Vehicle Standard (Australian Design Rule 90/01 – Steering System) 2021

I, MICHAEL MCCORMACK, Deputy Prime Minister, determine this vehicle standard under section 12 of the *Road Vehicle Standards Act 2018*.

Dated

[NOT FOR SIGNING]

Michael McCormack

Deputy Prime Minister

CONTENTS

1. LEGISLATIVE PROVISIONS

1.1. Name of Standard

1.1.1. This Standard is the Vehicle Standard (Australian Design Rule 90/01 – Steering System) 2020.

1.1.2. This Standard may also be cited as Australian Design Rule 90/01 – Steering System.

1.2. Commencement

1.2.1. This Standard commences on the day after it is registered.

2. FUNCTION

2.1. The function of This Standard is to ensure safe steering under normal operating and failure conditions.

3. APPLICABILITY

3.1. This Standard applies to category LB, LD, LE and all category M and N vehicles from the dates set out in clauses 3.1.1 to 3.1.3 and the applicability table under clause 3.3 below.

3.1.1. [1 Month 202X] for all new model vehicles.

3.1.2. [1 Month 202X] for all vehicles.

3.1.3. The Australian Design Rule 90/00 – Steering System is an acceptable prior rule for all vehicles not equipped with a steering system exhibiting the functionality defined as an *ACSF* of Category B2, D or E.

3.2. For the purposes of clause 3.1.1, a "new model" is a vehicle model first produced with a *'Date of manufacture'* on or after the agreed date in that clause.

3.3. Applicability Table

Vehicle Category	ADR Category Code	UN Category Code*	Manufactured on or After**	Acceptable Prior Rules
Moped 2 wheels	LA	L1	N/A	
Moped 3 wheels	LB	L2	[1 Month 202X]	See clause 3.1.3.
Motor cycle	LC	L3	N/A	
Motor cycle and sidecar	LD	L4	[1 Month 202X]	See clause 3.1.3.
Motor tricycle	LE	L5		
	LEM		[1 Month 202X]	See clause 3.1.3.
	LEP		[1 Month 202X]	See clause 3.1.3.
	LEG		[1 Month 202X]	See clause 3.1.3.
Passenger car	MA	M1	[1 Month 202X]	See clause 3.1.3.
Forward-control passenger vehicle	MB	M1	[1 Month 202X]	See clause 3.1.3.
Off-road passenger vehicle	MC	M1	[1 Month 202X]	See clause 3.1.3.
Light omnibus	MD	M2		
up to 3.5 tonnes '*GVM'* and up to 12 seats	MD1		[1 Month 202X]	See clause 3.1.3.
up to 3.5 tonnes *'GVM'* and more than 12 seats	MD2		[1 Month 202X]	See clause 3.1.3.
over 3.5 tonnes and up to 4.5 tonnes *'GVM'*	MD3		[1 Month 202X]	See clause 3.1.3.
over 4.5 tonnes and up to 5 tonnes *'GVM'*	MD4		[1 Month 202X]	See clause 3.1.3.
Heavy omnibus	ME	M3	[1 Month 202X]	See clause 3.1.3.
Light goods vehicle	NA	N1	[1 Month 202X]	See clause 3.1.3.
Medium goods vehicle	NB	N2		
over 3.5 tonnes up to 4.5 tonnes *'GVM'*	NB1		[1 Month 202X]	See clause 3.1.3.
over 4.5 tonnes up to 12 tonnes *'GVM'*	NB2		[1 Month 202X]	See clause 3.1.3.
Heavy goods vehicle	NC	N3	[1 Month 202X]	See clause 3.1.3.
Very light trailer	TA	O1	N/A	
Light trailer	TB	O2	N/A	
Medium trailer	TC	O3	N/A	
Heavy trailer	TD	O4	N/A	

* The category code may also be in the format L_1, L_2, L_3 etc
** See clause 3.1.

4. DEFINITIONS

4.1. For vehicle categories, definitions and meanings used in This Standard, refer to:

4.1.1. Vehicle Standard (Australian Design Rule Definitions and Vehicle Categories) 2005;

4.1.2. Definitions in Appendix A of This Standard or the alternative standards at clause 7; and

4.1.3. Definitions in Appendix B of This Standard.

5. REQUIREMENTS

5.1. Failure of any non-mechanical component of the steering system must not prevent effective steering of the vehicle.

5.2. Vehicles with *full power steering equipment* must be capable of providing steering failure and defect visual warning signals to the *Operator*.

5.3. Category LB, LD, LE, MA, MB, MC, MD and NA and subcategory NB1 vehicles must have a *turning circle* in either direction, as determined according to the definition in paragraph 2.4.6 of Appendix A, not exceeding 12 metres in radius.

5.4. In the case of category ME, NB2 and NC vehicles, the extreme outer edge of the tyre track at ground level, must be capable of turning in either direction within a circle with a 12.5 metre radius.

