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Data entry – draft starts next page

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Preface

This standard was prepared by the Event Recorders Development Group, overseen by the ARISO Rolling Stock Standing Committee.

Objective

The objective of this Standard is to describe the performance and technical requirements for event recorders installed in locomotive, self-propelled passenger, and infrastructure maintenance rolling stock.

The primary purpose of the requirements is to ensure that event recorders fitted to rolling stock capture a minimum set of appropriate data for the use of Rolling Stock Operators (RTO), Rail Infrastructure Managers (RIM), maintainers and investigators in the forensic investigations of rail incidents.

Compliance

There are four types of provisions contained within Australian Standards developed by ARISO:

- (a) Requirements.
- (b) Recommendations.
- (c) Permissions.
- (d) Constraints.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term ‘shall’.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred.

Recommendations are identified within the text by the term ‘should’.

Recommendations recognize that there could be limitations to the universal application of the control, i.e. the identified control is not able to be applied, or other controls are more appropriate or better.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities or interfacing organisations where the risk may be shared.

Permissions – conveys consent by providing an allowable option. Permissions are identified within the text by the term ‘may’.

Constraints – provided by an external source such as legislation. Constraints are identified within the text by the term ‘must’.

ARISO Standards address known hazards within the railway industry. Hazards, and clauses within this Standard that address those hazards, are listed in Appendix A.

Appendices in ARISO Standards may be designated either “normative” or “informative”. A “normative” appendix is an integral part of a Standard and compliance with it is a requirement, whereas an “informative” appendix is only for information and guidance.

Commentary

Commentary *C Preface*

This Standard includes a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by 'C' preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the Standard.

DRAFT FOR PUBLIC CONSULTATION

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Section 1 Scope and general

1.1 Scope

This document applies to the design, construction and maintenance of new, modified and existing self-propelled locomotive, passenger, autonomous automatic rolling stock and infrastructure maintenance rolling stock capable of operating in travel mode at speeds greater than 30 km/h.

It is recommended that rolling stock not fitted with event recorders as specified in this document be assessed and, where practical, modified to meet the requirements of this document.

The document is not specifically intended to cover rolling stock used on light rail, cane railway, monorail and heritage railways operating on isolated networks, but items from this document may be applied to such systems as deemed appropriate by the relevant RIM.

This document does not apply to:

- operation of rolling stock in regard to network safeworking rules and route standards; or
- juridical event recorders.

1.2 Normative references

The following documents are referred to in the text in such a way that *some* or all of their content constitutes requirements of this document:

- AS 7502:2025, *Road Rail Vehicles*
- AS 7511:2020, *Onboard train protection systems*
- AS IEC 62443:2024 *Cybersecurity*
- AS/NZS ISO 8601.2:2021, *Date and time - Representations for information interchange, Part 2: Extensions*
- IEC 62625-1:2013, *Electronic railway equipment - On board driving data recording system - Part 1: System specification*
- IEEE 1482.1:2013, *IEEE Standard for Rail Transit Vehicle Event Recorders*

NOTE:

Documents for informative purposes are listed in a Bibliography at the back of the Standard.

1.3 Defined terms and abbreviations

For the purposes of this document, the following terms and definitions apply:

1.3.1

electronically controlled pneumatic (ECP)

electronically controlled pneumatic brakes (ECPB)

electronically controlled brake equipment that complies with AAR standards

1.3.2

Global Navigation Satellite System (GNSS)

global satellite navigation networks that allow users to determine their exact position, velocity, and time anywhere on Earth

1.3.3

juridical recording unit (JRU)

event recorder embedded within the European train control system as per ERA ETCS SUBSET-027

1.3.4**logging rate**

how often the processed measured data is stored onto the non-volatile crash protected memory

1.3.5**master clock**

common standard time source adopted by a railway infrastructure manager or rail operator

Note 1 to entry: The master clock could include a network time server, GPS or mobile telephone network time source.

