AUSTRALIAN RAIL TRACK CORPORATION LTD

Discipline
Engineering Standard

Category
Rolling Stock

Standard for Driver Safety Systems

WOS 01.D

Applicability

ARTC Network wide	
New South Wales	✓
Western Jurisdiction	
Victoria	

Primary Source
(RIC Standard RSU Appendix D Version 2.0)

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1.0	07/12/2005	All	Reformatting to ARTC Standard

Contents

This standard is set out as follows:

WOS 01.D – Driver Safety Systems

D[1] Purpose

D1.1 Define minimum requirements for Driver Safety Systems.

D1.2 Specify functional requirements for Driver Safety Systems components.

D1.3 Specify performance and technical requirements related to Driver Safety Systems.

D1.4 To define the requirements for Driver Safety Systems in the procurement of new and substantially modified rolling stock.

D[2] Scope

D2.1 The requirements of this Appendix will apply to all driven vehicles operating on the Australian Rail Track Corporation Network in NSW.

D2.2 Old vehicles which do not meet the requirements of this Appendix will be assessed on an individual basis.

D[3] Definitions

D3.1 **Circumvention**

Improper evasion of the safety system

D3.2 **Coasting**

Operating trains with the reverser in the neutral or off positions.

D3.3 **Deadman Device**

A device which reacts if a continuous input required of the Driver is interrupted.

D3.4 **Driver Safety System**

The combination of safety elements such as deadman, vigilance devices and train stops on a single train.

D3.4 **Existing Vehicles**

Vehicles currently in operation on the Australian Rail Track Corporation network.

D3.6 **Isolation & Circumvention**

D3.6.1 Isolation is the removal of the safety system under an authorised procedure.

D3.6.2 Circumvention is the removal of the safety system other than under an

authorised procedure.

D3.7 **New Vehicles**

Vehicles which are designed after January 1997.

D3.8 **NSW Rail System**

The whole of the Australian Rail Track Corporation network which includes the following operating areas:

- Sydney Suburban area is bounded by Cowan, Bondi, Emu Plains, Richmond, Macarthur and Waterfall.
- Sydney Outer Suburban area is bounded by Wyong, Springwood, Macarthur and Kiama.
- Inter City area is bounded by Newcastle, Lithgow, Moss Vale and Port Kembla.

D3.9 **Observer and driver**

Train crew who perform duties on trains operating on the Australian Rail Track Corporation network as defined by Safeworking Unit SWU 141.

D3.10 **Substantially Modified Vehicles**

Vehicles modified to accommodate their use for a different purpose. Vehicles undergoing major refurbishment with updated equipment which may include the installation of part or all of the current Standard for Driver Safety Systems.

D3.11 **Task Linked Vigilance System**

A vigilance system which accepts specified task functions as input to satisfy the vigilance control system.

D3.12 **Train stop**

A system which stops a train which passes a signal at stop.

D3.13 **Vigilance system**

A system which will react if a discrete input is not received within a specified time.

D3.14 **Fail Safe - Driver Safety**

To fail safe requires that where possible the system and components of the Driver Safety System shall be designed such that:

(a) the system must be operative for the train to start and;

(b) that an emergency brake application shall be initiated should differences in the sequence of events or signals occur in the system operation.

D[4] Types of driver safety systems

D4.1 The following types of Driver Safety Systems shall be applicable to vehicles operating on Australian Rail Track Corporation track;

D4.1.1 **System 1**

Deadman system with handle or pedal and handle control plus train stop

D4.1.2 **System 2**
Deadman system with handle or pedal and handle control plus train stop plus task linked vigilance system

D4.1.3 **System 3**

Deadman system with handle or pedal and handle control plus task linked vigilance system

D4.1.4 **System 4**

Non task linked vigilance system

D4.1.5 **System 5**

Task linked vigilance system

D[5] Minimum requirements

D5.1 The minimum requirements for Driver Safety Systems to be fitted to new and substantially modified vehicles shall be as follows:

D5.2 **Suburban**

System 1 with circumvention of deadman system by coasting barred by the train control system.