5.5. Except as provided in clause 5.5.1 below, vehicles must not be equipped with any steering system exhibiting the functionality defined as an *ACSF* of Category B2, D or E.

5.5.1. Until [1 Month 202Y], a vehicle may be equipped with a steering system exhibiting the functionality defined as an *ACSF* of Category B2, D or E, provided it meets the requirements of Appendix A as varied by Appendix B of this standard.

5.5.2. A steering system exhibiting the functionality defined as an *ACSF* of Category B2, D or E is considered part of an *ADS*, as defined in Appendix B.

5.5.3. A driver is considered an *Operator*, as defined in Appendix B.

5.6. Category M and N vehicles that meet the requirements of Appendix A as varied by Section 6 Exemptions and Alternative Procedures and are not equipped with any steering system exhibiting the functionality defined as an *ACSF* of Category B2, D or E, will be deemed to comply with this rule.

6. EXEMPTIONS AND ALTERNATIVE PROCEDURES

6.1. Compliance with the following parts, sections and annexes of Appendix A is not required for the purposes of clause 5.5 of this standard:

Sections

Section 3	Application for approvals
Section 4	Approval
Section 7	Conformity of production
Section 8	Penalties for non-conformity of production
Section 9	Modification and extension of approval of the vehicle type
Section 10	Production definitively discontinued
Section 11	Names and addresses of Technical Services responsible for conducting approval tests, and of Type Approval Authorities
Section 12	Transitional provisions

Annexes

Annex 1	Communication
Annex 2	Arrangement of approval mark

7. ALTERNATIVE STANDARDS

7.1. For category M and N vehicles not equipped with any steering system exhibiting the functionality defined as an *ACSF* of Category B2, D or E; the technical requirements of the United Nations Regulation No. 79 – UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES WITH REGARD TO STEERING EQUIPMENT, incorporating from the 01 series of amendments up to and including the 03 series of amendments, are deemed to be equivalent to the technical requirements of this standard.

APPENDIX A

Agreement

Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations*

Revision 4 (03 series), including the amendments which entered into force on 7 November 2018

Addendum 78: UN Regulation No. 79

Incorporating by the Department of Infrastructure, Transport, Regional Development and Communications, all valid text up to:

Incorporating:
Supplement 1 to the 03 series of amendments – Date of entry into force: 11 January 2020
Supplement 2 to the 03 series of amendments – Date of entry into force: 25 September 2020
Supplement 3 to the 03 series of amendments – Date of entry into force: 3 January 2021

Uniform provisions concerning the approval of vehicles with regard to steering equipment

* Former titles of the Agreement:
Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958 (original version);
Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, done at Geneva on 5 October 1995 (Revision 2).

UN Regulation No. 79

Uniform provisions concerning the approval of vehicles with regard to steering equipment

Contents

0. Introduction

The intention of the Regulation is to establish uniform provisions for the layout and performance of steering systems fitted to vehicles used on the road. Traditionally the major requirement has been that the main steering system contains a positive mechanical link between the steering control, normally the steering wheel, and the road wheels in order to determine the path of the vehicle. The mechanical link, if amply dimensioned, has been regarded as not being liable to failure.

Advancing technology, coupled with the wish to improve occupant safety by elimination of the mechanical steering column, and the production advantages associated with easier transfer of the steering control between left and right hand drive vehicles, has led to a review of the traditional approach and the Regulation is now amended to take account of the new technologies. Accordingly it will now be possible to have steering systems in which there is not any positive mechanical connection between the steering control and the road wheels.

Systems whereby the driver remains in primary control of the vehicle but may be helped by the steering system being influenced by signals initiated on-board the vehicle are defined as "Advanced Driver Assistance Steering Systems". Such systems can incorporate an "Automatically Commanded Steering Function", for example, using passive infrastructure features to assist the driver in keeping the vehicle on an ideal path (Lane Guidance, Lane Keeping or Heading Control), to assist the driver in manoeuvring the vehicle at low speed in confined spaces or to assist the driver in coming to rest at a pre-defined point (Bus Stop Guidance). Advanced Driver Assistance Steering Systems can also incorporate a "Corrective Steering Function" that, for example, warns the driver of any deviation from the chosen lane (Lane Departure Warning), corrects the steering angle to prevent departure from the chosen lane (Lane Departure Avoidance) or corrects the steering angle of one or more wheels to improve the vehicle's dynamic behaviour or stability.

In the case of any Advanced Driver Assistance Steering System, the driver can, at all times, choose to override the assistance function by deliberate action, for example, to avoid an unforeseen object in the road.

It is anticipated that future technology will also allow steering to be influenced or controlled by sensors and signals generated either on or off-board the vehicle. This has led to several concerns regarding responsibility for the primary control of the vehicle and the absence of any internationally agreed data transmission protocols with respect to off-board or external control of steering. Therefore, the Regulation does not permit the general approval of systems that incorporate functions by which the steering can be controlled by external signals, for example, transmitted from roadside beacons or active features embedded into the road surface. Such systems, which do not require the presence of a driver, have been defined as "Autonomous Steering Systems".

