures against intrusion from foreign bodies such as tools and dirt, and moisture. It is expected that underframe and roof-mounted equipment will achieve at least IP66 rating.

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### 6.5.2 ETCS onboard subsystem: drainage

6.5.2.1 Splash-proof drains shall be provided on underframe boxes and conduits where water is likely to accumulate. (Normative)

**Rationale**

G 6.5.2.2 Reliability and availability: Accumulated moisture could adversely affect system reliability and availability.

**Guidance**

G 6.5.2.3 Water could accumulate from leaks (through gravity or motion of the train) or condensation.

G 6.5.2.4 The accumulation of water can be mitigated by:

a) Avoiding the use of conduits and ducts where they terminate in housings that could act as a sump; and
b) Using single and multicore cables that enter underframe cases through suitable ingress resistant gland arrangements, with mechanical protection for such cables provided by open cable trays.

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### 6.5.3 ETCS onboard subsystem: spillage protection

6.5.3.1 Interior-mounted equipment shall be sealed to an appropriate level to protect against fluid spillage, contamination or debris. (Normative)

**Rationale**

G 6.5.3.2 Reliability and availability: The reliability and availability of internally mounted parts of the ETCS onboard subsystem could be adversely affected through fluid spillage, contamination, or debris.

**Guidance**

G 6.5.3.3 Interior mounted equipment might be subject to ingestion of dirt and debris. Equipment mounted in ventilated compartments might require protection to at least IP57 rating if there is a likelihood of ingress of powdered snow or water.

G 6.5.3.4 Other potential contaminants may require a different level of protection.

G 6.5.3.5 Other sources of contamination include:

a) Splashes to equipment around the train driver's desk or passenger seats (for example, drink spillages)
b) Rain ingress to equipment mounted near doorways.

G 6.5.3.6 Cable routes can act as paths for fluid spillages to enter equipment cases. To prevent inadvertent fluid ingress into an enclosure, cable connections between items of equipment can be sealed using multipole cable and connectors, or glanded cable entries into the equipment cases.

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### 6.5.4 ETCS onboard subsystem: internal equipment tolerance to cleaning

6.5.4.1 All internal ETCS onboard subsystem equipment shall be tolerant of cleaning using the typical range of cleaning materials and processes used in the railway environment. (Normative)

**Rationale**

G 6.5.4.2 Reliability and availability: Rail vehicle asset management processes will expose ETCS onboard subsystems to materials and interventions that could cause cosmetic damage as well as adversely affecting system reliability and availability.

**Guidance**

G 6.5.4.3 This requirement applies to:

a) Driving cab equipment (including the ETCS DMI and all other controls and indicators)
b) Saloon-mounted equipment accessible to cleaning staff or that could be exposed to cleaning materials by inadvertent spillage or spray.

G 6.5.4.4 Cleaning these items does not require additional provisions to the processes currently used.

G 6.5.4.5 Typical internal equipment cleaning materials include: water, household washing up liquid, glass cleaner, alcohol based cleaning fluid.

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### 6.5.5 ETCS onboard subsystem: external equipment tolerance to cleaning

6.5.5.1 All external ETCS onboard subsystem equipment shall be tolerant of cleaning using the typical range of cleaning materials and processes used in the railway environment. (Normative)

**Rationale**

G 6.5.5.2 Reliability and availability: Rail vehicle asset management processes will expose ETCS onboard subsystems to materials and interventions that could cause cosmetic damage as well as adversely affecting system reliability and availability.

**Guidance**

G 6.5.5.3 This applies to all externally-mounted equipment, including the BTM, radio antenna and odometry.

G 6.5.5.4 Cleaning these items does not require additional provisions to the ones currently used.

G 6.5.5.5 Exterior equipment is subjected to acid and / or alkaline cleaning chemicals being applied at pressure or forcibly through brushing action. High pressure hot water, with or without detergent, or steam might also be applied.

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## 6.6 Crashworthiness

### 6.6.1 ETCS onboard subsystem: crashworthiness

6.6.1.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, any modifications undertaken to the driving desk, cab or any other part of the rail vehicle shall not degrade the existing crashworthiness provision. (Normative)

**Rationale**

G 6.6.1.2 Economic: It is economically beneficial to achieve ETCS onboard subsystem fitment so that the conformity assessment needed for authorisation is limited to conformity with the basic parameters applicable to the ETCS system and its interfaces.

**Guidance**

G 6.6.1.3 In low-speed collisions, the train driver's desk often provides a significant proportion of the front end stiffness. The recommendations of the Uff/Cullen Report are relevant.

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## 6.7 Vandalism and accidental damage

### 6.7.1 ETCS onboard subsystem: protection from vandalism and accidental damage

6.7.1.1 The ETCS onboard subsystem shall be designed to afford protection from vandalism and accidental damage. (Normative)

**Rationale**

G 6.7.1.2 Reliability and availability: The environmental conditions in which trains are operated will expose the ETCS onboard subsystem to potential sources of intentional and unintentional damage and abuse that could adversely affect system reliability and availability.

**Guidance**

G 6.7.1.3 Damage could arise from actions of train crew, other railway staff and members of the public.

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### 6.7.2 ETCS onboard subsystem: tolerance to environmental conditions in which trains are operated

6.7.2.1 Externally-mounted equipment shall be designed to continue to function when subjected to the conditions and impacts reasonably expected in normal service operation. (Normative)

**Rationale**

G 6.7.2.2 Reliability and availability: The environmental conditions in which trains are operated will expose the ETCS onboard subsystem to potential sources of damage that could adversely affect system reliability and availability.

**Guidance**

G 6.7.2.3 It is reasonable to expect that external equipment will be impacted by flying ballast, snow and ice build-up, and minor flood waters during normal operation. OTMs might be exposed to harsher environments, including exposure to ballast dust, and grinding cinders.

G 6.7.2.4 Any ETCS component that needs to be mounted externally should function as seamlessly as any other external train component.

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### 6.7.3 ETCS onboard subsystem: scratch resistance

6.7.3.1 The ETCS DMI surface shall be robust and scratch-resistant, and support simple routine cleaning without scratching. (Normative)

**Rationale**

G 6.7.3.2 Integration with train operations: Scratches have the potential to degrade readability of the DMI.

**Guidance**

G 6.7.3.3 None.

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## 6.8 Health and Safety

### 6.8.1 ETCS onboard subsystem: control of safety hazards

6.8.1.1 No part of the ETCS onboard subsystem shall be capable of exposing any person to harm while safety guards are in place. (Normative)

**Rationale**

G 6.8.1.2 Safe integration: The Management of Health and Safety at Work Regulations 1999 places obligations on duty holders to carry out risk assessment and put measures in place to control the risk.

G 6.8.1.3 Safe integration: This requirement is used to control *Hazard OB-H013*.

**Guidance**

G 6.8.1.4 Any person includes: authorised users of the ETCS onboard subsystem (train drivers, maintainers etc), other railway personnel and members of the general public.

G 6.8.1.5 Potential hazards include:

a) Heat sources, causing burns by radiation, conduction or convection
b) Electromagnetic radiation - GLGN1610 provides guidance on the application of the Control of Electromagnetic Fields at Work Regulations 2016 in the railway environment.
c) Electrostatic charge
d) Electric shock
e) Tripping hazards

f) Sharp edges.

### 6.8.2 ETCS onboard subsystem: electrical hazards

6.8.2.1 The ETCS onboard subsystem shall not include exposed electrical conductors in areas that have to be accessed for routine maintenance of live equipment. (Normative)

**Rationale**

G 6.8.2.2 Safe integration: The Electricity at Work Regulations 1989 places obligations on duty holders to control electrical safety risk.

G 6.8.2.3 Safe integration: This requirement is used to control *Hazard OB-H013*.

**Guidance**

G 6.8.2.4 If suitable protection measures are not in place, the asset maintainer would need to implement a permit to work system.

### 6.8.3 ETCS onboard subsystem: slips, trips and falls

6.8.3.1 Retrofitting a rail vehicle with an ETCS onboard subsystem shall not increase the risk of slips, trips, falls, cuts and other injuries to both railway personnel and the general public compared with the rail vehicle prior to fitment. (Normative)

6.8.3.2 The risks of slips, trips, falls, cuts and other injuries to both railway personnel and the general public due to fitting an ERTMS onboard subsystem shall be acceptable. (Normative)

**Rationale**

G 6.8.3.3 Safe integration: The Management of Health and Safety at Work Regulations 1999 places obligations on duty holders to carry out risk assessment and put measures in place to control the risk.

G 6.8.3.4 Safe integration: This requirement is used to control *Hazard OB-H014*.

**Guidance**

G 6.8.3.5 This includes the location of access for maintenance staff to effect fitment or repairs.