1.3.6**measured data**

data received by the event recorder from a transducer or other signal source

1.3.7**onboard train protection system (OTPS)**

safety system installed on rolling stock that reduces the likelihood of and protects against the consequences of a failure in the manual onboard functions for safe train operation

Note 1 to entry: Refer to AS 7511 for more information.

1.3.8**passenger emergency device**

equipment provided to enable passengers to alert train crew to an emergency situation

Note 1 to entry: A passenger emergency device can also include an internal emergency door release (i.e. a system which enables a passenger doorway to be released from the inside for emergency egress purposes).

1.3.9**parameter**

individual measurable condition which the event recorder is capable of recording

1.3.10**rail transport operators (RTO)**

As defined in Rail Safety National Law.

1.3.11**regenerative braking**

rolling stock retardation that utilizes traction motors to generate electrical energy that is fed into the off-train supply system

1.3.12**sampling rate**

number of times a signal is measured (sampled) per second

1.3.13**UTC**

Coordinated Universal Time

General rail industry terms and definitions are maintained in the ARISO Glossary. Refer to:
<https://www.ariso.org.au/glossary/>

Section 2 Device type, status and identification

Rolling stock capable of operating at speeds greater than 30 km/h shall be fitted with an event recorder compliant with the requirements of this document.

Event recorders shall:

- (a) be compliant to IEC 62443 (all parts) where applicable based on the application;
- (b) record continuously while the rolling stock is in operation;
- (c) continuously monitor all measured data for change of state and record the processed data while the rolling stock is in operation;
- (d) record data on non-volatile solid-state memory;
- (e) have input impedances designed to avoid influencing, impairing or corrupting the circuits being monitored;
- (f) be designed so that failure of any recorder component, or related component, does not affect the operation of other systems;
- (g) include self-monitoring to display operational status (i.e. working or failed);
- (h) provide system integrity status indication in the driver's cab via indicator lamp or display;
- (i) for autonomous automated operation, provide equivalent system integrity indication to the monitoring operator showing both operational and non-operational status (see Clause 3.4); and
- (j) incorporate a unique, traceable identification feature (e.g., serial number) accessible without removing the recorder from its mounting.

Event recorders should record a snapshot of all processed data at regular intervals while the rolling stock is in operation.

Section 3 Data to be recorded

3.1 Operational requirements

3.1.1 General

Event recorders shall:

- (a) where more than one recorder is fitted, record all required data on each recorder;
- (b) not be required to duplicate data that is already recorded independently by subsystems;
- (c) where a subsystem records mandatory AS 7527 data, be time-synchronized and compatible with other mandatory data;
- (d) record the vehicle identification number of the vehicle on which it is installed;
- (e) have the capability to accept and record driver identification information;
- (f) record its own operational status;
- (g) record sufficient information for investigators to determine its operational status at the time of an incident; and
- (h) record information sufficient for an investigator to be able to identify the odometer reading at the time each recorded event occurred.

Where more than one recorder is fitted, event recorder should record the same data on each recorder.

RTOs shall establish and maintain documented procedures to ensure recorded data is correctly associated with the vehicle from which it was obtained.

Implementation of these procedures shall be undertaken by personnel who are trained and competent.

3.2 Locomotive and self-propelled passenger rolling stock

The event recorder fitted to locomotive and self-propelled passenger rolling stock shall, at a minimum, record the:

- (a) time and date as describe in Clause 3.7 of this document;
- (b) vehicle speed as displayed to the RTC;
- (c) if available, vehicle speed recorded from an alternate source to that displayed to the RTC;
- (d) distance;
- (e) throttle/master controller setting, including all driven cabins operating as locomotive distributed power or multiple unit passenger trains;
- (f) direction of train travel as selected by the RTC;
- (g) operation/application and status of each braking system as described in Clause 3.5 of this document;
- (h) operational status (i.e. active/inactive) of any fitted tilt devices;
- (i) operation and status of OTPS in accordance with Clause 3.6 of this document;
- (j) operation and status of the headlights, including on/off, high and low mode, and location of operation;
- (k) direct operation and status of the visibility lights (i.e. on, off or flashing), including the end they are operating on the rolling stock;
- (l) direct operation and status of the marker lights, including the aspect and the end they are operating on the rolling stock;
- (m) operation of any audible warning device (e.g., vehicle horn or whistle), on the leading unit in case of multiple units, including high and low operation and the start and finish of each activation;
- (n) operation of sanding equipment (i.e. sand dispensed, isolated) of each bogie (if fitted);
- (o) for passenger trains:
 - (i) doors released and doors closed commands as performed by the RTC;
 - (ii) door open trainline status (one or more doors are open);
 - (iii) platform screen doors (PSD) status of each car (e.g., bypassed, aligned, open/closed) if fitted and not recorded by another event recording system;
 - (iv) activation of a passenger emergency device;
 - (v) crew response to the passenger emergency device;
 - (vi) reset of the passenger emergency device;
 - (vii) the door open and door close commands as shown to the RTC; and
 - (viii) the status of the door traction interlock, where fitted, as shown to the RTC.

NOTE 1:

OTPSs include systems described in AS 7511 and Clause 3.6 of this document.

NOTE 2:

Inputs recorded for passenger trains are dependent on the type of passenger emergency device installed on the train.

Event recorders should record:

- (p) vehicle GPS speed;
- (q) the fault status of the headlight;
- (r) indirect operation and status of the visibility lights (i.e. on, off or flashing), including the end they are operating on the rolling stock;
- (s) indirect operation and status of the marker lights, including the aspect and the end they are operating on the rolling stock;
- (t) continuously self-monitor each input and provide a signal health check report;
- (u) the state of any emergency shutdown activations performed by the RTC (e.g., main circuit breaker emergency trip);
- (v) the fault acknowledgement by the RTC of the train control system;
- (w) the fault reset action by the RTC of the train control system;
- (x) audio signals from alerting or warning devices for fire or passenger emergency alarms;
- (y) the self-propelled vehicle position in a consist (i.e. lead, non-lead, or coupled);
- (z) the activation of any wheel slip/slide equipment (if equipped);
- (aa) the activation and operation of the cab radio equipment;
- (bb) the level of traction system effort during both powering and, where applicable, braking modes;
- (cc) the traction system response from all locomotives or traction units including locomotive distributed power or multiple unit passenger trains operations;
- (dd) rolling stock energy supply source (e.g., overhead traction line voltage);
- (ee) operation of the pantograph and main/line circuit breaker (if fitted);
- (ff) the recording status of onboard CCTV equipment;
- (gg) for passenger trains, if not recorded by other means:
 - (ix) the door open status of each individual door;
 - (x) passenger emergency door release activation trainline (i.e. one or more doors passenger emergency released);
 - (xi) passenger emergency door release activation of each door;
 - (xii) door operation override status (e.g., guards override);
 - (xiii) the door isolation status of each individual door; and
 - (xiv) incorrect side door inhibited status (if fitted); and
 - (xv) if fitted, should record status of the sensitive edge of each door for incidents involving objects or people caught in doors.

The event recorder can also record:

- (hh) acceleration/deceleration rates;

- (ii) operation of automatic power control (APC) when traversing neutral sections (if fitted);
- (jj) all messages received and transmitted by any fitted train protection system;
- (kk) status and operation of cab radio system;
- (ll) voice communications transmitted from or received by the RTC radio and intercom systems;
- (mm) voice communications in the RTC cab;
- (nn) the RTC voice communications;
- (oo) the operation of any device that signals to the RTC to proceed with train movement (e.g., guards right-of-way (ROW) bell).
- (pp) if not recorded by a judicial event recorder, train control management data both received or transmitted;
- (qq) time, speed and position of the rolling stock as determined by the satellite navigation;
- (rr) cab-based forward-looking video recording; and
- (ss) interior passenger lights status.