This Regulation also prevents the approval of positive steering of trailers by means of electrical control from the towing vehicle as there are currently no standards applicable to this application. It is expected that at some time in the future, ISO 11992 will be amended to include messages associated with the transmission of steering control.

1. Scope

1.1. This Regulation applies to the steering equipment of vehicles of categories M, N and O.[1]

1.2. This Regulation does not apply to:

[1] As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.6, para. 2 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

1.2.1. Steering equipment with a purely pneumatic transmission;

1.2.2. Autonomous Steering Systems as defined in paragraph 2.3.3.;

1.2.3. Steering systems exhibiting the functionality defined as ACSF of Category B2, D or E in paragraphs 2.3.4.1.3., 2.3.4.1.5., or 2.3.4.1.6., respectively, until specific provisions are introduced in this UN Regulation.

2. Definitions

For the purposes of this Regulation:

2.1. "*Approval of a vehicle*" means the approval of a vehicle type with regard to its steering equipment.

2.2. "*Vehicle type*" means a vehicle which does not differ with respect to the manufacturer's designation of the vehicle type and in essential characteristics such as:

2.2.1. Type of steering equipment, steering control, steering transmission, steered wheels, and energy source.

2.3. "*Steering equipment*" means all the equipment the purpose of which is to determine the direction of movement of the vehicle.

The steering equipment consists of:

- The steering control,
- The steering transmission,
- The steered wheels,
- The energy supply, if any.

2.3.1. "*Steering control*" means the part of the steering equipment which controls its operation; it may be operated with or without direct intervention of the driver. For steering equipment in which the steering forces are provided solely or partly by the muscular effort of the driver the steering control includes all parts up to the point where the steering effort is transformed by mechanical, hydraulic or electrical means;

2.3.2. "*Steering transmission*" means all components which form a functional link between the steering control and the road wheels.

- The transmission is divided into two independent functions:
- The control transmission and the energy transmission.
- Where the term "*transmission*" is used alone in this Regulation, it means both the control transmission and the energy transmission. A distinction is drawn between mechanical, electrical and hydraulic transmission systems or combinations thereof, according to the means by which the signals and/or energy is transmitted.

2.3.2.1. "*Control transmission*" means all components by means of which signals are transmitted for control of the steering equipment.

2.3.2.2. "*Energy transmission*" means all components by means of which the energy required for control/regulation of the steering function of the wheels is transmitted.

2.3.3. "*Autonomous Steering System*" means a system that incorporates a function within a complex electronic control system that causes the vehicle to follow a defined path or to

alter its path in response to signals initiated and transmitted from off-board the vehicle. The driver will not necessarily be in primary control of the vehicle.

2.3.4. "*Advanced Driver Assistance Steering System*" means a system, additional to the main steering system, that provides assistance to the driver in steering the vehicle but in which the driver remains at all times in primary control of the vehicle. It comprises one or both of the following functions:

2.3.4.1. "*Automatically commanded steering function (ACSF)*" means a function within an electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate control action in order to assist the driver.

2.3.4.1.1. *"ACSF of Category A"* means a function that operates at a speed no greater than 10 km/h to assist the driver, on demand, in low speed or parking manoeuvring.

2.3.4.1.2. *"ACSF of Category B1"* means a function which assists the driver in keeping the vehicle within the chosen lane, by influencing the lateral movement of the vehicle.

2.3.4.1.3. *"ACSF of Category B2"* means a function which is initiated/activated by the driver and which keeps the vehicle within its lane by influencing the lateral movement of the vehicle for extended periods without further driver command/confirmation.

2.3.4.1.4. *"ACSF of Category C"* means, a function which is initiated/activated by the driver and which can perform a single lateral manoeuvre (e.g. lane change) when commanded by the driver.

2.3.4.1.5. *"ACSF of Category D"* means a function which is initiated/activated by the driver and which can indicate the possibility of a single lateral manoeuvre (e.g. lane change) but performs that function only following a confirmation by the driver.

2.3.4.1.6. *"ACSF of Category E"* means a function which is initiated/activated by the driver and which can continuously determine the possibility of a manoeuvre (e.g. lane change) and complete these manoeuvres for extended periods without further driver command/confirmation.

2.3.4.2. *"Corrective Steering Function (CSF)"* means a control function within an electronic control system whereby, for a limited duration, changes to the steering angle of one or more wheels may result from the automatic evaluation of signals initiated on-board the vehicle, in order:

(a) To compensate a sudden, unexpected change in the side force of the vehicle, or;

(b) To improve the vehicle stability (e.g. side wind, differing adhesion road conditions "μ-split"), or;

(c) To correct lane departure. (e.g. to avoid crossing lane markings, leaving the road).

