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Technical Note - TN 027: 2017

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Subject: Update to ETCS certification

This technical note is issued by Asset Standards Authority (ASA) to update T HR SC 01650 SP *ETCS Onboard Equipment* version 1.0 to include the certification requirements for ETCS onboard equipment.

Certification requirements for the ETCS onboard subsystem were originally contained in T HR SC 00006 ST *Rolling Stock Signalling Interface Requirements*, version 1.0 but were removed with version 2.0. These requirements are now included in T HR SC 01650 SP in accordance with the following direction –

Add the following after Section 5. *ETCS baseline*:

5.1. Certification

The ETCS onboard subsystem and associated equipment shall have evidence of conformity as required for operation in the European Community. This typically includes the following evidence:

i. EC declaration of conformity for the interoperability constituents of the CCS TSI by the manufacturer

ii. quality management system approval certificate based on module CH1 from a notified body

iii. EC design examination certificate based on module CH1 from a notified body

iv. evidence of conformity to CENELEC Railway Standards produced by an independent certification body that includes the amendments defined in this document

The equipment shall be supported by evidence of compliance with the standards required by this specification.

Equipment that is not in-service as part of a multi-vendor ETCS rail environment shall be tested to certify compatibility with existing ETCS equipment as configured for the TfNSW environment.

The equipment shall have a TfNSW type approval for use in the application. Type approval is in accordance with T MU MD 00005 GU *Type Approval of Products.*

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T HR SC 01650 SP

Specification

ETCS Onboard Equipment

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Standard governance

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Authoriser: Chief Engineer Rail, Asset Standards Authority

Approver: Executive Director, Asset Standards Authority on behalf of the ASA Configuration Control Board

Document history

Version	Summary of Changes
1.0	First issue

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Preface

The Asset Standards Authority (ASA) is an independent unit within Transport for NSW (TfNSW) and is the network design and standards authority for defined NSW transport assets.

The ASA is responsible for developing engineering governance frameworks to support industry delivery in the assurance of design, safety, integrity, construction, and commissioning of transport assets for the whole asset life cycle. In order to achieve this, the ASA effectively discharges obligations as the authority for various technical, process, and planning matters across the asset life cycle.

The ASA collaborates with industry using stakeholder engagement activities to assist in achieving its mission. These activities help align the ASA to broader government expectations of making it clearer, simpler, and more attractive to do business within the NSW transport industry, allowing the supply chain to deliver safe, efficient, and competent transport services.

The ASA develops, maintains, controls, and publishes a suite of standards and other documentation for transport assets of TfNSW. Further, the ASA ensures that these standards are performance-based to create opportunities for innovation and improve access to a broader competitive supply chain.

Specifications are requirements documents that describe the mandatory physical and performance characteristics of a system or an asset.

This specification defines the requirements for European train control system (ETCS) onboard equipment, its configuration and installation for TfNSW.

This document is a first issue.

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1. Introduction

European train control system (ETCS) is a form of automatic train protection (ATP). Specifications, standards and documentation for ETCS are available from the European Railway Agency website.

The TfNSW *Rail Systems Strategy* recommended 'deployment of ETCS Level 2, as far as possible without lineside signals' and 'the addition of automatic train operation (ATO) is also recommended where necessary to support reliable, high frequency operations and when this technology is proven in service.' These recommendations have been adopted for implementation on the TfNSW metropolitan heavy rail passenger network.

TfNSW amendments and additions to the base ETCS standards have been identified as a result of stakeholder consultation, interface limitations and requirements not yet defined in the ETCS standards.

2. Purpose

This document sets out the requirements for ETCS onboard equipment based on the documentation published by European Railway Agency. Amendments and additions required for the application on TfNSW metropolitan passenger heavy rail network are defined with reference to the base ETCS standards and specifications.

This document provides the basis for selection and approval of equipment and generic requirements for the design and application of ETCS onboard equipment to rolling stock.

2.1. Scope

This document covers the selection criteria, configuration and application of ETCS onboard equipment to rolling stock for operation on the TfNSW metropolitan passenger heavy rail network.

ATO requirements are not considered yet. Specific requirements for ATO will be defined after the inclusion of ATO into the ETCS documents published by the European Railway Agency.

2.2. Application

This document applies to ETCS onboard equipment for fitment to existing rolling stock or as part of new rolling stock and any upgrades of fitted ETCS onboard equipment.

Specific requirements for the fitment of ETCS to maintenance vehicles or freight rolling stock have not been considered in developing this document. Any specific requirements for maintenance vehicles and freight rolling stock will be developed when a decision is made to fit these vehicles.

The fitted rolling stock shall be operational for ETCS Level 0, Level 1 and Level 2. Level NTC is not required.

3. Reference documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Australian standards

AS/RISSB 7527 Railway Rolling Stock – Event Recorder

AS/RISSB 7702 Rail Equipment Type Approval

European Railway Agency

CCS TSI as defined in European Union Commission Decision 2015/14 using Set of specifications # 2 (ETCS baseline 3 and GSM-R baseline 0)

International standards

EN 50155 Railway applications – Electronic Equipment Used on Rolling Stock

EN 50159 Railway Applications – Communications, Signalling and Processing Systems – Safety-related Communication in Transmission System

EN 50343 Railway Applications – Rolling Stock – Rules for Installation of Cabling

IEC 60077-1 Railway Applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules

IEC 60571 Railway Applications – Electronic equipment used on rolling stock

IEC 60947 Low-voltage switchgear and controlgear

IEC/TR 62380 Reliability data handbook – Universal model for reliability prediction of electronics components, PCBs and equipment

Transport for NSW standards

T HR HF 00001 ST Human Factors Integration – Rolling Stock

T HR SC 00006 ST Rolling Stock Signalling Interface Requirements

T HR RS 00100 ST RSU 100 Series – Minimum Operating Standards for Rolling Stock – General Interface Standards