Event recorders fitted to existing rolling stock that record on tape shall, at a minimum, record the following information:

- (tt) train speed;
- (uu) distance;
- (vv) time; and
- (ww) operation of the braking system as described in Clause 3.5 of this document.

3.3 Infrastructure maintenance rolling stock

Infrastructure maintenance rolling stock capable of operating in travel mode at speeds greater than 30 km/h shall have an event recorder installed which meets the applicable requirements of this document.

The event recorder shall automatically record once the rail guidance equipment (RGE) is out of the stowed position.

The event recorder fitted to infrastructure maintenance rolling stock shall record, as a minimum:

- (a) time and date as describe in Clause 3.7 of this document;
- (b) speed (as displayed to the RTC);
- (c) direction of travel;
- (d) throttle position (demand);
- (e) distance;
- (f) operation of the braking system as described in Clause 3.5 of this document;
- (g) horn activation;
- (h) headlight operation;
- (i) vigilance time-out and acknowledgment (where fitted); and
- (j) RGE status.

Where available, the event recorder fitted to infrastructure maintenance rolling stock should record the vehicle speed from an alternate source to that displayed to the RTC.

NOTE:

Refer to AS 7502 for core requirements for infrastructure maintenance rolling stock.

3.4 Autonomous automatic or remote-operated vehicle

Event recorders fitted to autonomous automatic or remote operated vehicles shall record, as a minimum:

- (a) changes to the vehicle's operational mode (e.g., unsupervised automatic, supervised automatic, manual); and
- (b) all control messages sent and received by the vehicle, in addition to other requirements specified in this document.

Event recorders fitted to autonomous automatic or remote operated vehicles should record, as a minimum, all status messages sent and received by the vehicle, in addition to other requirements specified in this document.

3.5 Brake system

Event recorders shall record:

- (a) separately, the activation and application of each braking system fitted to the vehicle;
- (b) the brake activation level and duration on the leading driving vehicle;
- (c) emergency brake applications;
- (d) penalty brake applications;
- (e) the status of the park brake;
- (f) electronically controlled pneumatic (ECP) brake commands; and
- (g) dynamic or regenerative braking brake commands.

NOTE:

The intent is to record the operation and activation response of all braking systems and technologies. This includes parameters such as brake pipe pressure, brake cylinder pressure, ECP brake demand signals, or other relevant braking system parameters.

Event recorders should:

- (h) separately record the response of each braking system on a bogie-by-bogie basis for the fitted vehicle, and optionally for other vehicles;
- (i) record the rolling stock main reservoir air pressure as displayed to the driver;
- (j) record the status of the isolation cock of the pressure sensing source; and
- (k) have pressure sensing points that are on the bogie side of the isolating cock;

3.6 Onboard train protection systems**3.6.1 Background**

Onboard train protection systems (OTPS), also known as driver supervisory systems, are safety systems installed on rolling stock to reduce the likelihood of, and protect against, the consequences of failures in the manual onboard functions necessary for safe train operation. Refer to AS 7511 for OTPS requirements.

3.6.2 Recording OTPS

Event recorders shall record:

- (a) the operational status (e.g., on, off, isolated) of all fitted OTPSs;
- (b) OTPS alarms and warning;
- (c) RTC acknowledgement of OTPS alarms;
- (d) OTPS acknowledgements by both RTC where fitted for non-driver-only or two-crew operation;
- (e) OTPS acknowledgements by RTC in both cabs for bank or assisting locomotive operations; and
- (f) penalty brake applications resulting from OTPS intervention.

Event recorders should record:

- (g) all messages sent and received by any fitted OTPS;
- (h) all enforcement of movement authorities by OTPS; and
- (i) Automatic Train Operation (ATO) status, including state code (0–7) for:
 - (i) no power;
 - (ii) configuration;
 - (iii) not available;
 - (iv) available;
 - (v) ready to engage;
 - (vi) engaged;
 - (vii) disengaging; and
 - (viii) failed.