2.3.4.3. "*Emergency Steering Function (ESF)*" means a control function which can automatically detect a potential collision and automatically activate the vehicle steering system for a limited duration, to steer the vehicle with the purpose of avoiding or mitigating a collision, with:

(a) Another vehicle driving[2] in an adjacent lane:

(i) Drifting towards the path of the subject vehicle and/or;

(ii) Into which path the subject vehicle is drifting and/or;

[2] The vehicle may be driving in the same or the opposite direction as the subject vehicle.

(iii) Into which lane the driver initiates a lane change manoeuver.

(b) An obstacle obstructing the path of the subject vehicle or when the obstruction of the subject vehicle's path is deemed imminent.

ESF shall cover one or more use cases from the list above.

2.3.4.4 "*Remote Control Manoeuvring (RCM)*" means a function actuated by the driver that provides direct control on steering angle, acceleration, and deceleration for low speed manoeuvring. The actuation is made by a remote control device in close proximity to the vehicle.

2.3.4.18. "*Specified maximum RCM operating range (SRCMmax)*" means the maximum distance between the nearest point of the motor vehicle and the remote-control device up to which RCM is designed to operate.

2.3.5. "*Steered wheels*" means the wheels, the alignment of which may be altered directly or indirectly in relation to the longitudinal axis of the vehicle in order to determine the direction of movement of the vehicle. (The steered wheels include the axis around which they are rotated in order to determine the direction of movement of the vehicle);

2.3.6. "*Energy supply*" includes those parts of the steering equipment which provide it with energy, regulate that energy and where appropriate, process and store it. It also includes any storage reservoirs for the operating medium and the return lines, but not the vehicle's engine (except for the purpose of paragraph 5.3.2.1.) or its drive to the energy source.

2.3.6.1. "*Energy source*" means the part of the energy supply, which provides the energy in the required form.

2.3.6.2. "*Energy reservoir*" means that part of the energy supply in which the energy provided by the energy source is stored, for example, a pressurised fluid reservoir or vehicle battery.

2.3.6.3. "*Storage reservoir*" means that part of the energy supply in which the operating medium is stored at or near to the atmospheric pressure, for example a fluid reservoir.

2.4. Steering parameters

2.4.1. "*Steering control effort*" means the force applied to the steering control in order to steer the vehicle.

2.4.2. "*Steering time*" means the period of time from the beginning of the movement of the steering control to the moment at which the steered wheels have reached a specific steering angle.

2.4.3. "*Steering angle*" means the angle between the projection of a longitudinal axis of the vehicle and the line of intersection of the wheel plane (being the central plane of the wheel, normal to the axis around which it rotates) and the road surface.

2.4.4. "*Steering forces*" mean all the forces operating in the steering transmission.

2.4.5. "*Mean steering ratio*" means the ratio of the angular displacement of the steering control to the mean of the swept steering angle of the steered wheels for a full lock-to-lock turn.

2.4.6. "*Turning circle*" means the circle within which are located the projections onto the ground plane of all the points of the vehicle, excluding the external devices for indirect vision and the front direction indicators, when the vehicle is driven in a circle.

2.4.7. "*Nominal radius of steering control*" means in the case of a steering wheel the shortest dimension from its centre of rotation to the outer edge of the rim. In the case of any other form of control it means the distance between its centre of rotation and the point at which

the steering effort is applied. If more than one such point is provided, the one requiring the greatest effort shall be used.

2.4.8. *"Remote Controlled Parking (RCP)"* means an ACSF of category A, actuated by the driver, providing parking or low speed manoeuvring. The actuation is made by remote control in close proximity to the vehicle.

2.4.9. "*Specified maximum RCP operating range (S_{RCPmax})*" means the maximum distance between the nearest point of the motor vehicle and the remote control device up to which ACSF is designed to operate.

2.4.10. "*Specified maximum speed V_{smax}* " means the maximum speed up to which an ACSF is designed to operate.

2.4.11. "*Specified minimum speed V_{smin}*" means the minimum speed down to which an ACSF is designed to operate.

2.4.12. *"Specified maximum lateral acceleration ay_{smax}"* means the maximum lateral acceleration of the vehicle up to which an ACSF is designed to operate.

2.4.13. An ACSF is in "*off mode*" (or "*switched off*") when the function is prevented from generating a steering control action to assist the driver.

2.4.14. An ACSF is in "*standby mode*" when the function is switched on, but the conditions (e.g. system operating conditions, deliberate action from driver) for being active are not all met. In this mode, the system is not ready to generate a steering control action to assist the driver.

2.4.15. An ACSF is in "*active mode*" (or "*active*") when the function is switched on and the conditions for being active are met. In this mode, the system continuously or discontinuously controls the steering system is generating, or is ready to generate, a steering control action to assist the driver.

2.4.16. A "*Lane Change Procedure*" in the case of ACSF of Category C starts when the direction indicator lamps are activated by a deliberate action of the driver and ends when the direction indicator lamps are deactivated. It comprises the following operations:

(a) Activation of the direction indicator lamps by a deliberate action of the driver;

(b) Lateral movement of the vehicle towards the lane boundary;

(c) *Lane Change Manoeuvre*;

(d) Resumption of the lane keeping function;

(e) Deactivation of direction indicator lamps.