T HR RS 00117 ST Electric Circuits and Equipment for Passenger Rolling Stock

T HR RS 00126 ST Electronic Equipment Supplied for Passenger Rolling Stock

T HR RS 00164 ST Cable for Passenger Rolling Stock

T HR RS 00600 ST RSU 600 Series – Minimum Operating Standards for Rolling Stock – Multiple Unit Train Specific Interface Standards

T HR RS 00840 ST RSU Appendix D – Driver Safety Systems

T HR RS 01701 ST Mounting and Installation of Electrical Equipment

TS TOC Train Operating Conditions (TOC) Manual

Legislation

Radio communications (Low Interference Potential Devices) LIPD Class Licence 2000

4. Terms and definitions

The following terms and definitions apply in this document:

AEO Authorised Engineering Organisation

ATO automatic train operation

ATP automatic train protection; ATP is a generic term. ETCS is a common set of specifications for interoperable ATP products.

baseline an approved set of specifications for a system

CCS control-command and signalling

current legal reference in the context of this document, this is the latest CCS TSI adopted by the European Union by a Commission decision

DMI driver machine interface

DTRS digital train radio system

EMI electromagnetic interference

ERA European Railway Agency

ERIENE European integrated railway radio enhanced network

ERTMS European rail traffic management system – includes ETCS and ERIENE

ETCS European train control system

LS limited supervision (an ETCS mode)

NTC national train control

RAMS reliability, availability, maintainability and safety

SIL safety integrity level

THR tolerable hazard rate

TSI technical specification for interoperability

UN unfitted (an ETCS level 0 mode)

UTC coordinated universal time

5. ETCS baseline

The ETCS onboard equipment for ATP applied to rolling stock shall be a European train control system (ETCS) 'level 2 class A train protection system' as defined in the technical specification for interoperability control-command and signalling subsystems for the trans-European rail system (CCS TSI).

The rolling stock ETCS implementation shall comply with European Union Commission Decision 2015/14 which amends Decision 2012/88/EU in accordance with set of specifications # 2 (ETCS baseline 3 and GSM-R Baseline 0).

The application date for TfNSW shall be the issued date of this document instead of the dates defined in Article 1, section 7.3.3 and article 3 of the European Union Commission Decision.

This document will be reviewed when the current legal reference for ERTMS is updated on the European Railway Agency website. The aim of the review is to consider adoption of the revised current legal reference as the ETCS baseline. Compatibility with the existing trackside infrastructure will be the primary consideration for adoption of the revised current legal reference for ERTMS.

Compliance with the associated ‘supporting informative specifications’ for the *TSI CCS Application Guide* as published on the ERA website is expected. Suppliers of ETCS onboard equipment shall identify any noncompliances for their equipment for evaluation as part of type approval.

This document includes amendments and additions for onboard requirements that shall be incorporated in the ETCS equipment on rolling stock.

T HR SC 00006 ST also defines amendments and additions related to the interface between rolling stock and trackside. Requirements stated in T HR SC 00006 ST *Rolling Stock Signalling Interface Requirements* take precedence over this document in the case of conflict.

6. ETCS baseline amendments and additions

Amendments and additions to the subsets in the ETCS baseline are detailed in Section 6.1 through to Section 6.8.

6.1. Subset 026 amendments and additions

Table 1 shows the subset 026 amendments and additions.

Table 1 – Subset 026 amendments and additions

Relevant clause(s)	Topic	Requirement	Change type
2.6.5.2.3	Onboard equipment	Euroloop transmission equipment is not required. Radio infill transmission equipment is not required.	Selected option
3.6.6.1	Disable the geographical position feature	To avoid confusion with trackside distance markers, the geographical position feature on the DMI shall be disabled and hidden by configuration change on the DMI. Geographical position data is not being provided by the trackside ETCS implementation.	Amendment
3.11.7.1.3	Setting of the speed limit when in staff responsible mode	The driver functions for setting the staff responsible speed shall be either permanently disabled by configuration or disabled at the factory in a non-configurable manner prior to delivery.	Amendment
3.14.1.1	Use of emergency or service brake where not specified	ETCS is to use the service brake for brake applications that do not require use of the emergency brake.	Addition
3.14.1.2	Emergency brake in case of service brake failure	The national value Q_NVEMRRLS emergency brake release condition shall be met before emergency brakes applied in this case are released.	Addition
3.14.1.7.5	Text message with emergency brake command	The national value Q_NVEMRRLS emergency brake release condition shall also be met before releasing any emergency brake command due to not acknowledging a text message.	Addition
3.16.2.6.1	Linking reaction response for 'no reaction'	In level 1 when the linking reaction is 'no reaction' the driver shall be informed of the data consistency problem with the expected balise group. *Note: This results in the DMI system status message 'balise read error'.*	Addition

Relevant clause(s)	Topic	Requirement	Change type
3.18.3.2.1	Automatic entry of 'train data' by the train	To avoid unnecessary data entry by the driver, the 'train interface' shall provide 'train data' as described in section 3.18.3 of Subset 026 where it is practical to do so. This can be practical when ETCS is fitted as part of the original train design. Alternatively train data entered by the driver shall be limited to selection from a range of pre-configured values for the particular train type. This shall be expressed as the number of cars and bogies cut out for multiple unit self-propelled passenger trains.	Amendment
A3.1	Fixed value data	The following fixed value data is changed. All other values remain as specified. Name Revised Value dV_ebi_min 10 km/h dV_ebi_max 10 km/h dV_sbi_min 7.5 km/h dV_sbi_max 7.5 km/h dV_warning_min 5 km/h T_preindication 0 s *Note: If integer values are required then the value is rounded up to the next integer.*	Amendment
4.4.3.1.1	Method of isolating ERTMS/ETCS equipment	The device used for isolation mode shall be physically and functionally independent of the other DMI controls and indications	Addition
4.4.3.1.2	Indicating to the driver that the ERTMS/ETCS equipment is in isolation mode	The isolation status of ERTMS/ETCS equipment shall be indicated to the driver. The isolation indication shall be in the driver's normal field of view	Addition
4.4.3.1.3	Operating procedure required for leaving isolation mode	The special operating procedure required to leave isolation mode shall include an engineering control that ensures the maintainer accepts that the onboard subsystem can return to service. Use of a maintainer's key is an accepted solution to enable leaving isolation mode.	Addition
4.7.2	DMI function when driver's cabin status is 'cab not active'	DMI shall provide output information 'train speed' when 'cab not active' and ETCS onboard mode is not NP, SF, IS or SB. This addition is to support the train guard's role and the driver under the bypass function.	Addition

