

Vehicle Standard (Australian Design Rule 98/01 – Advanced Emergency Braking for Passenger Vehicles and Light Goods Vehicles) 2021

Made under section 12 of the *Road Vehicle Standards Act 2018*

Explanatory Statement

Approved by the Hon Kevin Hogan MP, Assistant Minister to the Deputy Prime Minister

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1. LEGISLATIVE AUTHORITY

1.1. National Road Vehicle Standards

Vehicle Standard (Australian Design Rule 98/01 – Advanced Emergency Braking for Passenger Vehicles and Light Goods Vehicles) 2021, also referred to as ADR 98/01, is made under the *Road Vehicle Standards Act 2018* (the Act). The Act enables the Australian Government to establish nationally uniform standards that apply to new road vehicles or road vehicle components when they are provided to the market in Australia. The Act applies to vehicles or components whether they are manufactured in Australia or imported.

The making of the vehicle standards necessary for the Act’s effective operation is provided for in section 12, which empowers the Minister to “determine standards for road vehicles or road vehicle components”.

1.2. International Harmonisation

A majority of Australian road vehicle standards such as ADR 98/01 harmonise closely with international regulations. This is so that manufacturers can more easily comply with regulation, and so that regulations capture the well-developed views of the international community. This ultimately leads to safer and cheaper products for Australians.

Australian Design Rules (ADR) often directly incorporate United Nations (UN) Regulations as an appendix, where the appendix provides the technical requirements of the ADR and the rest of the ADR facilitates its application to Australia. To this end, Section 6 creates exemptions and alternate procedures. For instance, manufacturers are exempt from requirements that pertain to UN type approvals, and instead, need to comply with the approvals process set out in the Act. Likewise, Section 7 provides for the acceptance of certain alternate standards that have equivalent requirements to the appendix. For instance, a vehicle covered by a type approval under the UN Regulation would be deemed to comply with the ADR.

1.3. Advanced Emergency Braking Systems

Where Advanced Emergency Braking Systems (AEBS) are fitted to new vehicles, they are closely integrated with a vehicle’s other systems, feature a sensor array and have the capacity to anticipate certain crashes based on the sensor data collected. The function of an AEBS conforming to ADR 98/01 is to avoid or mitigate the severity of

- a) rear-end in lane collisions; and
- b) pedestrian collisions.

2. PURPOSE AND OPERATION

2.1. Overview of the ADR

Clause 2.1 clarifies that this national road vehicle standard sets out requirements for AEBS to be fitted to passenger vehicles and light goods vehicles.

The policy intent of the AEBS requirements mandated through ADR 98/01 is to reduce the occurrence of rear-end in-lane crashes in urban traffic and impacts with

pedestrians. This is because a combination of driver distraction and the relative cognitive complexity of roadways means that crashes occur around 20 per cent more frequently on urban than on rural roads. Risk of a pedestrian being struck by a vehicle increases in urban areas where high pedestrian activity and traffic densities converge. Australian specific data shows that pedestrians comprise 13 per cent of all road fatalities in Australia.

2.2. Design Requirement – Advanced Emergency Braking Systems

AEBS is a driver-assist safety feature that relies on fully functioning traditional brakes and other advanced braking systems, such as Antilock Braking Systems (ABS) to work properly.

AEBS conforming to ADR 98/01 are designed to reduce the likelihood of an in-lane rear end crash with a car in front or a pedestrian by first warning the driver and then automatically braking to reduce impact speed when a collision is imminent, if the driver has not reacted.

AEBS read inputs from a variety of sensors and cameras to monitor the road environment. In the event that a collision with a vehicle in front or a pedestrian is predicted, the driver is warned. This warning occurs by at least two modes and may be acoustic, haptic or optical. If the driver does not respond, a warning brake phase may be initiated. If the driver still does not react to the event, the system will execute an emergency braking phase in order to mitigate the collision.