D5.3 **Outer suburban/intercity**

System 2 with acknowledgment of vigilance system also by downward depression of deadman pedal and circumvention of deadman system by coasting barred by the train control system.

D5.4 **Long distance passenger operations (non locomotive hauled trains)**

System 3 with acknowledgment of vigilance system also by downward depression of deadman pedal and circumvention of deadman system by coasting barred by the train control system.

D5.5 **Freight and locomotive hauled passenger operations**

System 4 or 5 with coasting barred by the train control system.

D5.6 **Track maintenance vehicles operating as a train.**

System 4 or 5 with coasting barred by the train control system.

D[6] Train stop system

D6.1 **Function**

The train stop system fitted to suburban and intercity trains shall enforce emergency braking when the train passes a signal at stop.

D6.2 **Operation**

D6.2.1 **Interfacing**

The train stop system shall interface with existing signal trips and the train braking system.

D6.2.2 **Trackside equipment**

Operation of the train stop is by existing trackside trip equipment adjacent to the signal, which has its arm raised when the signal is at a stop.

D6.2.2 **Onboard equipment**

The trip valve, which shall be mounted at the left hand side of the bogie, at the lead end of the lead car shall have a lever which is engaged by the raised trip arm to open the trip valve, discharge the brake pipe and apply the brakes.

When the brake pipe pressure drops to a predetermined level, (250 kPa) the control governor shall isolate power to the train, which together with brake application will bring the train to a halt.

The trip valve shall not reset until the brake pipe pressure is below a predetermined level (70 kPa). Reset shall be achieved by moving the brake controller handle to the emergency application position.

Trip arms will be in the raised position until time has elapsed for the train to travel below a certain speed (determined by the signal aspect) from the previous signal.

D[7] Deadman system

D7.1 **Function**.

The function of the deadman system shall be to bring the train to a standstill by an emergency brake application, if a continuous input is interrupted.

An emergency brake application shall be brought about by opening the emergency application valve to discharge the brake pipe resulting in brake application and traction power isolation as in D6.2.2 above.

The deadman system shall interface and be compatible with the train braking system.

D7.2 **Operation**

D7.2.1 **Controls**

The Driver shall be required to maintain either a spring loaded foot pedal, handle or other deadman system controller continuously in a predetermined position. An emergency brake application shall be initiated if at any time all of the deadman controllers are released.

Resetting the deadman system shall be achieved by moving either the brake controller to give an approved brake cylinder pressure or the master controller to the "off" position and then moving any of the deadman controllers again to the predetermined position.

D7.2.2 **Failsafe**

In addition to the failsafe requirements in Clause 7.8, the system providing the deadman function shall failsafe at speeds of greater than 10 kph, ie. it must be operative to allow the train to proceed at speeds of greater than 10 kph. This requirement shall apply unless the deadman system is isolated in accordance with Safeworking Unit SWU 141 and it shall be designed to initiate an emergency brake application if it becomes inoperative due to technical failure or actions by the Driver while the train is moving, at greater than 10 kph.

D[8] Vigilance system

D8.1 **Function**.

"The Driver (or Observer, where appropriate), depresses the acknowledgement button at predetermined regular interval. If this does not occur, the system shall prompt the Driver with a visual or auditory signal or both.

If the Driver does not respond to the visual and auditory signals, the train will be brought to a standstill by application of the emergency brake."

D8.2 **Operation**

D8.2.1 **Vigilance cycle**

If after a given period of time has elapsed (refer table D1) the Driver has not made any of the selection of vigilance system control inputs at the driving position:

- An in-cab visible warning (in accordance with Clause D10.3.4) may be given. The Driver (or Observer where appropriate) shall be required to respond to the visible warning by fully depressing the deadman foot pedal for no more than two (2) seconds, or operation of any of the task linked driving controls, or the Driver (or Observer, where appropriate) be required to press a vigilance acknowledgement button.