# Part 7 Maintenance

## 7.1 General

### 7.1.1 ETCS onboard subsystem: maintenance requirements

7.1.1.1 The ETCS onboard subsystem shall, as a minimum, meet the maintenance related requirements set out in the ERTMS Reliability Specification (NR/AM/SA/SPE/00147). (Normative)

**Rationale**

G 7.1.1.2 Reliability and availability: Maintenance influences the availability performance of the ERTMS/ETCS as a whole.

**Guidance**

G 7.1.1.3 NR/AM/SA/SPE/00147 sets out reliability and availability targets for the ETCS, which are then apportioned to the respective elements of the onboard and trackside subsystems.

G 7.1.1.4 ETCS onboard subsystem maintenance requirements set out in NR/AM/SA/SPE/00147 include:

a) Mean active repair time (MART) requirements for interior and under-body mounted equipment.
b) Minimum times for software revisions to be loaded, tested and for equipment to be returned to service.
c) Detection rates for in-built testing capability.
d) Requirements related to maintainability.

G 7.1.1.5 NR/AM/SA/SPE/00147 is called up by the requirements in the GB Digital Rail generic requirements suite and is published as a supporting document on the SR&I webpage alongside that suite. The link to the SR&I webpage can be found on the standards landing page for this RIS on the RSSB's website (www.rssb.co.uk).

### 7.1.2 ETCS onboard subsystem: maintainer skills

7.1.2.1 ETCS onboard subsystem maintenance tasks shall be designed to be accomplished by maintainers with skills equivalent to those of existing maintenance staff. (Normative)

**Rationale**

G 7.1.2.2 Asset management: Rail vehicles fitted with an ETCS onboard subsystem are likely to be maintained and serviced in existing maintenance depots using existing resources.

**Guidance**

G 7.1.2.3 The likelihood of failure due to incorrect maintenance or component fitment can also be mitigated by ETCS onboard subsystem design, for example, using coded plugs and sockets, and provision of diagnostics.

G 7.1.2.4 While recognising that maintaining new trains will require some level of additional training for maintenance staff, the principle remains to maintain established skill sets.

### 7.1.3 ETCS onboard subsystem: impact on rail vehicle servicing

7.1.3.1 The design and location of the ETCS onboard subsystem shall not adversely affect the cleaning and maintenance of rail vehicle interiors and exteriors. (Normative)

**Rationale**

G 7.1.3.2 Asset management: Minimising the impact on existing rail vehicle maintenance processes supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.1.3.3 When retrofitting a rail vehicle with an ETCS onboard subsystem, the design and location of the ETCS onboard subsystem equipment considers existing processes for the cleaning and maintenance of rail vehicle interiors and exteriors.

G 7.1.3.4 Where equipment is exposed within the rail vehicle interior, flush surfaces without dirt traps facilitate effective cleaning without the use of excessive quantities or concentrations of cleaning fluids or excessive force.

G 7.1.3.5 Grilles or louvres on floor-mounted equipment might allow ingress to the equipment enclosure during service or cleaning. Floor mounted equipment might also impede cleaning of floors using mops or vacuum cleaners.

G 7.1.3.6 Access for maintenance is considered when locating equipment on the vehicle.

G 7.1.3.7 Exterior-mounted equipment that does not impede effective exterior machine washing, or create dirt traps which lead to dirt streaks on roofs or body-sides as the wash and rinse chemicals drain off, facilitates effective cleaning.

### 7.1.4 ETCS onboard subsystem: component replacement

7.1.4.1 The ETCS onboard subsystem shall be configured so that at least 90 % of predicted equipment failures can be rectified by replacement of the applicable LRU. (Normative)

**Rationale**

G 7.1.4.2 Asset management: LRU replacement supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.1.4.3 The aim is to achieve LRU replacement to rectify 99 % of predicted equipment failures.

### 7.1.5 ETCS onboard subsystem: component delimitation and marking

7.1.5.1 ETCS LRUs shall be clearly delimited and marked to support traceability, and prevent subdivision or loss of configuration. (Normative)

**Rationale**

G 7.1.5.2 Asset management: Clarity in LRU configuration supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.1.5.3 This is important for equipment within which staff may exchange components during fault-finding, resulting in loss of configuration and traceability.

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### 7.1.6 ETCS onboard subsystem: component accessibility

7.1.6.1 All ancillary electrical equipment within the ETCS onboard subsystem, such as terminals, circuit breakers, fuses, relays, and contactors, shall be easily accessible for testing or replacement. (Normative)

**Rationale**

G 7.1.6.2 Asset management: Good equipment maintainability supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.1.6.3 None.

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### 7.1.7 ETCS DMI replacement

7.1.7.1 The ETCS onboard subsystem shall be implemented so that the ETCS DMI can be replaced, configured and tested by a single trained person within 15 minutes. (Application specific)

**Rationale**

G 7.1.7.2 Asset management: The ETCS DMI is expected to need replacing more frequently than other components. It is expected that DMIs will be exchanged by station-based maintenance staff while the train is in service; therefore, the time needed to change a DMI is an important maintenance factor.

**Guidance**

G 7.1.7.3 None.

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### 7.1.8 ETCS onboard subsystem: component mounting

7.1.8.1 The design of the ETCS onboard subsystem shall reflect good ergonomic practice in mounting components and accessing fasteners and connectors. (Application specific)

**Rationale**

G 7.1.8.2 Asset management: Good ergonomic design supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.1.8.3 Ergonomic maintenance practice avoids problems such as:

a) Trapping, scraping or straining hands
b) Difficulty aligning mounting holes
c) Placement of screws with tips of fingers
d) Trapping loose cables behind components
e) Hardware, connections or cable looms obstructing access to fasteners; and
f) Accidental dropping of fasteners or tools into inaccessible or hazardous locations.

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### 7.1.9 ETCS onboard subsystem: maintenance schedules

7.1.9.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, preventative maintenance tasks for the ETCS onboard subsystem shall fit within the existing rail vehicle maintenance schedules. (Normative)

**Rationale**

G 7.1.9.2 Asset management: Rail vehicles retrofitted with an ETCS onboard subsystem are likely to be maintained and serviced in existing maintenance depots. Minimising the impact on existing rail vehicle maintenance processes supports efficiencies in asset management.

**Guidance**

G 7.1.9.3 Rail vehicle examination schedules are well defined for existing rolling stock. New maintenance tasks are specified to fit within the existing stoppage pattern to avoid changing the periodicity at which rail vehicles are stopped for maintenance.

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### 7.1.10 ETCS onboard subsystem: rail vehicle maintenance

7.1.10.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, the ETCS onboard subsystem shall not adversely affect the maintenance of existing equipment. (Normative)

**Rationale**

G 7.1.10.2 Asset management: Good equipment maintainability supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.1.10.3 Examples of things that can adversely affect the maintenance of existing equipment include:

a) Blocking access to existing equipment and fasteners
b) Awkward new inter-vehicle or body-bogie connectors
c) Impeding or interrupting test cycles
d) Requiring additional limitations (for example, engines running, underframe clear, radio reception required) during routine maintenance

e) Impeding wheel re-profiling equipment.

### 7.1.11 ETCS onboard subsystem: maintenance environment

7.1.11.1 Specialist anti-static bench test or clean room precautions shall not be required to maintain the ETCS onboard subsystem. (Normative)

**Rationale**

G 7.1.11.2 Asset management: Minimising the impact on existing rail vehicle maintenance processes supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.1.11.3 The low projected failure rate of the ETCS onboard subsystem does not indicate a need for specialist equipment or technicians in depots. A separate clean and dry store for electronic equipment is permissible.

### 7.1.12 Identification of ETCS onboard failure during maintenance

7.1.12.1 Failure of redundant ETCS onboard subsystem elements shall be easily identifiable during maintenance. (Normative)

**Rationale**

G 7.1.12.2 Reliability and availability: Maintaining the effectiveness of designed levels of system redundancy supports continued system operations when primary systems experience a fault.

**Guidance**

G 7.1.12.3 It is common practice to use switches and contacts (in serial or parallel, depending upon the implementation) to reduce the chance of a single switch failure causing a hazard or immobilizing failure of the rail vehicle or train. If latent failures of equipment in such circuits are not identified, it may eventually lead to a hazard or a system failure.

G 7.1.12.4 This function may be achieved through monitoring of back contacts (either by the train management system or separate ‘tell-tale’ indicators), or EVC test cycles that independently test any parallel output at an appropriate juncture. A dedicated test tool may be deemed acceptable if it is simple to operate and requires limited intrusion into the vehicle systems.