Clause 5.1 requires that all applicable vehicles be fitted with AEBS and meet the requirements set out in Appendix A of this standard, as varied by Section 6 Exemptions and Alternative Procedures. Appendix A is the UN Regulation No. 152 – UNIFORM PROVISIONS CONCERNING THE APPROVAL OF MOTOR VEHICLES WITH REGARD TO THE ADVANCED EMERGENCY BRAKING SYSTEMS (AEBS) FOR M₁ AND N₁ VEHICLES (R152), incorporating the 01 series of amendments.

2.3. AEBS Warnings

AEBS designed to conform to ADR 98/01 have different types of warnings depending on the road environment and state of the AEBS. Some warnings alert the driver in case of potential failures or deactivation of the AEBS. Warnings also form an essential part of the core functionality of AEBS.

A ‘failure warning’ occurs when a fault in the AEBS prevents the requirements of ADR 98/01 being met. A fault in this instance may be electrical in nature, a failure in the self-check function of the AEBS or a non-electrical failure such as sensor occlusion or misalignment. The self-check function continuously checks the AEBS for a system failure while AEBS is active. The AEBS communicates a ‘failure warning’ with a constant yellow optical warning signal. The purpose of the ‘failure warning’ is to alert the driver to a fault in the AEBS.

A ‘deactivation warning’ occurs when the driver deactivates the AEBS. This is only possible if the vehicle is fitted with a means to deactivate the AEBS and such a means is not required by this standard. The AEBS communicates a ‘deactivation warning’ with a constant yellow optical warning signal. The warning signal used in this instance may be the same as the ‘failure warning’ signal. The purpose of the ‘deactivation warning’ is to alert the driver that the AEBS function has been deactivated.

A ‘collision warning’ occurs when the AEBS detects an imminent collision with a leading vehicle in the same lane or a pedestrian crossing the road. The AEBS must activate this warning type at least 0.8 seconds before it intervenes by activating the service brake system (emergency braking). The warning signal used in this instance must be provided by at least two modes selected from acoustic, haptic or optical. Optical warning signals must be visible even in daylight and be easily verifiable by the driver from the driver’s seat. The purpose of the ‘collision warning’ is to alert the driver that a collision is imminent so that the driver can take immediate action. This is because even small margins count in reducing speed to prevent or lessen the risk of fatality or severe injury.

2.4. AEBS Capability

An ‘emergency braking’ intervention occurs when the AEBS has detected the possibility of an imminent collision with a leading vehicle in the same lane or a pedestrian, after a ‘collision warning’; if no action from the driver has been detected. During an emergency braking intervention, the AEBS shall use the vehicle’s service brake system to cause deceleration of at least 5 m/s^2 for the purpose of avoiding or reducing the severity of impact with the leading vehicle or pedestrian. The AEBS will abort an automated ‘emergency braking’ intervention in the event that the AEBS no longer detects that a collision is likely. The AEBS may also abort the emergency braking intervention if it detects a ‘deliberate action’ by the driver which indicates that they are aware of the emergency, e.g. using the accelerator or operating the direction indicator control.

AEBS is required to be active and work within speeds ranging from 10 km/h up to 60 km/h. AEBS should work regardless of the load condition imposed on the vehicle during testing for compliance to UN R152. This requirement does not apply if the driver has deactivated the AEBS (assuming the option is available). The speed range specified in UN R152 is supported by research that identified AEBS having the potential to positively impact the outcome in up to 64 per cent of light vehicle crashes occurring in low speed zones (i.e. up to 60 km/h).

2.5. AEBS Performance and limitations

‘Speed reduction by braking demand’ sets out the environmental conditions in which the AEBS equipped vehicle must demonstrate its braking intervention performance as well as the speed reductions required of it, in order to comply with ADR 98/01.

The Standard requires AEBS fitted vehicles to perform in the following environmental conditions:

- on a flat, dry concrete or asphalt surface affording good adhesion
- where the ambient temperature is between 0°C and 45°C
- where the leading vehicle is visible throughout the test
- where there is no wind liable to affect results
- where natural ambient illumination is homogenous and in excess of 1000 lux

The intent behind these environmental conditions is to mitigate the contemporary limitations of the technology used to build AEBS.