- If the Driver (or Observer where appropriate) fail to acknowledge

within a given period (refer table D1) from the onset of the visible warning, an audible warning may sound (in accordance with Clause D10.3.5). The Driver (and Observer, where appropriate) shall be required to respond to the warning sound in the same manner as for the visible warning.

- If the Driver (or Observer, where appropriate) fails to take this action within the time stated in Table D1 from the onset of the audible warning, an emergency brake application shall be initiated that cannot be released within the time stated in Table D1. The vigilance cycle shall then be able to be reset by pressing the acknowledgement button and operating the brake in the normal manner.

D[9] Performance requirements

D9.1 Performance specification

This section of the Standard sets out the performance requirements of Driver Safety Systems which are to be incorporated in rolling stock for operation on the Australian Rail Track Corporation network in NSW.

The specific performance and technical requirements included in Section D10 define the technical and physical characteristics of the Driver Safety System components.

The design shall meet the performance requirements of the specification and be suitable for the purpose intended.

The design shall incorporate the selection of materials, components, processes and workmanship standards which ensure that the Driver Safety System is capable of maintaining the nominated performance requirements over the specified design life in Clause D9.2.

The specifications for materials, components, processes and workmanship standards applicable to Driver Safety Systems shall be as generally applicable to comparable areas of the vehicle on which the Driver Safety System is installed. However this requirement shall in no way relieve the obligation of meeting the performance required and the suitability of the Driver Safety System for its intended purpose.

D9.2 Design parameters

D9.2.1 Design life

The driver safety system shall be designed for the following duty:

- design life - 25 years
- operating cycle - continuous

D9.2.2 Operating environment

D9.2.2.1 Railway environment

All equipment for Driver safety systems shall be robust, fit for its intended purpose and suited to harsh railway environment. It

should be noted that the equipment may be operational in automatic washing plant and the design is to be suited to this condition.

D9.2.2.2 Climatic conditions

Equipment mounted external to the Driver's cab shall be subject to dust, rain, vibration, flying ballast and the typical range of climatic conditions shown below:

(a) Shade air temperatures -10°C to 50°C
(b) Relative humidity up to 100%
(c) Altitudes up to 1370 metres above sea level
(d) Periods of torrential rain
(e) Salt laden atmosphere and
(f) Dry and dusty conditions in summer e.g. relative humidity 20% and wind driven dust of particle of size of 1.4 ~m to 0.1 mm.

Provision must also be made for authorised isolation procedures.

D9.3 Circumvention

Driver Safety Systems shall be designed to ensure that circumvention of any of the systems cannot be made either by improper use of isolation devices or driving controls.

D9.4 Isolation

Driver Safety Systems shall be designed to permit isolation of each sub-system under an authorised procedure to allow the train to proceed in the event of failure of a Driver Safety System component.

D9.5 Reliability

D9.5.1 General

Driver Safety Systems shall comply with the concepts of Reliability as defined by AS 3960.

Documented, verifiable evidence shall be provided as part of the design process and system type testing as stated in Clause D9.6.

D9.5.2 Mean time between failures

The system shall have a Mean Time Between Failures (MTBF) greater than 100,000 hours. MTBF shall be defined as follows:

$$MTBF = \frac{N \times tk}{r}$$

Where
r = is the number of times adjustments or replacements are required to a system or component.
N = is the number of systems in SRA operation.
tk = is the elapsed time over which the failures are

measured.

D9.6 Compliance

D9.6.1 Drawings

Drawings showing the arrangement and function of the components of the Driver Safety System with details of the Driver Interface.

D9.6.2 Test certificates

Test Certificates issued by a recognised testing authority, or certified performance records shall be provided to evidence the reliability of the systems.

D9.6.3 Logic diagrams

Logic diagrams shall be provided which demonstrate conformance with the requirements of:

- Circumvention
- Isolation
- Fail Safe

D9.6.4 Operation

A narrative describing the operation of the Driver Safety System shall be provided.

D9.6.5 Maintainability

Drawings shall be provided which show the access for maintenance, together with lists of available replaceable components which may be required in the service and repair of the Driver Safety Systems. (refer Clause D9.7).