### 7.1.13 Interface configuration and system testing

7.1.13.1 The testing of non-ETCS trainborne systems interfaced to the ETCS onboard subsystem shall be independent of the presence or operational state of the ETCS onboard subsystem. (Normative)

**Rationale**

G 7.1.13.2 Asset management: This permits the effective testing of non-ETCS equipment on ETCS-fitted vehicles.

**Guidance**

G 7.1.13.3 Trainborne systems which may require testing without interference from the ETCS onboard subsystem include the train braking system.

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### 7.1.14 Verification of the ETCS onboard subsystem post-maintenance

7.1.14.1 Procedures for the testing of ETCS-fitted vehicles following maintenance shall be provided to verify that the ETCS onboard subsystem can re-enter full operational service. (Normative)

**Rationale**

G 7.1.14.2 Safety and performance: The documented process sets out the means by which the ETCS onboard subsystem is verified to be functioning correctly and safely.

G 7.1.14.3 This requirement controls *Hazards HH-H001, HH-H008a, HH-H008b, and OB-H004*.

**Guidance**

G 7.1.14.4 The component supplier's maintenance processes are reviewed and can be amended by the railway undertaking based on operational experience and having undertaken appropriate analysis.

G 7.1.14.5 Following maintenance where components may have been re-configured or replaced, rail vehicle maintenance staff verify that the ETCS onboard subsystem and interfaced systems that had the potential for being affected by the maintenance activity are operational and working within the required parameters. Depending on the implementation and the changes made, a self-test procedure may be sufficient.

G 7.1.14.6 The affected components, and required verification, following re-configuration or replacement can include:

a) Odometry subsystem (to confirm that performance lies within the parameters set out in in Subset-041)
b) ETCS DMI (for vehicles fitted with split-screen DMIs, the process includes verification that both elements of the DMI are fully operational)
c) EVC (verification of the ETCS configuration data including national values)
d) Balise antennas and BTMs (alignment)
e) EDORs (SIM cards and antennas)
f) TIMS, where fitted (operational)
g) JRU (recording and playback).

G 7.1.14.7 Maintenance procedures include both the calibration of individual sub-systems and verification of the correct integration and functioning of the train as a complete entity.

G 7.1.14.8 The test processes are expected to demonstrate that the ETCS onboard subsystem is capable of using all fitted EDORs to connect to both the GSM-R network and has the relevant keys to connect to an RBC. This may require the ability to isolate each EDOR. Where appropriate, the process includes details of the GSM-R network to support configuration of the ETCS onboard subsystem and of the RBC to be contacted.

G 7.1.14.9 The defective on-train equipment documentation defines the circumstances in which it is permissible for an ETCS-fitted vehicle to enter service with some equipment isolated if it has not been possible to complete some aspects of the post-maintenance verification checks.

G 7.1.14.10 The means by which this requirement is achieved, and the supporting maintenance verification processes, are supplier or vehicle type-specific.

G 7.1.14.11 It is expected that the procedures are supplier and fitment specific. The agreed procedures are applied by the railway undertaking.

## 7.2 Diagnostic tools

### 7.2.1 Guidance - definition

**Guidance**

G 7.2.1.1 Diagnostic tools include maintenance, download, fault-finding, interrogation and analysis tools.

### 7.2.2 ETCS onboard subsystem: diagnostic tools ease of use

7.2.2.1 Diagnostic tools shall be simple to operate and interpret by staff normally employed by the railway undertaking. (Normative)

**Rationale**

G 7.2.2.2 Asset management: Providing diagnostic tools that are easy to use supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.2.2.3 Complex diagnostic tools can lead to error or delay in determining faults.

G 7.2.2.4 Rail vehicles fitted with an ETCS onboard subsystem are likely to be maintained and serviced in existing maintenance depots using existing resources. While recognising that the operation and interpretation of new diagnostic tools will require some level of additional training, the principle is that diagnostic tools can be used by staff normally employed by the railway undertaking.

### 7.2.3 ETCS onboard subsystem: diagnostic software

7.2.3.1 Software-based diagnostic tools shall be designed for use on standard, modern operating systems. (Preferred)

**Rationale**

G 7.2.3.2 Asset management: Providing diagnostic tools that use standard operating systems supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.2.3.3 Standard, modern operating systems include, but are not limited to, Windows, iOS, Linux, and Android systems.

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### 7.2.4 ETCS onboard subsystem: manual diagnostic procedures

7.2.4.1 Software-based diagnostic tools shall not require complex procedures for manual input and recording of output. (Normative)

**Rationale**

G 7.2.4.2 Asset management: A software diagnostic tool that requires complex use or specialist knowledge to input data or record the output would increase asset management costs.

**Guidance**

G 7.2.4.3 None.

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### 7.2.5 ETCS onboard subsystem: diagnostic download integrity

7.2.5.1 Software-based diagnostic tools shall not cause data or software corruption during download. (Normative)

**Rationale**

G 7.2.5.2 Asset management: Corruption during download can lead to error or delay in interpretation.

**Guidance**

G 7.2.5.3 None.

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### 7.2.6 ETCS onboard subsystem: diagnostic interfaces

7.2.6.1 Software-based diagnostic tools shall use modern, universally available interfaces for communicating with the ETCS onboard subsystem. (Preferred)

**Rationale**

G 7.2.6.2 Asset management: Utilising Ethernet, Universal Serial Bus (USB) and other common electronic interfaces would minimise potential obsolescence issues with the device hardware.

**Guidance**

G 7.2.6.3 Legacy interfaces with potential obsolescence issues include RS232 and RS485.

#### 7.2.7 ETCS onboard subsystem: remote diagnostic download

7.2.7.1 Functionality shall be provided to download remotely ETCS diagnostic information stored onboard while the train is in service. (Application specific)

**Rationale**

G 7.2.7.2 Asset management: The ability to identify ETCS faults with the ETCS onboard subsystem from locations remote to the rail vehicle supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.2.7.3 Conformity with this requirement can include exporting system fault logs at defined intervals, or on demand, via a remote communication medium.

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### 7.3 Failure reporting and data recording

#### 7.3.1 ETCS onboard subsystem: fault reporting and feedback capabilities

7.3.1.1 When retrofitting a rail vehicle with an ETCS onboard subsystem, any devices interfaced with the ETCS onboard subsystem shall maintain their existing fault reporting and feedback capabilities. (Preferred)

**Rationale**

G 7.3.1.2 Asset management: Minimising the impact on existing rail vehicle maintenance processes supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.3.1.3 The ability for an existing train system's faults or status reports to be conveyed to authorised people at any time is not compromised when interfacing the train system with the ETCS onboard subsystem. This may be achieved by retaining existing fault reporting functionality or integrating the fault reporting with ETCS asset management processes.

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#### 7.3.2 ETCS onboard subsystem: multiple data recorders

7.3.2.1 Where more than one device is used for data recording, a robust means of correlating the data across the devices shall be provided. (Normative)

**Rationale**

G 7.3.2.2 Asset management: Failure and incident investigation is informed by correlated data from conventional and ETCS systems in order to explain fully the events that have occurred.

**Guidance**

G 7.3.2.3 Subset-027 sets out the data recording requirements for the ETCS.

G 7.3.2.4 RIS-2472-RST sets out the data recording requirements for trains that operate on the GB mainline railway.

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### 7.3.3 ETCS onboard subsystem: data recording spare channels

7.3.3.1 Any new data recorder fitted shall be provided with at least 20 % spare channels above those needed to comply with the requirements of RIS-2472-RST and the ETCS JRU. (Normative)

**Rationale**

G 7.3.3.2 Economic: Providing additional capacity is intended to avoid additional future cost if additional requirements for monitoring are introduced.

**Guidance**

G 7.3.3.3 RIS-2472-RST specifies the minimum requirements for onboard monitoring and recording.

G 7.3.3.4 This requirement is not applicable to existing data recorders that are retained on the rail vehicle.

G 7.3.3.5 In this context , data recorder may be either an independent JRU, or combined JRU/ OTMR equipment.

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### 7.3.4 ETCS onboard subsystem: remote data downloading

7.3.4.1 Functionality shall be provided to download remotely JRU data from the ETCS onboard subsystem while the train is in service. (Application specific)

**Rationale**

G 7.3.4.2 Asset management: The ability to identify ETCS faults with the ETCS onboard subsystem from locations remote to the rail vehicle supports efficiencies in rail vehicle asset management and incident investigations.

**Guidance**

G 7.3.4.3 Conformity can be achieved by exporting JRU logs at defined intervals, or on demand, via a remote communication medium.

G 7.3.4.4 The data to be available for download is sufficient for the requirements of the train operator. It may be acceptable for only a subset of the data to be available for download whilst the train is in motion.