As previously mentioned, AEBS can use a combination of sensors, for example radar and camera sensors. Radar systems can measure distances precisely but have a low angular resolution whereas cameras have much better angular resolution but cannot precisely determine distances. By combining radar and camera, the benefits of both sensor types contribute towards better positioning of surrounding objects. However, some of the disadvantages of the sensors are difficult to avoid completely, so they might fail to detect objects or detect “ghost targets”, i.e. misinterpret their surroundings and cause a false emergency braking intervention. Even though manufacturers take measures to reduce false or missed detections, the AEBS will not always perform flawlessly.

Traffic situations are complex, and many variables contribute to the outcome of any given traffic incident. Factors such as road curvature, road surface condition, the speed of vehicles, and the surrounding environment can affect the performance of AEBS. Manufacturers research the principles of automotive radar and camera systems so that they can identify and study potential weaknesses and improve AEBS. However, it is still a requirement that AEBS shall not deactivate or unreasonably switch the control strategy in these potentially adverse conditions.

An AEBS compliant to ADR 98/01 will be designed to generate as few unnecessary ‘collision warning’ signals as possible, and will avoid initiating emergency braking interventions in situations where an attentive driver would not anticipate a collision. AEBS equipped vehicles will demonstrate this capacity by carrying out two false reaction scenarios:

- a) driving between two stationary vehicles without the fitted AEBS communicating a collision warning or initiating an emergency braking intervention.
- b) driving past a stationary pedestrian target (dummy) that is placed approximately 1 meter away from the line of travel of the vehicle without the fitted AEBS communicating a collision warning or initiating an emergency braking intervention.

The primary purpose of reducing false warnings or emergency braking interventions is to reduce the likelihood of the driver switching the AEBS off. However, the requirement still exists for vehicles where there is no way to deactivate AEBS, as false alarms and interventions are nevertheless undesirable.

2.6. Exemptions and Alternative Procedures

Exemptions

Section 6 creates exemptions from some requirements of appendix A (UN R152) which pertain to gaining a Type Approval in the UN context. This is because they are not required in the Australian context where the Commonwealth administers approvals through the Act and the ADRs. Consequently, manufacturers supplying new vehicles to Australia are exempt from most administrative (non-technical) requirements of UN R152.

Clause 6.1 states that, sections 3, 4, 7, 8, 9, 10, 11, 12 and annexes 1 and 2 of UN R152 are not required for the purposes of complying with ADR 98/01. This is because they refer to gaining a Type Approval in the UN context.

Alternative Procedures

Section 6 identifies procedures to which vehicles may comply, which are acceptable alternatives to those created by UN R152. These have been adapted for the Australian market to enable vehicle manufacturer to demonstrate compliance to ADR 98/01 where they have not gained a type approval in the UN context.

Clauses 6.2 and 6.3 states that ADR 98/01 applies to vehicles seeking to demonstrate that they meet all the technical requirements for AEBS tested in car to car and car to pedestrian scenarios as defined in Appendix A.

Clause 6.4 states that category MA vehicles do not need to meet the requirements in paragraph 5.1.7 of Appendix A if they comply with ADR 31/... This is because this standard features equivalent requirements pertaining to ABS as the UN R13-H specified in 5.1.7, which are necessary for optimal brake performance during an AEBS intervention. This allows vehicle manufacturers to more easily demonstrate compliance to ADR 98/01.

Clause 6.5 states that category MB, MC and NA vehicles do not need to meet the requirements in paragraph 5.1.7 of Appendix A if they comply with ADR 31/... or ADR 35/... This is because these standards feature sufficiently equivalent requirements pertaining to ABS, which are necessary for optimal brake performance during an AEBS intervention. This allows vehicle manufacturers to more easily demonstrate compliance to ADR 98/01.

Clause 6.6 clarifies that where Appendix A refers “to the technical service at the time of type approval”, it is to be substituted with “to the Approved Testing Facility”. The purpose of this clause is to replace language in Appendix A, which originally referred to the UN application process with language accurate to the Australian context.