6.2. Subset 027 amendments

Table 2 shows the subset 027 amendments.

Table 2 – Subset 027 amendments

Relevant clause(s)	Topic	Requirement	Change type
4.3.1.1	Trigger events	Provide a trigger event for the general message whenever the train speed sent to the DMI changes by 1 km/h or more.	Amendment

Refer to Section 8.6 for more details.

6.3. Subset 034 amendments and additions

Table 3 shows the subset 034 amendments and additions.

Table 3 – Subset 034 amendments and additions

Relevant clause(s)	Topic	Requirement	Change type
General	Management of interfaces between ETCS equipment and other train systems	The functional interfaces between the ETCS equipment and other train systems shall be implemented to the fullest extent described in Subset 034 given the systems provided on the train. That is, if a system exists on the train that performs a function described in Subset 034, the interface between that system and the ETCS equipment shall be provided as described. Note: Track condition related interfaces are not required as they are not being implemented trackside.	Addition
General	Location of ETCS system pneumatic isolation cock	If fitted, the ETCS system's pneumatic isolation cock shall be positioned within the crew compartment and in a location accessible to the driver. The location and position of the isolation cock shall be clearly labelled	Addition
2.2.2.3.3	Configuration of the passive shunting feature	Passive shunting shall be permanently configured as 'passive shunting not permitted'	Selected option

6.4. Subset 036 amendments and additions

T HR SC 00006 ST requires train type tests to demonstrate compliance with Subset 036.

Dynamic tests for each train type shall be conducted to demonstrate compliance with Subset 036 Safety Quantification under the full range of conditions and events defined in T HR SC 00006 ST. The test report shall identify any specific types of EMI event that prevents detecting or reading a balise.

6.5. Subset 040 amendments

Balise antenna mounting position is constrained by the requirements in T HR SC 00006 ST. Refer to T HR SC 00006 ST for details.

6.6. Subset 085 additions

An additional test for guard rail crosstalk is required. Refer to T HR SC 00006 ST for this requirement.

6.7. Subset 091 amendments

Assumptions and values for conventional rail are reasonable for TfNSW implementation and operation given the amendment detailed in Table 4.

Table 4 – Subset 091 amendments

Reference Number	Amendment	Comment
10.3.2.16	Time spent in modes without ETCS supervision of safe speed and distance (e.g. UN and LS) is < 90% instead of < 20%	LS mode is planned for the majority of trackside.

The amendments for Subset 091 shown in Table 4 affect the ETCS_OB10 *ETCS Auxiliary Hazard THR.* Related considerations are as follows:

a) LS mode implementation provides supervision of train speed in accordance with trackside speed boards which provides an additional hazard barrier compared to UN mode.

b) ETCS Auxiliary Hazard THRs derived in Subset 118 have a 'factor of 5' reduction applied due to uncertainty.

The ETCS onboard system supplier shall provide assurance that compliance with the Subset 091 defined ETCS_OB10 *ETCS Auxiliary Hazard THR* manages the ETCS auxiliary hazards under the Subset 091 assumptions and the amended assumptions so far as is reasonably practicable.

6.8. ERA_ERTMS_015560 amendments and additions

See Table 5 for the amendments and additions for ERA_ERTMS_015560.

Table 5 – ERA_ERTMS_015560 amendments and additions

Relevant clause(s)	Topic	Requirement	Change type
General	Lights that may distract the driver	After ERTMS/ETCS equipment has been isolated, it shall be possible, either via system design or user action, to extinguish any ETCS related lights indicating fault, failure, or warning in the driver's primary field of view.	Addition
General	Configuration of 'text messages'	The text for 'text messages' generated by the onboard equipment (other than those nominated in ETCS driver machine interface document) for display on the DMI shall be defined by consultations with the driver, operator and maintainer stakeholders.	Addition
General	Configuration of 'text messages'	'Text messages' generated by the onboard equipment for display on the DMI shall be minimised. The decision to display messages on the DMI and the associated display conditions shall be by consultation with driver, operator and maintainer stakeholders.	Addition
5	Synchronised visual and auditory warnings	Where the DMI provides both visual and auditory warning status information, both shall activate and deactivate within 0.5 s of each other.	Addition
5.3.2.5.5	Hide functions that are not used	Menu options and other functions that are not implemented in the TfNSW configuration shall be option 'b) not shown at all'.	Selected option
5.5.1.1	Pre-configured languages	English shall be the only pre-configured onboard language.	Addition
8.2.1.1.3	Speed dial range	The range of the pre-configured speed dial displayed on the DMI shall be 0 km/h to 180 km/h (option c).	Selected option