D9.6.6 Standards

A listing of the applicable Australian and Industry Standards to which the equipment conforms shall be provided by the manufacturer/supplier of Driver Safety System.

D9.7 Maintainability

D9.7.1 Inspection and maintenance

Driver Safety Systems shall operate satisfactorily between scheduled inspection and maintenance periods.

D9.7.2 Accessibility

Driver Safety Systems shall be designed to be readily accessible and to allow easy replacement of equipment and components. The system shall be designed to provide for:

(a) Checking the equipment to determine if a fault exists

(b) Quickly diagnosing a defective module or assembly. Consideration shall be given to the provision of test equipment, test procedures, test points and identification of assemblies and modules.

(c) The method of repairing faults.

(d) Determining that repaired equipment is functioning within the design limits.

The system supplier shall supply a Maintenance Manual covering the Driver Safety System to suit the operator's requirements..

D9.7.3 **Time to repair**

When a fault develops within the Driver Safety System, it shall be possible for repairs to be made and a vehicle to be returned to service within 2 hours working time for 95 percentile of failures.

D9.7.4 **Failsafe**

Where possible systems and components of the Driver Safety Systems shall fail safe. This requires that the systems and components shall be operative for the train to start.(unless isolated in accordance with formal procedures) and shall be designed where ever possible to initiate an emergency brake application should differences in sequence of events or signals occur in the system operation while the train is moving.

D[10] Specific performance & technical requirements

D10.1 **Train stop**

The major components of the train stop system are;

- Trackside trip arm
- Bogie mounted trip valve
- Control governor
- Safety Apparatus Isolating cock (SAI)

The trip valve shall be mounted on the left hand side of the lead end of the bogie on the lead car.

A manual latch shall be provided on the train trip valve to raise the trip lever on the non-lead cars. The trip lever shall be spring loaded to allow passing obstructions such as ballast, other signal trip arms in the reverse travel direction.

The trackside trip valve system shall be fail safe and designed to meet the above requirements, however, lightweight construction consistent with a robust design is an important factor in reducing the dynamic loading on the mechanism and its attachment to the bogie axle box. The unit design shall be such that, if the operating trip arm is latched up (out of service) the trip valve is held open. The trip valve shall be mounted to an adaptor bracket by two bolts. The adaptor bracket shall be attached to the axle box by two bolts. The mounting arrangement shall be for

approval

D10.2 **Deadman device**

D10.2.1 **Worksafe standards**

The Driver interface (foot pedal, handle or other controller) shall meet the relevant requirements of the Worksafe National Standard for Manual Handling No. NOHSC 1001-1990 and the National Code of Practice No. NOHSC 2005-1990. In particular, the design of the interface controller shall consider the following factors in preventing the risk of strain injuries:

(a) actions and movements
(b) workplace and workstation layout
(c) working posture and position
(d) duration and frequency of force application
(e) locations of forces and distances moved
(f) magnitude of the forces
(g) characteristics of loads and equipment

Suitable positions for location of the control interface and acceptable force for operation are contained in Section D11.5 Ergonomics.

D10.2.2 **Driver incapacitation**

The interface shall be designed so far as is practicable to detect Driver incapacitation.

D10.2.3 **Circumvention**

The interface shall be designed so far as is practicable so that it is not possible to intentionally or accidentally circumvent its operation.

D10.3 **Vigilance control - driver interface**.

D10.3.1 **Vigilance system acknowledgment & task linking**

The control inputs which shall prevent the onset of the vigilance warning shall include:

(a) movement of the power controller
(b) movement of the brake controller
(c) operation of a vigilance acknowledgement button
(d) operation of the deadman controller
(e) operation of the warning horn

D10.3.2 **Timing**

When there is no control input detected, then the cumulative time periods which shall elapse before the onset of the visible and audible indication and emergency brake application shall be specified as stated in Table D1. If the acknowledgement button is depressed continuously, the cycle continues as if no acknowledgement has been made.