Clauses 6.7 and 6.8 clarify that where Appendix A and Annex 3 of Appendix A refer to “Technical Service”, it is to be substituted with “Approved Testing Facility”. The purpose of these clauses is to replace language in Appendix A, which originally referred to the UN application process with language accurate to the Australian context.

Clause 6.9 clarifies where Annex 3 of Appendix A refers to “Type Approval Authority”, it is to be substituted with “Secretary”. The purpose of this clause is to replace language in Appendix A, which originally referred to the UN application process with language accurate to the Australian context.

Clause 6.10 establishes the requirement that the vehicle manufacturer must retain the documentation pertaining to the technical requirements referred to in paragraph 5.1.3 and Annex 3 of Appendix A, for a period specified by the approval. This is so that the information is available for a Type Approval and/or a Conformity of Production assessment. This section reflects the requirement created by section 30 of the Act.

2.7. Alternative Standards

Section 7 sets out standards which are considered to be equivalent to ADR 98/01. If a vehicle meets the requirements of one of these standards, it also complies with ADR 98/01. These alternative standards are acceptable because they do not compromise the performance requirements set out in UN R152. Vehicle manufacturers have the flexibility to gain compliance to ADR 98/01 through clause 5.1 and Appendix A as varied by Section 6 Exemptions and Alternative Procedures, or through Section 7 Alternative Standards.

Clause 7.1 identifies the United Nations Regulation No. 152 – UNIFORM PROVISIONS CONCERNING THE APPROVAL OF MOTOR VEHICLES WITH REGARD TO THE ADVANCED EMERGENCY BRAKING SYSTEMS (AEBS) FOR M₁ AND N₁ VEHICLES, incorporating the 01 series of amendments, as an acceptable alternate standard. This standard is also featured in Appendix A of ADR 98/01 and makes up most of the technical requirements of ADR 98/01. It is the first series of amendments to the original internationally agreed standard for AEBS regarding passenger vehicles and light goods vehicles and sets requirements for detecting vehicles and pedestrians in the forwards impact zone, making it particularly effective in light vehicle rear-end in-lane collisions and impacts with pedestrians.

Clause 7.1.1 clarifies that paragraphs 5.1.3, 6.10 and Annex 3 of the United Nations Regulation No. 152, incorporating the 01 series of amendments are applicable for the purposes of this national standard as they relate to technical requirements with respect to car to car and car to pedestrian AEBS performance.

Clause 7.2 identifies the United Nations Regulation No. 152 – UNIFORM PROVISIONS CONCERNING THE APPROVAL OF MOTOR VEHICLES WITH REGARD TO THE ADVANCED EMERGENCY BRAKING SYSTEMS (AEBS) FOR M₁ AND N₁ VEHICLES, incorporating the 00 series of amendments, as an acceptable alternate standard. This standard is featured in Appendix A of ADR 98/00 and makes up most of the technical requirements of ADR 98/00. It is the original internationally agreed standard for AEBS regarding passenger vehicles and light goods vehicles and sets requirements for detecting vehicles and pedestrians in the forwards impact zone, making it particularly effective in light vehicle rear-end in-lane collisions and impacts with pedestrians.

Clause 7.2.1 clarifies that paragraphs 5.1.3, 6.10 and Annex 3 of the United Nations Regulation No. 152, incorporating the 00 series of amendments are applicable for the purposes of this national standard as they relate to technical requirements with respect to car to car and car to pedestrian AEBS performance.

3. MATTERS INCORPORATED BY REFERENCE

3.1. Other Legislative Instruments

Clause 4.1.1 of ADR 98/01 includes a reference to the Vehicle Standard (Australian Design Rule Definitions and Vehicle Categories) 2005 (which may also be cited as the Australian Design Rule – Definitions and Vehicle Categories). This sets out definitions for many terms used in the ADRs, including the vehicle categories used in ADR applicability tables.

Clauses 6.4 and 6.5 of ADR 98/01 each include a reference to the Australian Design Rule 31/... – Brake Systems for Passenger Cars, which prescribes braking system requirements for passenger vehicles (other than omnibuses) and light goods vehicles to ensure safe braking under normal, and emergency conditions.