Relevant clause(s)	Topic	Requirement	Change type
8.3.5.7	Presentation of gradient numbers	Gradient profile numbers shall either be displayed in the same form as normally presented to drivers on the TfNSW rail network or not shown at all. The "per mille" (‰) format is not consistent with the "ratio" (1 in X) format provided to drivers on the TfNSW rail network.	Amendment
8.4.4.3	Disable the geographical position feature	As per amendment to Clause 3.6.6.1 of Subset 026 described in Section 6.1 *Subset* 026 amendments and additions.	Amendment
11.2.1.3	Disable 'maintain shunting' functionality	The 'maintain shunting' functionality shall be disabled.	Amendment
11.2.3	Disable 'SR Speed / Distance' and 'Train Integrity' buttons	The special window 'SR Speed / Distance' and 'Train Integrity' buttons shall be disabled.	Amendment
11.2.4.5	Cleaning of DMI	An additional technical function is required. This shall allow the driver to clean the DMI screen without inadvertently activating any functions or being distracted from driving. The cleaning function shall be accessed quickly, only available at standstill and automatically disable itself when the train moves or time delay.	Addition
11.2.4.5	Access to menus	DMI menus for additional technical functions that are not intended for use by drivers shall be protected against access by unauthorised personnel.	Addition
11.3.2.7 11.3.2.8	Hide ETCS levels that are not able to be supported	The keyboard associated with the ERTMS/ETCS level shall display only currently supported ETCS levels.	Addition
11.3.3 11.3.10	Disable 'Driver ID' and 'SR Speed / Distance' data entry windows	The 'Driver ID' and 'SR Speed / Distance' data entry windows shall be disabled. If necessary, a pre-configured default Driver ID may be used.	Amendment
11.3.12 11.3.13 11.4.2 11.4.3	Disable 'Set VBC' and 'Remove VBC' functions	The 'Set VBC' and 'Remove VBC' functions shall be disabled. The VBC functionality is being managed by the trackside implementation.	Amendment
11.5.1.4	Items displayed in the data view window	The 'Driver ID' item shall not be displayed on the data view window.	Amendment

7. TfNSW application

Application of ETCS to TfNSW rolling stock is detailed in Section 7.1 through to Section 7.5.

7.1. Application tailoring

Particular specifications and contracts may set requirements in addition to this specification by applying the following options for application to a train type:

- bypass
- RAM enhancement
- provision as part of a new train
- driver acknowledgement of intervention
- cold movement detection
- delayed Level 2 commissioning

7.1.1. Bypass

The particular specification for fitment to an existing train type may nominate that a bypass function is required for the train. Bypass functionality permits ETCS fitted trains to be used as intended by ETCS accredited drivers and have ETCS bypassed by the non-accredited drivers.

The bypass function shall not be provided unless required by the particular fitment specification.

Bypass is implemented by a two position switch. One position is normal with the other position being bypass. A bypass switch is provided for each ETCS fitted driver's cabin. The bypass switch shall be positioned in a location not accessible to the driver while they are in the driving position.

The bypass position of the switch shall prevent the ETCS onboard detecting that the driver’s cabin is active. This results in sleeping mode (or equivalent) for ETCS onboard system when the bypass switch is in bypass and the driver's cabin is active.

The normal position of the switch shall allow the ETCS onboard subsystem to function without any effect from the bypass switch.

The design and implementation of the bypass function shall not require changes to the ETCS onboard subsystem to comply with the tolerable hazard rate allocated under Subset 091 based on Hazardous Event id. TI-3 'Inappropriate sleeping request'.

The status of the bypass switch shall be recorded by the juridical recorder.

In bypass the following ETCS related functions shall be available to the driver:

a) view speed display which shall be displayed at the same system integrity level as during normal operation

b) adjust DMI screen brightness and sound levels

c) use DMI cleaning function

d) observe system status messages configured to be provided when the bypass function is in operation

7.1.2. RAM enhancement

The particular specification for the fitment to an existing train type can specify enhanced reliability, availability and maintainability (RAM) requirements given a positive life cycle cost impact for the particular train type.

7.1.3. Provision as part of a new train

New train procurements can exclude Section 10 and apply RAM requirements defined for the train as a whole.

7.1.4. Driver acknowledgement of intervention

In fitting ETCS to existing TfNSW trains it may not be reasonably practicable to comply with the requirements of Section 7.2 to not cause a task based reset of the driver safety vigilance systems. In this case a driver acknowledgement shall be provided in addition to the defined conditions to revoke a brake intervention.

In ceiling speed monitoring the revocation of either the service brake command or the emergency brake command shall require a driver acknowledgement of the brake intervention in addition to the condition defined in Subset 026 Clause 3.13.10.3.3.

In target speed monitoring the revocation of either the service brake command or the emergency brake command shall require a driver acknowledgement of the brake intervention in addition to the conditions defined in Subset 026 Clause 3.13.10.4.10.1.

In release speed monitoring the revocation of the emergency brake command shall require a driver acknowledgement of the brake intervention in addition to the condition defined in Subset 026 Clause 3.13.10.5.4.

The driver acknowledgement to release a brake intervention shall comply with Section 8.2.2.3 of the *ETCS Driver Machine Interface* document given the driver acknowledgement requirements defined in this section.

7.1.5. Cold movement detection

Cold movement detection is not normally required. Cold movement can be selected for a train type.

7.1.6. Delayed Level 2 commissioning

The train type is initially commissioned for Level 1 operation only. Level 2 configuration and commissioning is delayed to align with Level 2 trackside commissioning.

7.2. Fitout

ETCS designs commenced after the issue date of this document shall be based on this document and the associated ETCS baseline.

The fitment of the ETCS onboard equipment shall not interfere with or hinder the correct operation of the trip gear, or other driver safety systems fitted to the rolling stock. In particular, the operation of the service brake by the ETCS equipment shall not cause a task based reset of the driver safety vigilance systems.

The ETCS onboard subsystem shall be implemented in accordance with T HR HF 00001 ST.