2.4.17. A "*Lane Change Manoeuvre*" is part of the *Lane Change Procedure* and,

(a) Starts when the outside edge of the tyre tread of the vehicle's front wheel closest to the lane markings touches the inside edge of the lane marking to which the vehicle is being manoeuvred,

(b) Ends when the rear wheels of the vehicle have fully crossed the lane marking.

2.5. Types of steering equipment

Depending on the way the steering forces are produced, the following types of equipment are distinguished:

2.5.1. For motor vehicles:

2.5.1.1. "*Main steering system*" means the steering equipment of a vehicle which is mainly responsible for determining the direction of travel. It may comprise:

2.5.1.1.1. "*Manual steering equipment*" in which the steering forces result solely from the muscular effort of the driver;

2.5.1.1.2. "*Power assisted steering equipment*" in which the steering forces result from both the muscular effort of the driver and the energy supply (supplies).

2.5.1.1.2.1. Steering equipment in which the steering forces result solely from one or more energy supplies when the equipment is intact, but in which the steering forces can be provided by the muscular effort of the driver alone if there is a fault in the steering (integrated power systems), is also considered to be power assisted steering equipment;

2.5.1.1.3. "*Full-power steering equipment*" in which the steering forces are provided solely by one or more energy supplies;

2.5.1.2. "*Self-tracking steering equipment*" means a system designed to create a change of steering angle on one or more wheels only when acted upon by forces and/or moments applied through the tyre to road contact.

2.5.1.3. "*Auxiliary Steering Equipment (ASE)*" means a system in which the wheels on axle(s) of vehicles of categories M and N are steered in addition to the wheels of the main steering equipment in the same or opposite direction to those of the main steering equipment and/or the steering angle of the front and/or the rear wheels may be adjusted relative to vehicle behaviour.

2.5.2. For trailers:

2.5.2.1. "*Self-tracking steering equipment*" means a system designed to create a change of steering angle on one or more wheels only when acted upon by forces and/or moments applied through the tyre to road contact.

2.5.2.2. "*Articulated steering*" means equipment in which the steering forces are produced by a change in direction of the towing vehicle and in which the movement of the steered trailer wheels is linked to the relative angle between the longitudinal axis of the towing vehicle and that of the trailer.

2.5.2.3. "*Self-steering*" means equipment in which the steering forces are produced by a change in direction of the towing vehicle and in which the movement of the steered trailer wheels is firmly linked to the relative angle between the longitudinal axis of the trailer frame or a load replacing it and the longitudinal axis of the sub-frame to which the axle(s) is (are) attached.

2.5.2.4. "*Additional steering equipment*" means a system, independent of the main steering system, by which the steering angle of one or more axle(s) of the steering system can be influenced selectively for manoeuvring purposes.

2.5.2.5. "*Full-power steering equipment*" means equipment in which the steering forces are provided solely by one or more energy supplies.

2.5.3. Depending on the arrangement of the steered wheels, the following types of steering equipment are distinguished:

2.5.3.1. "*Front-wheel steering equipment*" in which only the wheels of the front axle(s) are steered. This includes all wheels which are steered in the same direction;

2.5.3.2. "*Rear-wheel steering equipment*" in which only the wheels of the rear axle(s) are steered. This includes all wheels which are steered in the same direction;

2.5.3.3. "*Multi-wheel steering equipment*" in which the wheels of one or more of each of the front and the rear axle(s) are steered;

2.5.3.3.1. "*All-wheel steering equipment*" in which all the wheels are steered;

2.5.3.3.2. "*Buckle steering equipment*" in which the movement of chassis parts relative to each other is directly produced by the steering forces.

2.6. Types of steering transmission

Depending on the way the steering forces are transmitted, the following types of steering transmission are distinguished:

2.6.1. "*Purely mechanical steering transmission*" means a steering transmission in which the steering forces are transmitted entirely by mechanical means;

2.6.2. "*Purely hydraulic steering transmission*" means a steering transmission in which the steering forces, somewhere in the transmission, are transmitted only by hydraulic means;

2.6.3. "*Purely electric steering transmission*" means a steering transmission in which the steering forces, somewhere in the transmission, are transmitted only through electric means;

2.6.4. "*Hybrid steering transmission*" means a steering transmission in which part of the steering forces is transmitted through one and the other part through another of the above mentioned means. However, in the case where any mechanical part of the transmission is designed only to give position feedback and is too weak to transmit the total sum of the steering forces, this system shall be considered to be purely hydraulic or purely electric steering transmission.

2.7. "*Electric control line*" means the electrical connection which provides the steering control function to the trailer. It comprises the electrical wiring and connector and includes the parts for data communication and the electrical energy supply for the trailer control transmission.

3. Application for approval

3.1. The application for approval of a vehicle type with regard to the steering equipment shall be submitted by the vehicle manufacturer or by his duly accredited representative.