Clause 6.5 of ADR 98/01 also includes a reference to the Australian Design Rule 35/... – Commercial Vehicle Brake Systems, which prescribes braking requirements for commercial vehicles and large passenger vehicles to ensure safe braking under normal and emergency conditions.

The ADRs may be freely accessed online through the Federal Register of Legislation. The website is www.legislation.gov.au.

In accordance with subsection 12 of the Act, each of these ADRs are incorporated as in force or existing from time to time. The ellipses (...) indicates the version(s) (e.g. 00, 01 etc.) of the ADR in force at the time.

3.2. Other Documents

American Society for Testing and Materials

Paragraph 6.1.1.2 of Appendix A includes references to the American Society for Testing and Materials (ASTM) E1136 and ASTM Method E1337-90. These standards specify a standard reference test tyre, and a method for determining the peak braking coefficient of road test surfaces, respectively.

ASTM E1136 and ASTM E1337-90 may be freely accessed online through the ASTM International Reading Room. This requires the user to register using an email and password. The ASTM International Reading Room website is www.astm.org/readinglibrary/.

In accordance with subsections 14(1)(b) and 14(2) of the *Legislation Act 2003*, each of these ASTM standards are incorporated as in force on the date this national road vehicle standard is made.

International Organization for Standardization

Paragraph 6.3.1 of Appendix A includes a reference to ISO 19206-1:2018. This standard specifies detection requirements for a vehicle rear-end target to represent a passenger vehicle in terms of size, shape, reflection properties, to assess the system detection and activation performance of vehicle active safety systems, including AEBS.

Paragraph 6.3.2 of Appendix A includes a reference to ISO 19206-2:2018. This standard specifies detection requirements for pedestrian targets that represent an adult or a child in terms of size, shape, reflection properties, to assess the system detection and activation performance of vehicle active safety systems, including AEBS.

ISO 19206-1:2018 and ISO 19206-2:2018 are available for purchase only from the International Organization for Standardization (ISO) and various associated national standards bodies. While not freely available, these ISO standards are all readily accessible and widely used by vehicle manufacturers and test facilities as part of their professional libraries.

In accordance with subsections 14(1)(b) and 14(2) of the *Legislation Act 2003*, each of these ISO standards are incorporated as in force on the date this national road vehicle standard is made.

Clause 11 of the Act allows the Minister to incorporate a broad range of documents, both as in force at a particular time and as in force from time to time, when making national vehicle standards. This ensures that Australia's legislative framework is well-prepared for future developments in the international road vehicle space.

United Nations Regulations and/or Resolutions

Clauses 7.1 includes a reference to the 01 series of UN Regulation No. 152 – UNIFORM PROVISIONS CONCERNING THE APPROVAL OF MOTOR VEHICLES WITH REGARD TO THE ADVANCED EMERGENCY BRAKING SYSTEMS (AEBS) FOR M₁ AND N₁ VEHICLES (R152). This is an international standard for AEBS fitted to passenger vehicles (other than omnibuses) and light goods vehicles.

Clauses 7.2 includes a reference to the 00 series of UN Regulation No. 152 – UNIFORM PROVISIONS CONCERNING THE APPROVAL OF MOTOR VEHICLES WITH REGARD TO THE ADVANCED EMERGENCY BRAKING SYSTEMS (AEBS) FOR M₁ AND N₁ VEHICLES (R152). This is an international standard for AEBS fitted to passenger vehicles (other than omnibuses) and light goods vehicles.

Paragraph 1 of Appendix A includes a reference to the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6. This includes definitions for the UN vehicle category classifications used in Appendix A and the alternative standard under clause 7 of ADR 98/01.

Paragraph 5.1.2 of Appendix A includes a reference to the UN Regulation No. 10 (R10). This is an international standard for electromagnetic compatibility for vehicles and vehicle components.