3.7 Time and date recording

Event recorders shall continuously record both time and date while the rolling stock is in operation (i.e., when not stabled or in work mode). The following requirements apply:

- (a) Time and date shall be recorded in a format compliant with AS/NZS ISO 8601.2:2021
- (b) UTC shall be used as the base reference for both time and date.
- (c) Local time and date may also be displayed or recorded, automatically adjusted for time zones and daylight saving.
- (d) The time base shall maintain an accuracy of ± 10 s at all times.
- (e) Time shall be synchronized during commissioning and maintenance inspections against a master clock.
- (f) Time shall be automatically synchronized at least once every 24 hours to GNSS time (if fitted).
- (g) In synchronized multiple units, all event recorders shall display the same time.
- (h) If a GNSS is used as the primary reference:
 - (i) a backup mechanism shall be in place to maintain time and date in case of GNSS signal loss; and
 - (ii) the event recorder should also record GNSS speed, GNSS position (latitude and longitude), GNSS direction of travel and GNSS signal quality.

NOTE:

References to GNSS include other standardized satellite-based positioning systems.

Section 4 Data sampling rates

Event recorders shall:

- (a) operate at a data acquisition sampling rate of 50 Hz or faster;
- (b) store processed data to memory at a logging rate of 1 Hz or faster;
- (c) remain unaffected by power interruptions of 200 ms or less under normal power conditions;
- (d) record acquired data in non-volatile crash-protected memory within 500 ms of data acquisition;
- (e) timestamp each sample with a minimum resolution of 0.02 s;
- (f) allow debounce filtering adjustable software parameter that have an upper limit of 100 ms; and
- (g) processed data should be stored to memory at a logging rate of 4 Hz or faster.

NOTE:

This refers to the switch on time of the sample, e.g., analogue to digital convertor.

Section 5 Accuracy and resolution of recorded data

Event recorders shall:

- (a) record all changes of state of mandated data;
- (b) record inputs with an accuracy of $\pm 0.1\%$ or better;
- (c) record data with the following minimum resolutions:
 - (i) Distance: 1 m;
 - (ii) Speed: 0.1 km/h;
 - (iii) Air pressure: 1 kPa (include vacuum as negative pressure);
 - (iv) Time stamp: 0.02 s;
 - (v) Date: 1 day;
 - (vi) Position (longitude and latitude): 0.0001 minutes of arc;
 - (vii) Overhead supply voltage 1 kV; and
 - (viii) Tractive effort 1 kN; and
- (d) include a minimum of one checksum in each record to enable error detection during post event analysis.

Commentary C5-1

Accuracy specified as 0.1% of the full-scale parameter, noting that some parameters may be affected by secondary factors (e.g., wheel wear affecting distance/speed measurement, air pressure sensor tolerances).

Commentary C5-2

A vacuum is considered as negative air pressure.

Section 6 Survivability of data

Event recorders shall:

- (a) be installed in a location providing shock isolation and protection against crash forces to minimize potential damage;
- (b) have power supply arrangements designed to prevent inadvertent disconnection due to switching of unrelated functions or tripping of circuit protection from other devices or systems;
- (c) for locomotive and self-propelled passenger rolling stock, the event recorder shall incorporate crash-protected memory meeting the data survivability tests specified in IEEE 1482.1:2013 or EN 62625-1:YYYY Table 1 Column A; and
- (d) for infrastructure maintenance rolling stock, the event recorder shall, where reasonably practicable, incorporate crash-protected memory meeting the data survivability tests specified in IEEE 1482.1:2013 or EN 62625-1:YYYY, Table 1 Column A, or an alternative hardened memory solution that demonstrably preserves data through credible accident scenarios defined for these vehicles.

For infrastructure maintenance vehicles with lighter construction, the location should be selected to maximize survivability within the available structure.

NOTE:

Where practicable, locate the event recorder outside the vehicle's crumple zone.