A risk control shall be implemented to prevent ETCS onboard subsystem operation if configuration data for a different train type is incorrectly installed in the trains ETCS onboard equipment.

The ETCS onboard equipment fitted to a vehicle shall use one common source for time and date for the vehicle. Any existing time source on the vehicle should be used if reasonably practicable. Adjustments for daylight savings shall be automatic. The time shall not require adjustment by the driver or maintainer due to drift by the time source or ETCS equipment.

Internal time sources in ETCS equipment shall drift by less than 2 s per day from actual time when the common time source is not available for synchronisation.

Any test of the ETCS onboard equipment that requires the train at standstill or driver involvement shall not be required more than once every 24 hours.

A warning shall be provided to the driver if an ETCS onboard equipment test that requires the train at standstill and power off/on or driver involvement is required within the next hour.

The ETCS onboard equipment shall be configured to perform any tests that require the train at standstill when a driver workstation is activated for the first time after the ETCS mode transition from no power to standby. Some driver involvement in conducting these tests is acceptable.

A redundant ETCS data only radio arrangement shall be fitted for Level 2 implementation in accordance with the EIRENE SRS with the clarifications detailed in Section 11.

Radar units are not accepted as the only source of odometer information.

Two radar units of the one type may be installed as Odometer sources on a vehicle provided that diverse software is used for each radar unit.

A speedometer independent of the ETCS onboard subsystem shall be fitted in each driver's cabin. The speedometer is used when the ETCS onboard subsystem is isolated. Isolation of the ETCS shall enable the speedometer. Otherwise the speedometer function is disabled to avoid the potential for different speed information being displayed to the driver. Rolling stock standards apply to the independent speedometer. A vehicles' existing speedometer may be used for this purpose.

If other event recorders are fitted to the vehicle in addition to the juridical recorder then functionality shall be provided to facilitate cross referencing events in each recorder when time references are not synchronised. Solutions may include providing the juridical recorder with an external switched digital input for connection to an input common to both the juridical recorder and any other event recorder. The motoring trainline should be used as the common input.

The application design of the ETCS onboard equipment shall detect any isolation of the emergency brake interface. Partial isolation and complete isolation shall generate system status messages than can be displayed on the DMI. Complete isolation shall switch ETCS onboard equipment to the system failure mode.

The application of ETCS for rolling stock shall comply with T HR SC 00006 ST. The generic ETCS onboard subsystem shall have a conformity assessment. Specific amendments and additions identified in this document shall be supported by an independent safety assessor (ISA).

7.3. Supplier

TfNSW rail systems strategy is based on ERTMS for the metropolitan heavy rail passenger network. Currently TfNSW has no ability to directly influence change in the ERTMS development. Therefore assistance is sought from the ETCS equipment supplier and the supplier shall demonstrate the ability to manage and influence change in the ERTMS development.

7.4. AEO status

Organisations responsible for discipline specific specialist engineering services shall hold authorisation for the activity under the AEO framework for the applicable life cycle phase.

Table 6 defines discipline responsibilities for ETCS onboard equipment. An AEO or AEOs with authorisation in the nominated disciplines shall produce and assure the activity. The lead discipline has overall responsibility for the activity. The support discipline, if nominated produces and assures the discipline specific portion or interface from the disciplines perspective. The lead discipline shall have assurance from the support discipline to complete their assurance.

Note: AEO status is only required for the provision of specialist engineering services. AEO status is not required for the supply of products including both general and type approved products.

Table 6 – AEO discipline responsibility

Detailed life cycle activity	Lead discipline	Support discipline
Feasibility	Signals and Control Systems	Rolling Stock
Concept	Signals and Control Systems	Rolling Stock
Design	Signals and Control Systems	Rolling Stock
Fabricate / manufacture	Signals and Control Systems	NA
Install	Rolling Stock	Signals and Control Systems
Integrate, test and commission	Signals and Control Systems	Rolling Stock
Asset maintenance	Rolling Stock	Signals and Control Systems
Disposal	Rolling Stock	Signals and Control Systems

An example AEO Engineering Services Matrix showing the capability necessary to produce and assure ETCS onboard subsystems is provided in Figure 1 of Appendix A.

7.5. Asset maintenance

The asset strategy identified by TfNSW determine when to fit ETCS or upgrade the ETCS baseline for onboard equipment, this in turn informs the asset maintenance plan to sustain asset performance.

8. Equipment requirements

The equipment requirements are described in Section 8.1 through to Section 8.6.

8.1. General

The ETCS onboard equipment shall be designed to be compatible with the traction system used by the train and the rail lines it is intended to operate on.

Safety related communications between ETCS onboard equipment and to and from ETCS onboard equipment shall comply with EN 50159 for the combination of equipment, transmission systems, communication protocols and configuration.

The design and configuration of the ETCS onboard equipment shall implement defences against intentional technological attack. The level of defence shall be based on potential safety hazards and potential impact on train operations.

The ETCS odometry subsystem should not constrain the type of axle to which wheel sensors can be fitted.

Subset 104 *ETCS System Version Management* identifies ETCS versions as X.Y. ETCS onboard equipment provided with a particular X value shall have evidence of design allowances to support upgrades to the forecast Y increments without significant hardware upgrade or replacement. TfNSW strategy has forecast two upgrades. One is the use of packet switched communications (GPRS) for Level 2 and the other is ATO integrated with ERTMS. The evidence of design allowances shall include these forecast upgrades and an assessment of the extent of change required to the supplied product.

ETCS onboard equipment shall achieve signals and control systems type approval prior to operational use. Signals type approval requirements and process are defined in AS/RISSB 7702.

> *Note: A type approval of products guide (T MU MD 00005 GU) is being prepared for publication. When the guide document is published this document will be updated to reference it.*

8.2. IEC 60571 compliance

All electrical and electronic equipment provided as part of the ETCS onboard equipment shall comply with IEC 60571. Evidence of compliance with equivalent standard EN 50155 is accepted as meeting this requirement.