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### 7.3.5 ETCS onboard subsystem: data download format

7.3.5.1 Downloads from ETCS equipment shall be available in an easily readable and usable format. (Normative)

**Rationale**

G 7.3.5.2 Asset management: Providing data downloads that are easy to use supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.3.5.3 Downloaded data includes data from ETCS equipment that has been converted so that it is in an easily readible format by a human or another computer system.

## 7.4 Diagnostic information

### 7.4.1 ETCS onboard subsystem: diagnostic information

7.4.1.1 The ETCS onboard subsystem shall provide diagnostic information sufficient for authorised people to confirm that the ETCS onboard subsystem is operational and functioning correctly. (Normative)

**Rationale**

G 7.4.1.2 Asset management: Providing suitable and sufficient diagnostic information supports efficiencies in rail vehicle asset management.

**Guidance**

G 7.4.1.3 Diagnostic information is particularly important after corrective or preventive maintenance has been carried out. Authorised people are determined by railway undertakings in accordance with their safety management system. Relevant roles include technicians, fitters, train drivers, and maintainers.

### 7.4.2 ETCS onboard subsystem: diagnostic information granularity

7.4.2.1 The ETCS onboard subsystem shall provide diagnostic information sufficient for authorised people to diagnose faults to a single LRU. (Normative)

**Rationale**

G 7.4.2.2 Asset management: Providing suitable and sufficient diagnostic information supports efficient corrective actions and efficiencies in rail vehicle asset management.

**Guidance**

G 7.4.2.3 Authorised people are determined by railway undertakings in accordance with their safety management system. Relevant roles include technicians, fitters, train drivers, and maintainers.

### 7.4.3 ETCS onboard subsystem: diagnostic information accessibility

7.4.3.1 ETCS onboard subsystem diagnostic information shall be displayed to authorised people without the need for equipment other than access keys. (Preferred)

**Rationale**

G 7.4.3.2 Asset management: Providing authorised people with easy access to diagnostic information supports efficient corrective actions and efficiencies in rail vehicle asset management.

**Guidance**

G 7.4.3.3 Conformity with this requirement can be met if a maintainer can interrogate the ETCS diagnostic information from displays/interfaces integrated within the ETCS onboard subsystem without needing to use maintenance tools or laptop-based interrogation software. Access keys may be necessary if the diagnostic information is not located in a secure area.

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### 7.4.4 ETCS onboard subsystem: diagnostic information time stamp

7.4.4.1 Diagnostic information shall be recorded with a time stamp with sufficient resolution to identify all events accurately. (Normative)

**Rationale**

G 7.4.4.2 Asset management: A time stamp enables correlation of all recorded information and supports the Defect Recording Analysis and Corrective Action System (DRACAS) process.

**Guidance**

G 7.4.4.3 None.

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### 7.4.5 ETCS onboard subsystem: recording safety-critical faults

7.4.5.1 The details and nature of safety-critical faults within the ETCS onboard subsystem shall be recorded on board the rail vehicle. (Normative)

**Rationale**

G 7.4.5.2 Asset management: Safety-critical faults will be downloaded for later evaluation.

G 7.4.5.3 This requirement supports the DRACAS process.

**Guidance**

G 7.4.5.4 None.

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### 7.4.6 ETCS onboard subsystem: LRU fault monitoring

7.4.6.1 The ETCS onboard subsystem shall be able to identify malfunctioning LRUs to an authorised person before they cause a service failure. (Preferred)

**Rationale**

G 7.4.6.2 Reliability and availability: Identification of potential service-affecting failures enables the LRU to be proactively replaced.

**Guidance**

G 7.4.6.3 Examples of malfunctioning equipment include:

a) Partial failure of redundant system
b) Tolerable, but unusual, activity (for example, abnormal data errors, dropped connections, inconsistent ETCS input and software watchdog resets).

G 7.4.6.4 Not all equipment has to be redundant to meet this requirement.

G 7.4.6.5 Indication of failures in unmonitored hardware, for example wiring degradation or sticking relays, cannot reasonably be expected before a failure occurs.

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### 7.4.7 ETCS onboard subsystem: faults relating to trackside equipment

7.4.7.1 Faults reported by the ETCS onboard subsystem that relate to trackside equipment issues shall be supported with information on the location and nature of the failure. (Normative)

**Rationale**

G 7.4.7.2 Asset management: This requirement supports the efficient and timely correction of trackside faults, minimises the need for trackside fault identification and investigation, and supports the DRACAS process.

**Guidance**

G 7.4.7.3 Location information could be derived from the Last Relevant Balise Group and distance information, or other relevant co-ordinates if supported. Section 15 of ERA_ERTMS_015560 sets out requirements for system status messages.

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### 7.4.8 ETCS onboard subsystem: presenting ETCS fault indications

7.4.8.1 Information about ETCS faults that require immediate train driver attention shall be presented to the train driver in an unambiguous, operationally meaningful manner. (Normative)

**Rationale**

G 7.4.8.2 Integration with train operations: Providing information that is easy to identify and interpret supports the train driving task.

**Guidance**

G 7.4.8.3 None.

---

### 7.4.9 ETCS onboard subsystem: ETCS fault acknowledgment

7.4.9.1 Information about ETCS faults that require immediate train driver attention shall require acknowledgement. (Normative)

**Rationale**

G 7.4.9.2 Integration with train operations: The acknowledgement of the ETCS fault condition is intended to prevent the condition being ignored or overlooked by the train driver.

**Guidance**

G 7.4.9.3 ERA_ERTMS_015560 sets out the requirements for display and acknowledgement of text messages related to the system requirements specification (SRS) defined system status. The objective is for these messages to demand acknowledgement by the train driver. The precise form of acknowledgement of supplier-specific text messages informing of faults within the ETCS onboard subsystem is not specified.

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### 7.4.10 ETCS onboard subsystem: maintaining ETCS fault indications

7.4.10.1 Information about faults that require immediate train driver attention shall persist after acknowledgement. (Normative)

**Rationale**

G 7.4.10.2 Integration with train operations: Continuing to present the information after acknowledgement is intended to remind the train driver and reinforce train driver memory.

**Guidance**

G 7.4.10.3 ‘End of display’ determines whether the message is deleted after acknowledgement or is retained in a list that can be accessed by scrolling. Where a message requires the train driver's immediate attention, it is appropriate for it to remain in the scrolling list of text messages.

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### 7.4.11 ETCS onboard subsystem: information about fault cause

7.4.11.1 Detailed information about the cause of faults, and appropriate action to take, shall be provided via the ETCS DMI, or exported to train control systems. (Preferred)

**Rationale**

G 7.4.11.2 Asset management: This information is needed by train drivers and maintainers and supports appropriate action to be taken.

**Guidance**

G 7.4.11.3 When the rail vehicle is fitted with train control systems that report faults directly to train drivers, or to maintainers remotely, the ETCS fault logging system can be integrated with the rail vehicle system, if this is economical. The failure of one system in an integrated solution should not affect the fault logging of other systems.

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## 7.5 System security

### 7.5.1 Guidance - system security

**Guidance**

G 7.5.1.1 System security refers to security against unauthorised access to the ETCS onboard subsystem settings, configuration data, cryptographic keys and software.

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### 7.5.2 ETCS onboard subsystem: controlling access

7.5.2.1 An access control system for ETCS onboard subsystem configuration settings and data shall be provided. (Normative)

**Rationale**

G 7.5.2.2 Safe integration: An access control system restricts modifications to the configuration of settings and data to authorised personnel.

G 7.5.2.3 Safe integration: This requirement is used to control *Hazard OB-H024*.

**Guidance**

G 7.5.2.4 Access control incorporates user identifications and appropriate access levels.

G 7.5.2.5 Before entering service, the ETCS onboard subsystem will have ETCS cryptographic keys installed that are compatible with any ETCS Level 2 or Level 3 infrastructure on which it is required to operate.

G 7.5.2.6 RIS-0743-CCS sets out requirements for the management of ETCS cryptographic keys. Subset-037 sets out how the cryptographic keys are used.

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### 7.5.3 ETCS onboard subsystem: cyber security

7.5.3.1 The ETCS onboard subsystem shall be designed to reduce the risk from cyberattack to an acceptable level. (Normative)

**Rationale**

G 7.5.3.2 Safe integration: To allow the railway undertaking to fulfil its obligations in controlling the risk of cyberattack on train operations.

G 7.5.3.3 Safe integration: This requirement is used to control *Hazard OB-H024*.

**Guidance**

G 7.5.3.4 Hazards to consider include:

a) The possibility of malicious remote operation of the EVC
b) Remote editing of data within the EVC
c) Remote disabling of the ETCS
d) Unauthorised use of access keys to ETCS onboard equipment.

G 7.5.3.5 Further information about the rail industry strategy for managing cyber security risk can be obtained from the Rail Delivery Group (RDG).

G 7.5.3.6 The level of risk from a cyberattack is agreed with the Centre for the Protection of National Infrastructure (CPNI).