3.2. It shall be accompanied by the undermentioned documents in triplicate, and by the following particulars:

3.2.1. A description of the vehicle type with regard to the items mentioned in paragraph 2.2.; the vehicle type shall be specified;

3.2.2. A brief description of the steering equipment with a diagram of the steering equipment as a whole, showing the position on the vehicle of the various devices influencing the steering;

3.2.3. In the case of full power steering systems and systems to which Annex 6 of this Regulation applies, an overview of the system indicating the philosophy of the system and the fail-safe procedures, redundancies and warning systems necessary to ensure safe operation in the vehicle.

The necessary technical files relating to such systems shall be made available for discussion with the Type Approval Authority and/or Technical Service. Such files will be discussed on a confidential basis.

3.3. A vehicle representative of the vehicle type to be approved shall be submitted to the Technical Service responsible for conducting approval tests.

4. Approval

4.1. If the vehicle submitted for approval pursuant to this Regulation meets all relevant requirements given in this Regulation, approval of that vehicle type with regard to the steering equipment shall be granted.

4.1.1. The Type Approval Authority shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production as given in paragraph 7. of this Regulation, before type approval is granted.

4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 03) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign this number to another vehicle type or to the same vehicle type submitted with different steering equipment from that described in the documents required by paragraph 3.

4.3. Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the 1958 Agreement which apply this Regulation, by means of a form conforming to the model in Annex 1 to this Regulation.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.4.1. a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;[3]

4.4.2. the number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1.

4.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. need not be repeated; in such a case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

4.6. The approval mark shall be clearly legible and shall be indelible.

4.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.

4.8. Annex 2 to this Regulation gives examples of arrangements of approval marks.

5. Construction provisions

5.1. General provisions

5.1.1. The steering system shall ensure easy and safe handling of the vehicle up to its maximum design speed or in case of a trailer up to its technically permitted maximum speed. There

[3] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev. 6, Annex 3 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

shall be a tendency to self-centre when tested in accordance with paragraph 6.2. with the intact steering equipment. The vehicle shall meet the requirements of paragraph 6.2. in the case of motor vehicles and of paragraph 6.3. in the case of trailers. If a vehicle is fitted with an auxiliary steering system, it shall also meet the requirements of Annex 4. Trailers equipped with hydraulic steering transmissions shall comply also with Annex 5.

5.1.2. It shall be possible to travel along a straight section of road without unusual steering correction by the driver and without unusual vibration in the steering system at the maximum design speed of the vehicle.

5.1.3. The direction of operation of the steering control shall correspond to the intended change of direction of the vehicle and there shall be a continuous relationship between the steering control deflection and the steering angle. These requirements do not apply to systems that incorporate an automatically commanded or corrective steering function, or to ASE.

These requirements may also not necessarily apply in the case of full power steering when the vehicle is stationary, during low speed manoeuvres at speeds up to a maximum speed of 15 km/h and when the system is not energised.

5.1.4. The steering equipment shall be designed, constructed and fitted in such a way that it is capable of withstanding the stresses arising during normal operation of the vehicle, or combination of vehicles. The maximum steering angle shall not be limited by any part of the steering transmission unless specifically designed for this purpose. Unless otherwise specified, it will be assumed that for the purpose of this Regulation, not more than one failure can occur in the steering equipment at any one time and two axles on one bogie shall be considered as one axle.

5.1.5. The effectiveness of the steering equipment, including the electrical control lines, shall not be adversely affected by magnetic or electric fields. This shall be demonstrated by fulfilling the technical requirements and respecting the transitional provisions of UN Regulation No. 10 by applying:

(a) The 03 series of amendments for vehicles without a coupling system for charging the Rechargeable Electric Energy Storage System (traction batteries);

(b) The 04 series of amendments for vehicles with a coupling system for charging the Rechargeable Electric Energy Storage System (traction batteries).

5.1.6. Advanced driver assistance steering systems shall only be approved in accordance with this Regulation where the function does not cause any deterioration in the performance of the basic steering system. In addition they shall be designed such that the driver may, at any time and by deliberate action, override the function.

5.1.6.1. A CSF system shall be subject to the requirements of Annex 6.

5.1.6.1.1. Every CSF intervention shall immediately be indicated to the driver by an optical warning signal which is displayed for at least 1 s or as long as the intervention exists, whichever is longer.

5.1.6.1.2. In the case of a CSF intervention which is based on the evaluation of the presence and location of lane markings or boundaries of the lane the following shall apply additionally:

5.1.6.1.2.1. In the case of an intervention longer than:

(a) 10 s for vehicles of category M1 and N1, or

(b) 30 s for vehicles of category M2, M3 and N2, N3,

an acoustic warning signal shall be provided until the end of the intervention.

5.1.6.1.2.2. In the case of two or more consecutive interventions within a rolling interval of 180 seconds and in the absence of a steering input by the driver during the intervention, an acoustic warning signal shall be provided by the system during the second and any further intervention within a rolling interval of 180 seconds. Starting with the third intervention (and subsequent interventions) the acoustic warning signal shall continue for at least 10 seconds longer than the previous warning signal.