Particular compliance requirements are detailed in Table 7.

Table 7 – IEC 60571 compliance

Clause	Requirement	TfNSW requirement
4.1.2	Ambient temperature	Class T3
4.2	Special service conditions	Not required
4.2.1	Atmospheric pollutants	None specified
5.3	Installation	Any electrical installation requirements for the equipment shall be nominated by the supplier. Equipment should be designed to operate with either a floating vehicle battery supply (isolated from vehicle body) or a battery negative connected to the vehicle body.
6.1.1	Predicated reliability	The supplier shall provide details of the manufacturer's predicated reliability for the equipment including the methodology used, and assumptions made.
6.1.2	Proof of reliability	The supplier shall provide proof of reliability.

Clause	Requirement	TfNSW requirement
6.2	Useful life	The nominated useful life is accepted. Items with a shorter useful life may be accepted provided that their limitations have been detailed prior to purchase.
6.4.1	On-vehicle diagnosis	Manufacturer/supplier to provide proposal
7.2.1	Interfacing	Galvanic isolation is required for communications data links used by ETCS onboard equipment. The galvanic isolation should be rated at 600 V dc or higher.
9.1.2	Polarisation or coding	Line replaceable units (LRU) shall incorporate mechanical means of polarisation or coding to prevent incorrect insertion.
9.1.4	Sockets and connectors	The use of integrated circuit sockets and edge connectors shall be minimised. Normally only CPU integrated circuits will use sockets.
9.3.4	Other connections	T HR RS 01701 ST defines the accepted alternatives.
12.1.1	Type tests	The user requires type tests repeated under the conditions nominated in this clause.
12.2.8	Radio interference test	Both RFI susceptibility and emission tests are required as type tests.

8.3. Odometer radar

Odometer radars shall be compliant with *Radio communications (low interference potential devices) LIPD Class Licence 2000*.

Radars are exterior-mounted equipment that are mounted under-car. The requirements of T HR RS 01701 ST apply to mounting and installing this equipment. Resistance and protection against ballast impact is assessed in accordance with T HR RS 01701 ST.

8.4. Balise antenna

Balise antennae are exterior-mounted equipment that are mounted under-car. The requirements of T HR RS 01701 ST apply to mounting and installing this equipment. Resistance and protection against ballast impact is assessed in accordance with T HR RS 01701 ST.

8.5. DMI equipment

The driver machine interface (DMI) is also called the man machine interface (MMI) in some of the subset documents.

A touch screen based solution should be provided. Alternative solutions shall consider the organisational impact of potentially inconsistent DMIs that the train driver would be likely to encounter.

The DMI screen shall use technology designed to manage glare and reflections on the screen when installed in the vehicle cab.

The screen brightness shall be at least 400 cd/m² when set for maximum brightness.

The screen viewing angle shall be at least 45°/45° (left/right) and 45°/30° (up/down).

The contrast ratio for the screen shall be at least 500:1.

The DMI equipment shall be configurable by design so that when S1 – over-speed audible information is played at maximum volume setting the sound level exceeds 80 dB_{spl} at 1 m. The configured maximum sound level is determined as part of the human factors integration for the vehicle type.

The DMI equipment shall be configurable by design so that the minimum sound level that can be set by the driver is the level determined as part of the human factors integration for the vehicle type.

8.5.1. Switches

Separate switches that form part of the DMI shall comply with rolling stock standard T HR RS 00117 ST. Relevant international and Australian standards for switches are IEC 60077-1 and IEC 60947. Isolation and bypass switches are separate switches that form part of the DMI.

8.6. Juridical recorder

A juridical recorder shall be provided. The juridical recorder shall comply in part with AS/RISSB 7527. Sections 1, 3, 7, 8, 9 of AS/RISSB 7527 apply. Section 2, 5 and 6 of AS/RISSB 7527 do not apply. Section 4 is replaced by ERA Subset 027 *FIS Juridical Recording* as amended by Section 6.2 of this document.

9. Installation requirements

The installation requirements are described in Section 9.1 through to Section 9.5.

9.1. General installation

The requirements of T HR RS 01701 ST apply to mounting and installing the ETCS onboard equipment.

T HR RS 00117 ST applies with the following amendments to 'circuits and earthing' requirements:

a) ETCS safety significant and safety critical circuits are permitted to switch both positive and negative legs of circuits

b) ETCS input and output circuits are not required to be protected by an individual circuit breaker for each circuit function. However power supply circuits must comply with the requirement.

Circuit breakers installed external to the ETCS onboard equipment shall be consistent and compatible with the existing type of circuit breakers fitted to the vehicle.

Terminals mounted external to ETCS equipment shall comply with TfNSW rolling stock standards.

Relays mounted external to ETCS equipment shall comply with TfNSW rolling stock standards.

Installation design and installation shall ensure that the train remains compliant with its rolling stock outline in accordance with RSU 110 of T HR RS 00100 ST.

ETCS onboard equipment and any associated transmission systems shall be protected from unauthorised access via physical protection. The level of physical protection provided shall be based on the risk of and the risks due to unauthorised access. Physical protection may be provided by an enclosed wiring system, as part of the construction of the cable or by use of a barrier requiring use of a tool or key with restricted distribution to restrict access.

9.2. Emergency brake interface

The emergency brake interface may control the emergency valves fitted to an existing vehicle.

The emergency brake valves (existing or additional) and relays required for ETCS shall be included in reliability, availability, maintainability and safety (RAMS) analysis.

9.3. Traction cut off interface

The traction cut off (TCO) control shall be arranged so that traction control is only restored after the driving control is set to a non-powering state. This may be achieved via interface circuits between the ETCS onboard equipment and the train.