G 7.5.3.7 The acceptability of the risk from these hazards is demonstrated using an appropriate risk assessment approach, for example the common safety method for risk evaluation and assessment.

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### 7.5.4 ETCS onboard subsystem: protection against tampering

7.5.4.1 The ETCS onboard subsystem shall be designed to reduce the risk from physical tampering to an acceptable level. (Normative)

**Rationale**

G 7.5.4.2 Safe integration: This requirement is used to control *Hazard OB-H024*.

**Guidance**

G 7.5.4.3 Tampering is the action of touching or making changes to something, usually when trying to damage it or do something illegal.

G 7.5.4.4 Examples of controls to reduce the risk of tampering include:

a) Controlling or limiting access to products or systems of interest
b) Improving the tamper resistance to make tampering more difficult and time consuming
c) Any ETCS onboard equipment that is not contained within a secure enclosure being fail-safe in the event of tampering.

G 7.5.4.5 Mounting equipment in publicly inaccessible areas or the use of cabinet keys or 'relevant tools' are methods that can be used to control or limit unauthorised access.

G 7.5.4.6 The relevant tool will vary depending upon the fleet being fitted, but can be selected to align with the existing access arrangements for the particular fleet. This is also relevant to cyber security.

G 7.5.4.7 Examples of relevant tools include:

a) Gated 8 mm hex recess - maintainers (access to equipment cabinets)
b) Gated 8 mm square driver - train drivers (access to circuit breakers)
c) Gated 7 mm triangle - train driver manager (access to JRU and repeater ETCS DMI).

G 7.5.4.8 Where both maintainers and train drivers / train preparers need to access equipment, two separate locked areas can be provided so that they have access only to the appropriate parts of the system, using different relevant tools as appropriate.

G 7.5.4.9 Tamper proof screws can be used to improve tamper resistance.

G 7.5.4.10 The acceptability of the risk is demonstrated using an appropriate risk assessment approach, for example the common safety method for risk evaluation and assessment.

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### 7.5.5 ETCS onboard subsystem: access for maintenance and fault finding

7.5.5.1 Status or fault indicators, and download ports necessary for maintenance and fault-finding, shall be accessible using access keys only. (Normative).

**Rationale**

G 7.5.5.2 Integration with train operations: Maintenance and fault-finding indications that are not necessary for the train driving task might distract the train driver.

**Guidance**

G 7.5.5.3 None.

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### 7.5.6 ETCS onboard subsystem: visibility of status and fault indications

7.5.6.1 Status or fault indicators necessary for operations shall be visible without the need to gain entry using access keys. (Normative)

**Rationale**

G 7.5.6.2 Integration with train operations: The train driver needs to be able to easily access all indications that are necessary for the train driving task.

**Guidance**

G 7.5.6.3 If personnel need to observe an indicator in an unauthorised area, a window can be used that allows visibility from an authorised area.

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### 7.5.7 Cryptographic information verification

7.5.7.1 Procedures for the testing of ETCS-fitted vehicles following maintenance with the potential to interfere with cryptographic key stored within the ETCS onboard subsystem shall include the processes for the update and checking of cryptographic key. (Normative)

**Rationale**

G 7.5.7.2 Performance: To reduce reliance on degraded working procedures arising from trains being unable to establish secure communications when attempting to enter ETCS operation.

**Guidance**

G 7.5.7.3 The processes typically include the following:

a) Installation of a digital certificate – this may include public/private key exchange
b) Confirmation of validity of digital certificates
c) Installation of ETCS keys received in accordance with Subset-114

d) Viewing of key maintenance and update logs.

G 7.5.7.4 The means by which this requirement is achieved, and the supporting maintenance verification processes are supplier or vehicle type-specific.

G 7.5.7.5 It is expected that the procedures are supplier and fitment specific. The agreed procedures are applied by the railway undertaking.

# Part 8 Process and Procedure

## 8.1 System support

### 8.1.1 ETCS onboard subsystem: life-cycle management plan

8.1.1.1 The ETCS onboard subsystem shall be supported by a life-cycle management plan which is in place on first authorisation of an installation. (Normative)

**Rationale**

G 8.1.1.2 Asset management: A life-cycle management plan is part of the acceptance and strategy process on the GB railway.

**Guidance**

G 8.1.1.3 The onboard life-cycle management plan links into a life-cycle management strategy for the ETCS on the GB mainline network to enable effective management of configuration and reliability management through the industry DRACAS processes. Network Rail System Authority can provide further guidance in this area.

G 8.1.1.4 Standard life-cycle support arrangements are also expected to be established and may include but not be limited to:

a) Arrangements for update of equipment, including for obsolescence
b) Spares provision
c) Test equipment
d) Endemic and epidemic faults
e) Warranty support
f) Ongoing training
g) Repair processes
h) Documentation updates
i) Decommissioning and disposal
j) Support to DRACAS processes
k) Configuration management (including use of existing train operator systems, for example, component tracker)
l) Reliability
m) Monitoring and trend analysis for all relevant applications of the contractor's ETCS systems and interoperable constituents
n) Safety monitoring and reporting for all safety related incidents for all relevant applications of the contractor's ETCS systems and inter-operable constituents anywhere in Europe or the rest of the world.

### 8.1.2 ETCS onboard subsystem: Baseline 3 maintenance release updates

8.1.2.1 The ETCS onboard subsystem shall have its Baseline 3 software updated with Baseline 3 maintenance releases within an agreed timescale following the instruction for their implementation. (Normative)

**Rationale**

G 8.1.2.2 Asset management: The ETCS is a software based system defined by a core European specification, and the GB Programme is deploying the baseline of this specification known as Baseline 3. During the lifetime of the system, system updates or maintenance releases will be required to fix errors, implement compatible functionality, and act upon feedback from that and other projects. This means that the configuration version deployed on an installation will need to change during the lifetime of the system to allow incorporation of the updates, and should be formalised contractually between owner/operator and supplier.

**Guidance**

G 8.1.2.3 Software upgrades are to be expected throughout the lifetime of the ETCS. The timescale will be agreed between operator and supplier after assessment of the content of the release and consideration of its impact on individual fleet operation.

G 8.1.2.4 Compliance with this requirement will be judged on when first authorisation took place, when maintenance releases were issued, whether they had been deployed and, if not, checking that plans were in place to deploy, supported by the appropriate contracts and processes.

G 8.1.2.5 While it might be acceptable not to include a maintenance release change where it does not affect normal operation in the vehicle's current area of use, this may impact on the ability for the vehicle's area of use to be expanded in future. It is good practice to include the Network Rail System Authority in any case-by-case studies carried out by the supplier and/or operator to identify whether maintenance release changes impact on ETCS operation.

## 8.2 Human Factors

### 8.2.1 Scope of human factors studies

**Guidance**

G 8.2.1.1 The scope of human factors studies is limited to application principles and national elements only. It is not necessary to carry out a systematic validation of mandatory CCS NTSN requirements.

G 8.2.1.2 Any necessary changes to CCS NTSN requirements will be managed through the established change control management process.

### 8.2.2 ETCS onboard subsystem: ergonomic design techniques

8.2.2.1 The design of the ETCS onboard subsystem and its application onto the rail vehicle shall incorporate user-centred design activities in line with GB operational practice, to ensure that effective human factors and ergonomic design techniques are applied in all aspects of the system development and its operation and maintenance. (Normative)

**Rationale**

G 8.2.2.2 Safe integration: This requirement is used to control *Hazards OB-H001, OB-H002, OB-H003, OB-H004, OB-H005, OB-H006 and OB-H007*.

**Guidance**

G 8.2.2.3 BS EN ISO 9241-210:2010 provides guidance on applying user-centred design techniques to achieve quality in use throughout the life cycle of interactive computer-based systems. It describes user-centred design as a multi-disciplinary activity which incorporates ergonomics knowledge and techniques with the objective of enhancing effectiveness and productivity, improving human working conditions, and counteracting the possible adverse effects of use on human health, safety and performance. This includes everyone who comes into contact with any part of the ETCS onboard subsystem.

G 8.2.2.4 It is good practice to undertake an ergonomic assessment to review all incab sounds to identify whether any conflicts occur due to the introduction of the ETCS onboard subsystem. The removal of sound conflicts supports safe integration.

G 8.2.2.5 It is expected that a substantial amount of consultation with the end user of the respective system elements will be required in order to arrive at the optimum solution.