Table D1

System	Time before Visual Warning (seconds)	Time before Audible Warning (seconds)	Time before emergency brake Application (seconds)	Time before Reset (seconds)
Passenger				
-Suburban	1	-	-	-
-Outer sub/Intercity		75	90	120
-Long Distance	60	75	90	120
Freight				
-Driver Only	40	50	60	90
-Driver + Observer	60	75	90	120

Notes:

(1) Where specified timings are to be speed dependant i.e. to provide a speed dependant vigilance system.
(2) For track maintenance vehicles use freight timings.
(3) Some systems must be acknowledged only after the visual warning. Acknowledgement made before the visual warning does not reset the vigilance control system timing cycle.

D10.3.3 **Location of vigilance control**

The acknowledgement button/s shall be located on the Driver's desk or on a vertical face in the control area such that the Driver (or Observer where appropriate) shall be able to reach the button with an outstretched arm and without upper body movement. The location shall prevent the Driver or Observer normally resting a hand on the button.

The operating pressure for the vigilance acknowledgement button shall allow comfortable operation of the button.

D10.3.4 **Visible warning**

The visible warning shall be a flashing light located on the Driver's console. A second light shall be located on the Observers console where appropriate. Flashing frequency shall be 0.5 second on and 0.5 seconds off. The light intensity and location shall be such as to be clearly visible under all light conditions in the control cab.

Vigilance light colours shall be as follows:

Passenger

Intercity	-	Not Applicable
Outer Suburban Tangara	-	TBA
Interstate Operation		
Driver's side	-	White
Off side	-	Blue

Intrastate Operation	-	Red

Freight

Interstate Operation		
Both sides	-	White
Centre above windscreen	-	Blue
Intrastate Operation		
Both sides	-	White

D10.3.5 **Audible warning**

The audible warning shall comprise of an output tone of 2500 +/-100 Hz interrupted at 3 Hz +/- 0.5 Hz equal on/off periods. It shall be audible at the Driver position (and at the Observer position where provided) and in all operating conditions.

D10.3.6 **Driver interface**

The Driver interface shall meet with the relevant requirements of the Worksafe National Standard for Manual Handling No. NOHSC 1001-1990 and the National Code of Practice No. NOHSC 2005-1990.. In particular, the design of the interface controller shall consider the following factors in preventing the risk of strain injuries:

(a) actions and movements
(b) workplace and work station layout
(c) working posture and position
(d) duration and frequency of force application
(e) locations of forces and distances moved
(f) magnitude of the forces
(g) characteristics of loads and equipment.

Suitable positions for location of the control interface and acceptable force for operation are contained in Section D11.5 Ergonomics.

D10.4 **On board data logging**.

Where a separate Maintenance Data Logger is not installed on a vehicle then the Driver Safety System shall include a facility for logging of information relating to the operation of the train.

D10.4.1 The minimum data that shall be recorded continuously while the train is in operation are:

1. date
2. time
3. train speed
4. brake pipe and/or brake cylinder pressure

D10.4.2 The following data that should also be recorded continuously while the train is in operation are:

1. distance travelled
2. vigilance acknowledgement *****
3. deadman pedal/handle operation *****

4. train stop operation *****
5. throttle operation
6. brake operation
7. horn operation, and
8. headlight operation

* delete where not part of the relevant Driver Safety System

D10.4.3 Data to be recorded on each commencement of operation and on occurrence (as required) are:

1. driver's identity
2. train number
3. clock reset
4. data logger power on, and
5. memory module installation
6. isolation of any of Driver Safety System and identification of system

D10.4.4 The data logging system shall be capable of recording 14 days operation with a sampling frequency of no greater than 10 seconds for each data item. (except for data items in subclauses D10.4.2 which are recorded on occurrence).

D10.4.5 In addition to the requirement of subclause D10.4.3, in the event of a collision, derailment or other event which causes disruption to the operation of the power car, all data items must be preserved in 1 second intervals for the period 15 minutes prior to the event (except for data items in subclause D10.4.2 which are recorded on each commencement of operation and on occurrence.