Note: This sets consistent behaviour for driver response for each ETCS intervention of traction cut off, service brake command and emergency brake command.

9.4. Isolation switch

ETCS onboard installation is a driver safety system as per T HR RS 00840 ST. If the ETCS onboard subsystem has been isolated then an authorised procedure is applied. The 'authorised procedure' for proceeding when ETCS is isolated shall include the engineering control defined in T HR HF 00001 ST which requires any safety system overrides control to 'not be operable from the driving position'. This control is separate to the ETCS onboard isolation switch.

The design and installation of the ETCS onboard subsystem isolation switch arrangement shall not interfere with the operation of other driver safety systems or safety system override control.

The status of the isolation switch shall be recorded by the juridical recorder.

9.5. Cabling

Onboard cabling for ETCS shall comply with the technical specifications' set by the ETCS equipment supplier.

The cabling design and installation shall be in accordance with EN 50343.

The cables shall comply with T HR RS 00164 ST with the following amendments:

- Section 7.8 'Foil screen without an overall tinned copper braid shall not be used' requirement is a preference only. The mandatory requirement is compliance with equipment manufactures' requirements as part of their original design
- Section 9 the 'communications cables comply with requirements for equipment cords in T HR TE 81001 ST' requirement is a preference only. The mandatory requirement is compliance with the ETCS equipment manufactures' requirements as part of their original design

10. Reliability, availability and maintainability

European Union Commission Decision 2015/14 on the TSI CCS in Section 4.2.1.2 Availability/Reliability item (1) 'Mean time of hours of operation between failures of a CCS onboard subsystem requiring the isolation of the train protection functions: [open point]' leaves the reliability requirement open.

This requirement is closed for TfNSW by satisfying the following requirements:

a) The theoretical 'Mean time of hours of operation between failures of a CCS onboard subsystem requiring the isolation of the train protection functions' shall be more than 43,500 operational hours. Failure of DMI functionality will result in the CCS onboard subsystem being isolated.

b) The theoretical mean time of hours of operation between service affecting failures of a CCS onboard subsystem shall be more than 21,750 operational hours. A service affecting failure has an immediate effect or restriction on the operational use of the train.

c) The theoretical mean time of hours of operation between failures of any CCS onboard equipment shall be more than 4350 operational hours.

d) The CCS onboard subsystem shall function without degradation for a minimum of 4 hours with one redundant equipment item in a failed state. So that the train can continue in operational service until the end of a peak period and then return to a maintenance depot with an operational ETCS onboard system.

e) Operation from the power on of ETCS to completion of multiple missions totalling 8 hours duration shall be able to be completed with any single odometer source failed. This is required so that the train can continue in operational service until the end of the day and then return to a maintenance depot with an operational ETCS onboard system

f) The CCS onboard subsystem shall be able to operate for 5 days for 90% of single redundant equipment item failures. The train can continue in operational service until the end of the working week and then return to a maintenance depot with an operational ETCS onboard system.

g) The mean time to restore (MTTR) shall be less than 1.5 hours for active corrective maintenance activities.

h) The accepted method for theoretical reliability prediction is the application of IEC TR 62380. The defined mission profile is: T_{ae} 25°C, T_{ac} 40°C, ΔT 10°C, 16 operational hours per day in a mix of 80% level 1, 20% level 2, power on/off once per day in a ground, non-stationary, moderate environment.

i) The theoretical availability/reliability analysis shall be supported by in-service reliability information that provides at least a 50% confidence level that the theoretical values have

been achieved. If in-service reliability information is not available then the reliability demonstration shall be extended to achieve the 50% confidence level.

j) A reliability demonstration of each first of type ETCS train is required via 20 hours error and warning free operation of the fitted rolling stock under ETCS supervision. This demonstration is required to confirm application and compatibility with the particular rolling stock type.

k) Preventative maintenance, corrective maintenance and inspection or adjustment requirements shall be less often than once every 90 days assuming the defined mission profile.

l) Equipment shall include traceability information to support configuration, maintenance and investigation of hardware issues or software issues or both.

Note: These are the minimum requirements based on retro-fitting ETCS to an existing train. A non-redundant DMI and balise antenna configuration has been assumed.

11. DTRS interface

The digital train radio system (DTRS) implements EIRENE for TfNSW.

The ETCS to DTRS interface and the functionality required by the EIRENE FRS to support train number (also known as 'train running number') to be entered only once by the train driver for the ETCS and radio system shall be provided for ETCS Level 2 or higher implementations.

DTRS clarifications for EIRENE SRS to support ETCS onboard implementation are as follows:

- R-GSM band is not used due to local spectrum availability and the application is not 'relevant to interoperability of the rail system within the European Community'
- DTRS uses the 1800 MHz band (DSC 1800) for GSM due to local spectrum availability

12. Rolling stock vehicle class data

The initial source of general vehicle class data is *TS TOC Train Operating Conditions (TOC)* Manual.

Car length is the longest 'length coupled' for the particular vehicle class as defined in the *TOC Manual*. Train length is sum of car lengths in metres rounded up to nearest integer.

Maximum speed shall be as defined in the *TOC Manual*.

Train category is based on the vehicles 'track speed signs' allocation as defined in the *TOC Manual*.

Detailed information shall be obtained from the rolling stock operator or owner.