Section 7 Data extraction and data analysis software

To support reporting and analysis with accessible data streams, event recorders shall:

- (a) provide physical and software interfaces for data extraction (e.g., USB, wireless, ethernet);
- (b) make recorded data available for retrieval in read-only format;
- (c) protect recorded data against unauthorized access, modification, or deletion;
- (d) be compliant to AS IEC 62443:2024 where applicable based on the application;
- (e) be capable of continuous recording during data extraction;
- (f) record each data extraction occurrence as an event;
- (g) provide replay tool that allows wheel diameter adjustment;
- (h) allow data extraction without clearing memory;
- (i) retain and store a minimum of the last seven (7) days of nominal vehicle use case operation;
- (j) overwrite the oldest data first when storage limits are reached (i.e. first-in, first-out);
- (k) retain recorded data for at least two (2) years after loss of power;
- (l) provide replay tools that output data in industry standard formats (e.g., .xls, .txt, .csv, .odt);
- (m) provide command line tools that allow an entire raw data download to be extracted to industry standard formats (e.g., .xls, .txt, .csv, .odt) without the need of the replay tool;
- (n) provide replay tools that allow viewing all recorded signals simultaneously; and
- (o) provide replay tools that allow viewing of GPS position (if fitted) in a map view.

Event recorders should provide replay tools that:

- (p) allow event searching by combination of any signals and trigger conditions; and
- (q) allow merging and synchronisation of datasets from multi-event recorder installations on the same rolling stock.

Rail transport operators shall document procedures for data extraction, and storage.

Section 8 Maintenance

Event recorders shall:

- (a) be maintained in accordance with the manufacturer's instructions;
- (b) be downloaded and analyzed at least annually to confirm all recorded data is active and of acceptable quality;
- (c) be downloaded and analyzed after replacement or maintenance of the event recorder to confirm all recorded data is active and of acceptable quality; and
- (d) be downloaded and analyzed after maintenance or disturbance of any input signal source or sensors to confirm those affected signals are active and of acceptable quality.

The RSO shall:

- (e) maintain documented systems for inspection, testing, maintenance and calibration of event recorders and associated sensors;
- (f) maintain documentation specifying the source of all recorded parameters and any external signal conversions prior to recording;
- (g) establish procedures for providing event recorder data to external bodies following an incident;
- (h) establish procedures describing RTC actions if an event recorder fails or malfunctions;
- (i) implement a process to verify that clocks used for time and date recording are accurately set; and
- (j) maintain a documented procedure for storing wheel wear compensation used for speed and distance calculations:
 - (i) on the event recorder;
 - (ii) in maintenance records external to the vehicle; or
 - (iii) in both locations.

Rail transport operators should document and maintain a data dictionary that explains what each signal does and its origin source.

Appendix A Hazard Register (Informative)

Hazard number	Hazard
5.11.1.3	Brakes being Inadequate when Stationary, Human Error, Design Failure, Health Failure, Organisational SMS Failure, Security Breach and or Vandalism, Hand / park brakes not being applied.
5.4.1.38	Harm to Rolling Stock, Derailment or Collision, Human Error, Track Failure, Track Obstruction, Design Failure, Health Failure, Organisational SMS Failure, Security Breach - Load not Secure and or Vandalism.
5.52.1.1	The inability to determine the cause of rolling stock incidents, Derailment or Collision, Track Failure, Track Obstructions, Design Failure and or Environmental Impact - Deceased or uncooperative crews.
5.52.1.3	The inability to determine the cause of rolling stock incidents, Derailment or Collision, Track Failure, Track Obstructions, Design Failure and or Environmental Impact - Event recorders being faulty or inoperative.
5.52.1.4	The inability to determine the cause of rolling stock incidents, Derailment or Collision, Track Failure, Track Obstructions, Design Failure and or Environmental Impact - Insufficient or corrupted data from event recorders.
5.52.1.5	The inability to determine the cause of rolling stock incidents, Derailment or Collision, Track Failure, Track Obstructions, Design Failure and or Environmental Impact - Event recorders being damaged.