D10.4.6 For passenger rolling stock the requirements of the Data Logger shall be:

A minimum memory capacity capable of recording 6 days operation with one second sampling time and a removable memory module containing a minimum of the last 48 hours operation with one second sampling time.

All data recorded must be available for downloading for examination by authorised personnel.

D10.4.7 The manufacturer shall provide software and operational instructions for the analysis and printing of data.

D[11] Ergonomics

D11.1 **Work position**

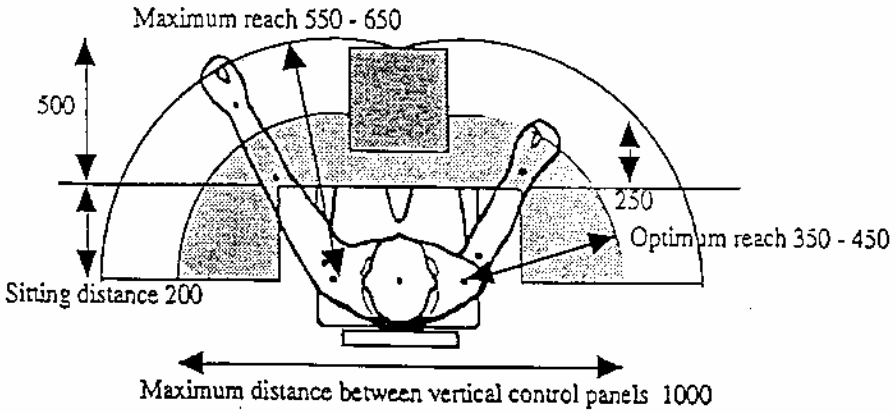
The workstation shall be designed to enable the Driver to adopt a natural, relaxed posture while still allowing for variations in that posture to be adopted. That is, the workstation design shall not restrict the Driver's posture unnecessarily. The workstation shall be designed as far as practical so that the Driver operates the controls with shoulders relaxed, upper arms hanging and elbows at 90 degrees or more.

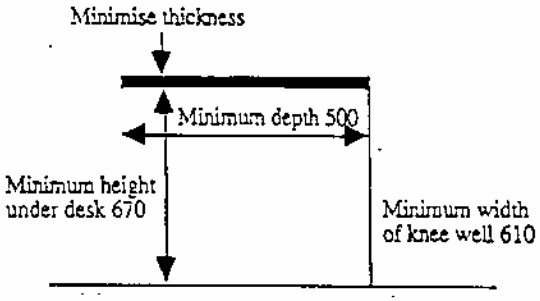
D11.2 **Reach distance**

The maximum height of any control above the horizontal plane of the workstation shall be 200 mm.

D11.3 **Seated workstation dimensions**

- Seat height; adjustable in the range 390 - 540 mm
- Seat width: minimum 420 mm
- Back support width: 360 - 400 mm
- Back support height: minimum 320 mm
- Back support: adjustable height and horizontal distance from seat





All dimensions are in mm.

D[12] Environmental

D12.1 **Lighting**

The Lighting inside the cab shall comply with the requirements of AS 1680.1 - 1990 Interior Lighting Part 1 General Principles and Recommendations.

D12.2 **Thermal**

The following optimum conditions shall be maintained inside the cab as far as

practicable:

- Dry bulb temperature: 19 - 23 degrees C
- Air velocity: 0.1 - 0.2 m/s
- Relative humidity: 30 - 70%

D12.3 **Acoustic**

- Maximum noise level: 85 dBA
- Maximum preferred Noise Criteria: NC 40
- Internal noise levels at infrasonic frequencies shall not exceed the third octave band limits shown in Table 13.1 of the ROA Manual of Engineering Practices.

D12.4 **Vibration**

- Vehicle body vibrations shall comply with all the requirements of the ROA Manual of Engineering Standards and Practices, Section 13.4.3, and Australian Standard 2670, Evaluation of Human Exposure to Whole-body Vibration.