Paragraph 5.1.7 of Appendix A includes references to UN Regulations No. 13 (R13) and 13-H (R13-H). Further, paragraph 6.1.1.3 of Appendix A also includes a reference to UN R13-H. These are international standards for road vehicle braking systems.

Paragraph 5.4.1.3 of Appendix A includes a reference to UN Regulation No. 121 (R121). This is an international standard for the identification of vehicle controls, tell-tales and indicators.

The Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, and the UN Regulations (including R10, R13, R13-H, R121, and R152), may be freely accessed online through the UN World Forum for the Harmonization of Vehicle Regulations (WP.29). The WP.29 website is www.unece.org/trans/main/welcwp29.html.

In accordance with subsections 14(1)(b) and 14(2) of the *Legislation Act 2003*, each of these UN documents are incorporated as in force on the date this national road vehicle standard is made.

4. CONSULTATION

4.1. General Consultation Arrangements

It has been longstanding practice to consult widely on proposed new or amended vehicle standards. For many years, there has been active collaboration between the Commonwealth and the state/territory governments, as well as consultation with industry and consumer groups. Much of the consultation takes place within institutional arrangements established for this purpose. The analysis and documentation prepared in a particular case, and the bodies consulted, depend on the degree of impact the new or amended standard is expected to have on industry or road users.

Proposals that are regarded as significant need to be supported by a Regulation Impact Statement (RIS) meeting the requirements of the Office of Best Practice Regulation (OBPR) as published in the *Australian Government Guide to Regulatory Impact Analysis* or the *Regulatory Impact Analysis Guide for Ministers' Meetings and National Standard Setting Bodies*.

4.2. Specific Consultation Arrangements

A consultation RIS for Reducing Trauma from Light Vehicles: Autonomous Emergency Braking was posted on the Department's website for an eight week public comment period, which closed on 11 December 2020. The RIS conforms to the requirements established by the OBPR in relation to regulatory proposals where the decision maker is the Australian Government's Cabinet, the Prime Minister, minister, statutory authority, board or other regulator. The OBPR reference number for the RIS is 42547.

Formal feedback to the RIS was received from members of the public, state government agencies, industry and road user organisations. A majority of the feedback strongly supported the implementation of a new ADR mandating car-to-car and pedestrian capable AEBS on light vehicles.

The Department also circulated drafts of ADR 98/00 and ADR 98/01 to the Technical Liaison Group (TLG) and the Strategic Vehicle Safety and Environment Group (SVSEG) for review and comment in June 2021.

TLG consists of technical representatives of government (Australian and state/territory), the manufacturing and operational arms of the industry (including organisations such as the Federal Chamber of Automotive Industries and the Australian Trucking Association) and of representative organisations of consumers and road users (particularly through the Australian Automobile Association).

SVSEG consists of senior representatives of government (Australian and state/territory), the manufacturing and operational arms of the industry and of representative organisations of consumers and road users (at a higher level within each organisation as represented in TLG).

5. REGULATORY IMPACT

There are costs associated with mandating AEBS for light vehicles, but the related RIS shows that there will be positive net benefits. Overall, it is estimated that the implementation of ADR 98/01, preceded by the associated ADR 98/00 (covered by a separate explanatory statement) will save 581 lives, and avoid 20,433 serious and 73,340 minor injuries. This includes around \$1,089 million in net benefits.

6. STATEMENT OF COMPATIBILITY WITH HUMAN RIGHTS

The following Statement is prepared in accordance with Part 3 of the *Human Rights (Parliamentary Scrutiny) Act 2011*.

6.1. Overview

ADR 98/01 specifies requirements for the fitment of AEBS to passenger vehicles (other than omnibuses), and to light goods vehicles, to avoid or mitigate the severity of rear-end in lane collisions and impacts with pedestrians.

6.2. Human Rights Implications

ADR 98/01 does not engage any of the human rights and freedoms recognised or declared in the international instruments listed in section 3 of the *Human Rights (Parliamentary Scrutiny) Act 2011*.

6.3. Conclusion

ADR 98/01 is compatible with human rights, as it does not raise any human rights issues.