Appendix A Example AEO engineering services matrix

Transport Asset Standards Authority

ETCS Onboard subsystem
Engineering Services Matrix

Correct as at: August 2015

Asset Life Cycle Phases: Plan | Acquire | Operate/Maintain | Dispose

Asset Life Cycle Activities: Transport Needs Analysis/Model/Plan; Operations Concept Development; Maintenance Concept Development; Optioneering; BRS / URD development; Single Option Development; Safety Change Planning; SRS development; Concept / Reference Design; Preliminary Design; Detailed Design to AFC; Material Procurement; Manufacturing / Fabrication; Construction / Installation; Subsystem Integration; Testing and Commissioning; Acceptance Services; Plan Asset Maintenance; Maintain / Upgrade Assets; Conduct Asset Condition Surveys; Manage Asset Configuration; Plan Decommissioning / Disposal; Conduct Decommissioning/Disposal; Update Asset Configuration Data

Detailed Life Cycle: Feasibility | Concept | Design | Fabricate / Manufacture | Install | Integrate, Test and Commission | Asset Maintenance | Disposal

Specialist Engineering Service/ Disciplines			Transport Needs Analysis/Model/Plan	Operations Concept Development	Maintenance Concept Development	Optioneering	BRS / URD development	Single Option Development	Safety Change Planning	SRS development	Concept / Reference Design	Preliminary Design	Detailed Design to AFC	Material Procurement	Manufacturing / Fabrication	Construction / Installation	Subsystem Integration	Testing and Commissioning	Acceptance Services	Plan Asset Maintenance	Maintain / Upgrade Assets	Conduct Asset Condition Surveys	Manage Asset Configuration	Plan Decommissioning / Disposal	Conduct Decommissioning/Disposal	Update Asset Configuration Data
			Feasibility					Concept				Design		Fabricate / Manufacture		Install	Integrate, Test and Commission				Asset Maintenance				Disposal		
	Rolling Stock	Locomotives																									
		Freight																									
		Heavy Commuter EMU / DMU																									
		Track Machine																									
		Rail Road Vehicle																									
		Trolley / Trailer																									
		Other Rail Vehicles																									
		Rolling Stock Subsystems	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A			P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A
	Signalling and Control Systems	Supervisory and Control Systems																									
		Interlocking Systems	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A	P/A
		Trackside Systems (including Cabling)																									
	Communications	Cables and Routes, Optical fibre and other																									
		Applications and Systems – Telephony (VOIP and Analogue)																									
		Applications and Systems – Passenger Information Systems																									
		Applications and Systems – Alarm and CCTV Surveillance																									
		Applications and Systems–Condition Monitoring and Wayside Telemetry																									
		Networks Wired - Packet switched (IP MPLS etc)																									
		Networks Wired - Circuit switched (SDH, DWDM, etc)																									
		Networks Wireless - Packet switched (WiFi, WiMax, LTE etc)																									
		Networks Wireless - Circuit switched (Radio systems, PMR, Tetra etc)																									
		Telecommunications Power Systems and Facilities																									
		Network and Information Management Systems and Security																									
	Track Engineering	Wheel/Rail Interface																									
		Geometry/Alignment																									
		Components/Structure																									
		Rail-Specific Survey																									
	Civil and related Engineering	Civil - Survey																									
		Civil - Geotechnical																									
		Civil - CSR																									
		Civil - Tunnelling																									
		Civil - Bridges and Structures																									
		Civil - Earthworks																									
		Civil - Roads and pavements																									
		Civil - Drainage and Hydrology																									
	Buildings and Stations	Manage Buildings Work																									
		Architectural Design																									
		Specialist Buildings Expertise (must specify in the Notes)																									
		Building Structures (must specify in the Notes)																									
		Building Services (must specify in the Notes)																									
		Specialist Rail Systems Buildings Expertise (must specify in the Notes)																									
	Electrical Engineering	High Voltage Aerial Feeders																									
		High Voltage Cables																									
		Traction Substation and Sectioning Hut																									
		Distribution Substations																									
		High Voltage Protection Systems																									
		LV Power Systems and LV Protection																									
		Earthing, Bonding, Electrolysis and Lightning Protection																									
		Electrical Control Systems (SCADA) (must specify in the Notes)																									
		Overhead Wiring																									
		Electrical Network Planning and Modelling																									
Note: ONLY use the below sections if you provide the service as a standalone service																											
	Systems Engineering and Assurance (all services)	Systems Engineering (all SE services)																									
		Systems Assurance																									
		RAM Management																									
		Safety Engineering / Assurance																									
		Independent Safety Assessment (ISA)																									
		Human Factors Integration																									
		Electromagnetic Compatibility																									
		System Modelling and Analysis																									
		Requirements Management Engineering																									
		Interface Management																									
		Systems Integration Services (use Notes to elaborate)																									
		Verification and Validation																									
	Non-Asset Specific Engineering Services	Acoustic / Noise Engineering																									
		Fire and Life Safety (Infrastructure or Vehicles)																									
		DDA Compliance Services (Infrastructure or Vehicles)																									
		Sustainability and Environmental Services (Engineering-related)																									
		Engineering Competence Management																									
		Multi-Discipline Engineering Management (Use notes to elaborate)																									
		Other Specialist Engineering Services (unspecified)																									
	Asset Management	Configuration Management																									
		Integrated Logistics																									
		Asset Management																									

Action per discipline

A	"Assure only" means that the AEO does not produce the actual deliverable/service, but has competence, processes and systems in place to assure it (i.e. providing confidence that the requirements are fulfilled). For example, a company may specialise in providing independent inspections, verification, certification, assessments, testing, design reviews, installation QA inspections, fabrication QA inspections etc. Such an "assurance" AEO may be engaged directly or indirectly with TfNSW (or by an AEO) to assure some work or service produced by another AEO, or will team-up with the other AEO producing the service.
P/A	"Produce/Assure" means the organisation produces / delivers and assures engineering service/product within the scope of a selected life cycle process / activity for a particular engineering discipline/service.

Notes: specify details of the selected discipline or activity if required:

1	A bold P/A with a green background identifies the lead discipline in providing a specialist engineering service that must be supported by another discipline.
2	P/A with a yellow background identifies the support discipline necessary to provide the specialist engineering service.

Figure 1 - Example of AEO engineering services matrix