5.1.6.1.2.3. For vehicles of categories M2 and M3 equipped with a Lane Departure Warning System (LDWS) fulfilling the technical requirements of Regulation No. 130, the acoustic warning signal specified in paragraphs 5.1.6.1.2.1. and 5.1.6.1.2.2. may be replaced by a haptic warning, provided it is not solely given via the steering wheel.

5.1.6.1.3. The steering control effort necessary to override the directional control provided by the system shall not exceed 50 N in the whole range of CSF operations.

5.1.6.1.4. The requirements in paragraphs 5.1.6.1.1., 5.1.6.1.2. and 5.1.6.1.3. for CSF, which are reliant on the evaluation of the presence and location of lane markings or boundaries of the lane, shall be tested in accordance with the relevant vehicle test(s) specified in Annex 8 of this Regulation.

5.1.6.2. Vehicles equipped with an ESF shall fulfil the following requirements.

An ESF system shall be subject to the requirements of Annex 6.

5.1.6.2.1. Any ESF shall only start an intervention in the case where a risk of a collision is detected.

5.1.6.2.2 Any vehicle fitted with ESF shall be equipped with means to monitor the driving environment (e.g. lane markings, road edge, other road users) in line with the specified use case. These means shall monitor the driving environment at any time the ESF is active.

5.1.6.2.3. An automatic avoidance manoeuvre initiated by an ESF shall not lead the vehicle to leave the road.

5.1.6.2.3.1. In the case of an ESF intervention on a road or a lane delimited with lane markings on one or both side(s), an automatic avoidance manoeuver initiated by an ESF shall not lead the vehicle to cross a lane marking. However, if the intervention starts during a lane change performed by the driver or during an unintentional drift into the adjacent lane, the system may steer the vehicle back into its original lane of travel.

5.1.6.2.3.2. In the absence of a lane marking on one or on both side(s) of the vehicle, a single ESF intervention is permitted, provided that it does not produce a lateral offset of the vehicle greater than 0.75 m in a direction where the lane marking is absent. The lateral offset during the automatic avoidance manoeuvre shall be determined using a fixed point on the front of the vehicle at the start and at the conclusion of the ESF intervention.

5.1.6.2.4. The ESF intervention shall not lead the vehicle to collide with another road user.[4]

5.1.6.2.5. The manufacturer shall demonstrate during type approval, to the satisfaction of the Technical Service, which means to monitor the driving environment are fitted to the vehicle to satisfy the provisions in the subparagraphs of paragraph 5.1.6.2. above.

[4] Until uniform test procedures have been agreed, the manufacturer shall provide the Technical Service with documentation and supporting evidence to demonstrate compliance with this provision. This information shall be subject to discussion and agreement between the Technical Service and the vehicle manufacturer.

5.1.6.2.6. Any intervention of an ESF shall be indicated to the driver with an optical and with an acoustic or haptic warning signal to be provided at the latest with the start of the ESF intervention and maintained as long as the intervention exists.

For this purpose appropriate signals used by other warning systems (e.g. blind spot detection, lane departure warning, forward collision warning) are deemed to be sufficient to fulfil the requirements for the respective optical, acoustic or haptic signals above.

5.1.6.2.7. A system failure shall be indicated to the driver with an optical warning signal. However, when the system is manually deactivated, the indication of failure mode may be suppressed.

5.1.6.2.8. The steering control effort necessary to override the directional control provided by the system shall not exceed 50 N.

5.1.6.2.9. The vehicle shall be tested in accordance with the relevant vehicle tests specified in Annex 8 of this UN Regulation.

5.1.6.2.10. System information data

The following data shall be provided, together with the documentation package required in Annex 6 of this UN Regulation, to the Technical Service at the time of type approval:

(a) Use case(s) where ESF is designed to operate (among the use cases a i, a ii, a iii and b. specified in the ESF definition in paragraph 2.3.4.3.),

(b) The conditions under which the system is active, e.g. the vehicle speed range Vsmax , Vsmin,

(c) How ESF detects a risk of a collision,

(d) Description of the means to detect the driving environment,

(e) How to deactivate/reactivate the function,

(f) How it is ensured that the overriding force does not exceed the limit of 50 N.

5.1.7. Towing vehicles equipped with a connection to supply electrical energy to the steering system of the trailer and trailers that utilise electrical energy from the towing vehicle to power the trailer steering system shall fulfil the relevant requirements of Annex 7.

5.1.8. Steering transmission

5.1.8.1. Adjustment devices for steering geometry shall be such that after adjustment a positive connection can be established between the adjustable components by appropriate locking devices.

5.1.8.2. Steering transmission which can be disconnected to cover different configurations of a vehicle (e.g. on extendable semi-trailers), shall have locking devices which ensure positive relocation of components; where locking is automatic, there shall be an additional safety lock which is operated manually.