# Appendices

## Appendix A Hazards Relevant to the ETCS Onboard Subsystem

A.1 Some of the requirements in this document can be used to control safety hazards. The relevant requirements have an associated 'safe integration' rationale that includes a reference to one or more of the hazards listed in the table below. This hazard information is an extract from the ETCS Reference Design Hazard Log, which is maintained by the Network Rail System Authority.

| Hazard ID | Description | Cause | Consequence |
|---|---|---|---|
| HH-H001 | If trains operate in NTC for extended periods of time, the odometry drift can exceed the allowable tolerances causing the RBC to reject the connection. | Normal odometry drift during operations;<br>Odometry not reset at regular interval. | Emergency brake application leading to: Passenger train: injuries to passengers from emergency brake. Freight train: buffer lock, shifted loads (out of gauge), train jerk, derailment. Performance delays with train failed on mainline. Freight train is out of gauge because of shifted load. |
| HH-H008a | A mismatch between the actual tyre sizes and the size entered in the ETCS system will result in odometry errors. This results in the train encountering balises outside the expectation window for them and potentially not acting upon the contents of the balises. | Tyre sizes not updated in the ETCS system after wheel turning;<br>Error in inputting the tyre sizes in the ETCS system. | There is no obstruction ahead.<br>The train exceeds its movement authority (SPAD) and the emergency brake is applied:<br>Passenger train: injuries to passengers from emergency brake.<br>Freight train: buffer lock, shifted loads (out of gauge), train jerk, derailment. |

| Hazard ID | Description | Cause | Consequence |
|---|---|---|---|
| HH-H008b | A mismatch between the actual tyre sizes and the size entered in the ETCS system will result in odometry errors. This results in the train encountering balises outside the expectation window for them and potentially not acting upon the contents of the balises. | Tyre sizes not updated in the ETCS system after wheel turning;<br>Error in inputting the tyre sizes in the ETCS system. | There is an obstruction ahead.<br>The train exceeds its movement authority (SPAD) and the inbuilt ETCS safety tolerances after the emergency brakes are applied because of the odometry error, leading to a possible low-speed collision or derailment at the end of the movement. The emergency brakes are applied when the train does not read the next balise. |
| M1-H001 | Driver does not remove traction power when required to | Driver error - distraction;<br>Lack of information provided to the driver;<br>Loss of route knowledge due to familiarity with driving under ETCS. | Brake snatching , train division, or buffer locking.<br>Excessive jerk due to traction demand when traction circuit breaker is opened/closed leading to passenger discomfort. |
| N-H051 | AWS / TPWS is not suppressed | Suppression failure | Failure to suppress could lead to ETCS onboard subsystem assuming that AWS/TPWS has failed, which could cause problems when exiting ETCS - those problems |

| Hazard ID | Description | Cause | Consequence |
|---|---|---|---|
| | | | could be a failure to transition or a lack of safety systems after transition;<br>Train tripped by TPWS loop present in new area - leading to passenger slips, trips / falls;<br>Driver does not respond timeously to AWS acknowledgment requests if AWS magnets in new area, resulting in brake application - leading to passenger slips, trips, or falls. |
| OB-H001 | Cab ergonomics not optimised | Incorrect isolation of ETCS | Train proceeds along route unprotected leading to a collision / derailment at line speed |
| OB-H002 | Cab ergonomics not optimised | Incorrect reset of ETCS | Sudden brake application leading to passenger slips, trips and falls, or brake snatching on Freight trains |
| OB-H003 | Cab ergonomics not optimised | Indication of ETCS isolation not optimised for ergonomics (for example, position, luminance) | Train proceeds along route unprotected leading to a collision and/or derailment at line speed |
| OB-H004 | Cab ergonomics not optimised | No indication that the ETCS is unfit for | No consequence identified |

| Hazard ID | Description | Cause | Consequence |
|---|---|---|---|
| | | service at start of mission | |
| OB-H005 | Cab ergonomics not optimised | Inadequate alarm volume.<br>Alarm tone conflict;<br>Existing non-ETCS alarms | Sudden brake application leading to passenger slips, trips and falls, or brake snatching on Freight trains |
| OB-H006 | Cab ergonomics not optimised | Not evident that the DMI has frozen | Sudden brake application leading to passenger slips, trips and falls, or brake snatching on Freight trains |
| OB-H007 | Cab ergonomics not optimised | Poor legibility of controls and indications - DMI not readable;<br>DMI susceptible to vibration. | Sudden brake application leading to passenger slips, trips and falls, or brake snatching on Freight trains |
| OB-H008 | Train fails to stop at intended location | DMI data entry error. Inappropriate access to configuration settings; Incorrect data preparation. | Collision between trains or train derailment due to insufficient braking curves |
| OB-H009 | Driver confused or distracted | Poor integration with other systems | No consequence identified |
| OB-H010 | Driver confused or distracted | AWS indications integrated with DMI | Operations delay |
| OB-H011 | Excessive electromagnetic emissions from system | Excessive electromagnetic emissions | Sudden brake application leading to passenger slips, trips and falls, or brake snatching on Freight trains |
| OB-H012 | System has insufficient immunity from | Inadequate electromagnetic immunity | Sudden brake application leading to passenger slips, trips and falls, or |

| Hazard ID | Description | Cause | Consequence |
|---|---|---|---|
| | electromagnetic interference | | brake snatching on Freight trains |
| OB-H013 | Potential for injury carrying out maintenance activities | Inadequate protection of live equipment; Inadequate safety guards. | Electrocution/ electric shock injury following contact with live terminals |
| OB-H014 | Potential for slip, trip, or fall | ETCS equipment introduces slip, trip, or fall risk | Slip, trip, or fall |
| OB-H015 | Train fails to stop at intended location | ETCS fitment compromises brake system | Brake failure leading to collision and/or derailment at line speed |
| OB-H016a | Train fails to stop at intended location | ETCS emergency or service brake not applied at rate, and response time, equivalent to that achievable by a driver-initiated application | No consequence identified |
| OB-H016b | Train fails to stop at intended location | ETCS emergency or service brake not applied at rate, and response time, equivalent to that achievable by a driver-initiated application; ETCS onboard subsystem cuts traction effort to the train too quickly | Sudden brake application leading to passenger slips, trips and falls, or brake snatching on Freight trains |
| OB-H018 | Train fails to stop at intended location | ETCS onboard subsystem does not disengage the set speed control automatically during brake intervention | Driver inattention |

| Hazard ID | Description | Cause | Consequence |
|---|---|---|---|
| OB-H019 | Train fails to stop at intended location | Cold movement detector fails to detect movement | Train proceeds along route unprotected leading to a collision and/or derailment at line speed |
| OB-H020 | Train fails to stop at intended location | ETCS onboard subsystem fails to suppress AWS/ TPWS when required | Sudden brake application leading to passenger slips, trips and falls, or brake snatching on Freight trains |
| OB-H021 | Train fails to stop at intended location | ETCS onboard subsystem suppresses AWS/ TPWS when not required to do so, including on selection of SH in Level NTC, NID_NTC=20 and 21; The AWS / TPWS system is not in the 'Operational Ready' state when required | Train proceeds along route unprotected - leading to a collision or derailment at line speed |
| OB-H022 | Train fails to stop at intended location | ETCS onboard subsystem suppresses AWS/ TPWS when not required to do so | Train proceeds along route unprotected - leading to a collision and/or derailment at line speed |
| OB-H023 | Train fails to stop at intended location | Class B system in-service monitoring suppressed incorrectly by ETCS onboard subsystem; Class B system failure and/or isolation not handled correctly. | Train proceeds along route unprotected leading to a collision / derailment at line speed |

| Hazard ID | Description | Cause | Consequence |
|---|---|---|---|
| OB-H024 | Train fails to stop at intended location | Inappropriate access to configuration settings; Inappropriate access to equipment; Cyber attack. | Train proceeds along route unprotected leading to a collision and/or derailment at line speed |
| OB-H025 | Train overspeeds | Incorrect speed units displayed on ETCS DMI; Confusion over set speed units. | Potential overspeed leading to a derailment |
| OB-H026 | Train overspeeds | Incorrect speed indicated to driver; Multiple speedometers present showing different speeds. | Poor ride quality resulting in slips, trips, or falls. |

## Definitions

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| Authorised person | A person authorised to carry out one or more duties set out in a safety management system. |
| Automatic Power Control (APC) | No definition. |
| Automatic Train Operation (ATO) | No definition. |
| Automatic Train Protection (ATP) | ATP is a system that continualy checks that a train does not exceed the permitted speed or distance allowed by the signalling system. |
| Automatic Warning System (AWS) | A system that gives train drivers in-cab warnings of the approach to signals, reductions in permissible speed and temporary/ emergency speed restrictions, and to apply the brakes in the event that a train driver does not acknowledge cautionary warnings given by the system within the specified time. Source: *GERT8075* |
| baseline | A set of specifications that forms a recognised legal version of ERTMS/ETCS. |
| Certificate Management Protocol (CMP) | No definition |
| Certificate Revocation List (CRL) | No definition. |
| Class B systems | Existing non-ETCS national signalling systems.<br>**Note:** For list of Class B systems, see European Union Agency for Railways technical documents *List of CCS Class B systems, ERA/TD/2011-11, version 3.0*. |
| Control Command and Signalling (CCS) | No definition. |
| defect | Non-fulfilment of specified or intended usage requirements, which can prevent a component or part of a system from accomplishing its design purpose.<br>**Note:** A defect can lead to a fault in a component or system. |
| drive/train driving | The human tasks and processes necessary to control the movement of a train in accordance with operating rules and procedures. |
| Driver Machine Interface (DMI) | Provides indications to the driver of the system status, as well as allowing the driver to control selected system functions. |
| ETCS Data only Radio (EDOR) | No definition. |

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| ETCS onboard subsystem diagnostic tools | Tools that support the following processes for the ETCS onboard subsystem: maintenance, fault-finding, data download, data analysis and data interrogation. |
| ETCS System Compatibility Check (ESC) | No definition. |
| European Rail Traffic Management System (ERTMS) | Signalling and operation management system encompassing ETCS for control command, and GSM-R for voice and data. It is a system for providing real-time control and supervision of trains, consisting of trainborne, track and lineside equipment. The objective is to enable the operation on compatible signalling systems across European borders. |
| European Train Control System (ETCS) | The signalling, control and train protection part of the European Rail Traffic Management System designed to provide interoperability and standardisation across European railways. |
| European Vital Computer (EVC) | The computer which is part of the ERTMS/ETCS onboard equipment. |
| fault [electrical] | A situation where an abnormal electric current is generated. For example, a short circuit due to dewirement is a fault in which current bypasses the normal load. In practice, the protection systems have a sufficiently fast response time to clear the fault in <1 s and so the risk of EMF exposure is considered tolerable as the time at risk is very small. This may be further refined in the future following the publication of additional guidance from the HSE and EU. |
| fault [software] | An incorrect software system state that prevents it from performing as required. It may result from failures in system components, design errors, environmental interference, or operator errors. |
| Full Supervision mode (FS) | ERTMS/ETCS on-board equipment mode giving full protection against overspeed and overrun. |
| Future Railway Mobile Communication System (FRMCS) | No definition |
| gauge | Set of rules, including a reference contour and its associated calculation rules allowing defining the outer dimensions of the vehicle and the space to be cleared by the infrastructure. Source: *ENE NTSN.*<br><br>**Note:** According to the calculation method implemented, the gauge will be a static, kinematic or dynamic. |
| GB mainline railway | 'Mainline railway' has the meaning given to it in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended) and the associated exclusions. 'GB mainline railway' is the mainline railway network excluding any railway in Northern |

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| | Ireland, the Channel Tunnel, the dedicated high-speed railway between London St Pancras International Station and the Channel Tunnel, and any other exclusions determined by the Secretary of State. |
| Global Navigation Satellite System (GNSS) | The technology of navigation by satellite applicable to all such systems, for example, GLONASS, GPS, and Galileo. |
| Global System for Mobile Communications – Railway (GSM-R) | The European Standard specific to railway applications for the transmission by radio of voice and data between train and trackside installations. Source: *GERC8517 Issue 1* |
| Great Western Automatic Train Protection (GW-ATP) | No definition |
| hazard | A condition that could lead to an accident. Source: *CSM RA* |
| Hyper Text Transfer Protocol (HTTP) | No definition. |
| interpret/interpreting [signalling system displays] | The action of understanding the information conveyed by the lineside sign, signal aspect or indication after it has been read. (For example, understanding that a red signal aspect means 'limit of MA'.) |
| Isolation mode (IS) | ETCS Isolation Mode. When the ERTMS/ETCS on-board equipment is disconnected from the vehicle braking system. Isolation is indicated to the driver. |
| Juridical Recording Unit (JRU) | A device to record actions and exchanges relating to the operation of trains, sufficient for off line analysis of events. |
| Kdry | A rolling stock correction factor configured in the ETCS onboard sybsystem and utilised in the ETCS braking algorithms. |
| Key Management System (KMS) | Collective term for the personnel, equipment and procedures used to manage ERTMS keys in the ERTMS key management domain. |
| Kwet | A rolling stock correction factor configured in the ETCS onboard sybsystem and utilised in the ETCS braking algorithms. |
| leading vehicle | A vehicle permitted to operate at the head of a train. Unpowered vehicles which are used at the head of a train only when following the rules for propelling movements are excluded. |
| Line replaceable unit (LRU) | A modular component of a structural system or subsystem that is designed to be replaced quickly. |
| Mean Time Between Mission Failures (MTBMF) | The arithmetic mean of the time between successive independent mission failures. |
| Mean Time Between System Affecting Failures (MTBSAF) | The arithmetic mean of the time between successive independent service affecting failures. |
| Mission Failure | An incident that is deemed to have occurred as a result of ETCS functional failure, is irrecoverable by the train driver and requires |

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| | isolation of the ETCS. The occurrence of the incident during any operational day or before the start of the operational day, results in cancellation of the train and its removal from service or the train not being permitted to enter service. Mission Failures are a sub-set of the Service Affecting Failures. |
| movement authority (MA) | The authority given by a signaller (or ground frame operator), issued via the signalling system to the train driver, which is the authority to move the train within defined limits. |
| multiple unit | A fixed formation of one or more vehicles capable of operation under their own traction power; the formation may be capable of working in multiple with other similar formations. |
| Multiple Working | Multiple working is where two or more traction units (locomotives, diesel multiple-units or electric multiple-units) are coupled together in such a way that they are all under the control of one driver. |
| National Technical Specification Notice (NTSN) | Document published by the Secretary of State pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011 (as amended) which sets out the standards, technical specifications and technical rules in use in the United Kingdom as amended or varied from time to time. These may be standards to be complied with in relation to the design, construction, placing in service, upgrading, renewal, operation and maintenance of the parts of the rail system. For the purposes of these Regulations, the essential requirements for a project subsystem conforms with applicable National Technical Specification Notices and National Technical Rules. Source: *RIR* |
| No power mode (NP) | ERTMS/ETCS on-board equipment mode in which the on-board equipment is not powered and the emergency brake is commanded. |
| Non-Leading mode (NL) | ERTMS/ETCS on-board equipment mode when it is connected to an active cab which is not in the leading engine of the train. |
| On Sight mode (OS) | ERTMS/ETCS on-board equipment mode that gives the train driver partial responsibility for the safe control of their train. In this mode the train possesses a movement authority but the track ahead might be occupied by another train. |
| on-train monitoring recorder (OTMR) | No definition. |
| Online Status Certificate Protocol (OCSP) | No definition. |
| Passive Shunting mode (PS) | ERTMS/ETCS on-board equipment mode that allows the on-board of a slave engine to be part of a shunting consist; or to carry on a shunting movement with a single engine fitted with one on-board equipment and two cabs, when the driver has to change the driving cab. |

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| Radio Block Centre (RBC) | A centralised computer unit working with an interlocking(s) to establish and control safe train separation. Receives location information via radio from trains and sends movement authorities via radio to trains. |
| railway undertaking (RU) | Has the meaning given to the term 'transport undertaking' in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended, but is limited to any private or public undertaking the principal business of which is to provide rail transport services for goods and/or passengers, with a requirement that the undertaking must ensure traction. Source*: ROGS* |
| Readability | The ease and reliability with which indications can be read by an authorised user throughout the range of operational and ambient conditions applicable to that hardware, within the operational context and while performing typical required duties. This ranges from never readable to always readable. |
| reliability | The ability of an item to perform a required function under given environmental conditions for a given period of time. Source: *BS EN 50128:2011* |
| risk | The combination of the likelihood of occurrence of harm and the severity of that harm (specifically defined in CSM RA regulation as: the frequency of occurrence of accidents and incidents resulting in harm (caused by a hazard) and the degree of severity of that harm). |
| route | The physical path of a journey to be undertaken by a vehicle or a collection of vehicles, where the path is comprised of a number of track sections, each of which has individually defined characteristics. |
| safe integration | The action to ensure the incorporation of an element (for example, a new vehicle type, network project, subsystem, part, component, constituent, software, procedure, organisation) into a bigger system, does not create an unacceptable risk for the resulting system. |
| Safety Integrity Level (SIL) | A number which indicates the required degree of confidence that a system will meet its specified safety function. *Source: BS EN 50129:2003* |
| Service Affecting Failure | An independent failure that disrupts or delays the scheduled revenue service of one or more trains. In the current industry standard, service affecting incidents are those causing a cancellation and/or delays of 3 minutes or more. |
| Shunting mode (SH) | ERTMS/ETCS on-board equipment operating mode which allows the train to move in shunting, without available train data. |
| Sleeping mode (SL) | ERTMS/ETCS on-board equipment mode that is used for the on-board equipment in slave engines controlled by a leading engine. |

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| Specific Transmission Module (STM) | Device allowing the ERTMS/ETCS onboard equipment to be interfaced with the onboard part of an existing National Train Control system. It allows smooth transitions from/to the National System and gives access to some ERTMS/ETCS on-board resources (e.g. DMI). Source: *ERTMS_and_ETCS Glossary of Terms UNISIG Subset-023 v3.1.0 dated 12/05/2014* |
| Staff Responsible mode (SR) | ETCS Staff Responsible mode. |
| Stand By mode (SB) | ERTMS/ETCS on-board equipment mode that is a default mode when the on-board equipment is powered up or that is entered when shunting or non-leading mode is left or when the active cab is closed. |
| subsystem [railway system] | A subdivision (in whole or in part) of the railway system as specified in the Railways (Interoperability) Regulations 2011 (as amended). Subsystems can be structural or functional. |
| supplier | The generic term for any organisation or individual that provides, supplies, or seeks to supply, products and services.<br>**Note:** The word contractor may be used to mean the same, particularly with regards to construction. |
| System Requirements & Integration (SR&I) | No definition. |
| technical compatibility | An ability of two or more structural subsystems or parts of them which have at least one common interface, to interact with each other while maintaining their individual design operating state and their expected level of performance. |
| Technical Specification for Interoperability (TSI) | A specification adopted by the European Commission to cover each subsystem or part subsystem to meet the essential requirements and ensure the interoperability of the EU rail system. |
| Telecom On-Board Architecture (TOBA) | No definition. |
| train formation | A group of vehicles which may include individual vehicles or units formed to make up the operational train. |
| Train Integrity Monitoring System (TIMS) | No definition. |
| Train Protection and Warning System (TPWS) | A system mitigating Signals Passed At Danger and non-respect of permissible speeds. |
| train | An operational formation consisting of one or more units. Source: *LOC&PAS NTSN* |
| Transmission Voie-Machine (TVM) | No definition. |
| vehicle | An individual vehicle or car of any train formation. |

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| wheelset | A complete unit comprising an axle and two complete wheels together with any gear wheels, brake discs, etc, but without axle bearings and their end caps, spacers, seals and other associated fittings. The wheels may be either tyred or monobloc. |

## References

The Standards catalogue gives the current issue number and status of documents published by RSSB: http://www.rssb.co.uk/standards-catalogue.

| | |
|---|---|
| RGSC 01 | Railway Group Standards Code |
| RGSC 02 | Standards Manual |

### Documents referenced in the text

#### Railway Group Standards

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|---|---|
| GERT8075 | AWS and TPWS Interface Requirements |
| GERT8402 | ERTMS/ETCS DMI National Requirements |
| GLGN1610 | Guidance on the Application of the Control of Electromagnetic Fields at Work Regulations |
| GMRT2100 | Rail Vehicle Structures and Passive Safety |
| GMRT2161 | Requirements for Driving Cabs of Railway Vehicles |
| GERT8006 | Route Availability Number for Assessment of Compatibility between Rail Vehicles and Underline Bridges |

#### RSSB documents

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|---|---|
| GERT8000-TW1 | Preparation and movement of trains |
| GERT8000-TW5 | Preparation and movement of trains: Defective or isolated vehicles and on-train equipment |
| GKGN0602 | Guidance on Train Rooftop Antenna Positioning |
| GMGN2460 | Guidance on Compliance with Noise and Vibration Legislation in the Railway Environment |
| RIS-0036-CCS | CCS System Transitions |
| RIS-0743-CCS | ERTMS Key Management |
| RIS-0775-CCS | AWS and TPWS Application Requirements |
| RIS-2004-RST | Rail Vehicle Maintenance |
| RIS-2472-RST | Requirements for Data Recorders on Trains |
| RIS-2761-RST | Rail Industry Standard for Driving Cabs |
| RIS-3451-TOM | Train Drivers – Suitability and Medical Fitness Requirements |
| RIS-8270-RST | Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure |
| RSSB research report T088 | Vibration environment for rail vehicle mounted equipment |

**Other references**

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|---|---|
| BS EN 15595:2018 | Railway applications. Braking. Wheel slide protection |
| BS EN 15892:2011 | Railway applications. Noise emission. Measurement of noise inside driver's cabs |
| BS EN 16186-2:2017 | Railway applications. Driver's cab. Integration of displays, controls and indicators |
| BS EN 50125-1:2014 | Railway applications. Environmental conditions for equipment. Rolling stock and on-board equipment |
| BS EN 50155:2007 | Railway applications. Electronic equipment used on rolling stock |
| BS EN 50155:2021 | Railway applications. Rolling stock. Electronic equipment |
| BS EN 50343:2014 | Railway applications. Rolling stock. Rules for installation of cabling |
| BS EN 60529:1992 | Degrees of protection provided by enclosures (IP code) |
| BS EN 61373:2010 | Railway applications. Rolling stock equipment. Shock and vibration tests |
| BS EN 894-1:1997 | Safety of machinery. Ergonomics requirements for the design of displays and control actuators. General principles for human interactions with displays and control actuators |
| BS EN 894-2:1997 | Safety of machinery. Ergonomics requirements for the design of displays and control actuators. |
| BS EN ISO 9241-400:2007 | Ergonomics of human-system interaction. Principles and requirements for physical input devices |
| BS EN ISO 9241-420:2011 | Ergonomics of human-system interaction. Selection of physical input devices |
| CCS NTSN | Command Control and Signalling National Technical Specification Notice (CCS NTSN), published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011 |
| CSM RA | Common Safety Method for Risk Evaluation and Assessment. COMMISSION REGULATION (EU) No 2015/1136 of 13 July 2015 amending Implementing Regulation (EU) No 402/2013 on the common safety method for risk evaluation and assessment. |
| ERA_ERTMS_015560 | ETCS Driver Machine Interface |
| ERA_ERTMS_040001 | Assignment of values to ETCS variables |
| ETCS Reference Design Hazard Log | |
| IEC 60529:1989 | Degrees of protection provided by enclosures (IP code) |
| ISO 9241-210:2010 | Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems |

| | |
|---|---|
| ISO/IEC 8859-1:1998 | Information technology — 8-bit single-byte coded graphic character sets — Part 1 |
| LOC & PAS NTSN | Rolling Stock - Locomotive & Passenger National Technical Specification Notice (LOC&PAS NTSN), published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011 |
| NOISE NTSN | Rolling Stock - Noise National Technical Specification Notice (NOI NTSN), published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011 |
| NR/AM/SA/SPE/00147 | ERTMS Reliability Specification, Issue A07 |
| Opinion OPI 2020-2 | Opinion OPI 2020 – 2 of the European Union Agency for Railways for the European Commission regarding error correction to the CCS TSI |
| RFC-6712 | Internet X.509 Public Key Infrastructure -- HTTP Transfer for the Certificate Management Protocol |
| RFC-6960 | X.509 Internet Public Key Infrastructure Online Certificate Status Protocol |
| RIA 12 | General Specification for Protection of Traction & Rolling stock Electronic Equipment from Transients & Surges in DC Control Systems |
| SI 1989/635 | The Electricity at Work Regulations 1999 |
| SI 1999/2244 | Railway Safety Regulations 1999 |
| SI 1999/3242 | The Management of Health and Safety at Work Regulations 1999 |
| SI 2005/1093 | The Control of Vibration at Work Regulations 2005 |
| SI 2005/1643 | The Control of Noise at Work Regulations 2005 |
| SI 2006/599 | The Railways and Other Guided Transport Systems (Safety) Regulations 2006 |
| SI 2011/3066 | Railways (Interoperability) Regulations 2011 (as amended) |
| SI 2016/588 | The Control of Electromagnetic Fields at Work Regulations 2016 |
| Subset-026 | System Requirements Specification, version 3.6.0 |
| Subset-027 | FIS Juridical Recording |
| Subset-034 | Train Interface FIS |
| Subset-035 | Specific Transmission Module FFFIS |
| Subset-037 | EuroRadio FIS |
| Subset-040 | Dimensioning and Engineering rules |
| Subset-041 | Performance Requirements for Interoperability |

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|---|---|
| Subset-091 | Safety Requirements for the Technical Interoperability of ETCS in Levels 1 & 2 |
| Subset-114 | KMC-ETCS Entity Off-line KM FIS |
| Subset-119 | Train Interface FFFIS |
| Subset-130 | ATO-ON / ETCS-OB Interface Specification |
| Subset-137 | On-line Key Management FFFIS |
| UFF/Cullen Report | The Southall and Ladbroke Grove Joint Inquiry into Train Protection Systems |