5.1.9. Steered wheels

The steered wheels shall not be solely the rear wheels. This requirement does not apply to semi-trailers.

5.1.10. Energy supply

The same energy supply may be used for the steering equipment and other systems. However, in the case of a failure in any system which shares the same energy supply steering shall be ensured in accordance with the relevant failure conditions of paragraph 5.3.

5.1.11. Control systems

The requirements of Annex 6 shall be applied to the safety aspects of electronic vehicle control systems that provide or form part of the control transmission of the steering function including advanced driver assistance steering systems. However, systems or functions, that use the steering system as the means of achieving a higher level objective, are subject to Annex 6 only insofar as they have a direct effect on the steering system. If such systems are provided, they shall not be deactivated during type approval testing of the steering system.

5.2. Special provisions for trailers

5.2.1. Trailers (with the exception of semi-trailers and centre-axle trailers) which have more than one axle with steered wheels and semi-trailers and centre-axle trailers which have at least one axle with steered wheels shall fulfil the conditions given in paragraph 6.3. However, for trailers with self-tracking steering equipment a test under paragraph 6.3. is not necessary if the axle load ratio between the un-steered and the self-tracking axles equals or exceeds 1.6. under all loading conditions.

However for trailers with self-tracking steering equipment, the axle load ratio between un-steered or articulated steered axles and friction-steered axles shall be at least 1 under all loading conditions.

5.2.2. If the towing vehicle of a vehicle combination is driving straight ahead, the trailer and towing vehicle shall remain aligned. If alignment is not retained automatically, the trailer shall be equipped with a suitable adjustment facility for maintenance.

5.3. Failure provisions and performance

5.3.1. General

5.3.1.1. For the purposes of this Regulation the steered wheels, the steering control and all mechanical parts of the steering transmission shall not be regarded as liable to breakage if they are amply dimensioned, are readily accessible for maintenance, and exhibit safety features at least equal to those prescribed for other essential components (such as the braking system) of the vehicle. Where the failure of any such part would be likely to result in loss of control of the vehicle, that part shall be made of metal or of a material with equivalent characteristics and shall not be subject to significant distortion in normal operation of the steering system.

5.3.1.2. The requirements of paragraphs 5.1.2., 5.1.3. and 6.2.1. shall also be satisfied with a failure in the steering equipment as long as the vehicle can be driven with the speeds required in the respective paragraphs.

In this case paragraph 5.1.3. shall not apply for full power steering systems when the vehicle is stationary.

5.3.1.3. Any failure in a transmission other than purely mechanical shall clearly be brought to the attention of the vehicle driver as given in paragraph 5.4. When a failure occurs, a change in the average steering ratio is permissible if the steering effort given in paragraph 6.2.6. is not exceeded.

5.3.1.4. In the case where the braking system of the vehicle shares the same energy source as the steering system and this energy source fails, the steering system shall have priority and shall be capable of meeting the requirements of paragraphs 5.3.2. and 5.3.3. as applicable. In addition the braking performance on the first subsequent application, shall not drop below the prescribed service brake performance, as given in paragraph 2. of Annex 3 of this Regulation.

5.3.1.5. In the case where the braking system of the vehicle shares the same energy supply as the steering system and there is a failure in the energy supply, the steering system shall have

priority and shall be capable of meeting the requirements of paragraphs 5.3.2. and 5.3.3. as applicable. In addition the braking performance on the first subsequent application shall comply with the prescriptions of paragraph 3. of Annex 3 of this Regulation.

5.3.1.6. The requirements for the braking performance in paragraphs 5.3.1.4. and 5.3.1.5. above shall not apply if the braking system is such that in the absence of any energy reserve it is possible with the service brake control to achieve the safety requirement for the secondary braking system mentioned in:

(a) Paragraph 2.2. of UN Regulation No. 13-H, Annex 3 (for M_{1-} and N_{1-} vehicles);

(b) Paragraph 2.2. of UN Regulation No. 13, Annex 4 (for M_{2-}, M_{3-} and N- vehicles).

5.3.1.7. In the case of trailers the requirements of paragraphs 5.2.2. and 6.3.4.1. shall also be met when there is a failure in the steering system.

5.3.2. Power assisted steering systems

5.3.2.1. Should the engine stop or a part of the transmission fail, with the exception of those parts listed in paragraph 5.3.1.1., there shall be no immediate changes in steering angle. As long as the vehicle is capable of being driven at a speed greater than 10 km/h the requirements given in paragraph 6., relating to a system with a failure, shall be met.

5.3.3. Full power steering systems

5.3.3.1. The system shall be designed such that the vehicle cannot be driven indefinitively at speeds above 10 km/h where there is any fault which requires operation of the warning signal referred to in paragraph 5.4.2.1.1.

5.3.3.2. In case of a failure within the control transmission, with the exception of those parts listed in paragraph 5.1.4., it shall still be possible to steer with the performance laid down in paragraph 6. for the intact steering system.

5.3.3.3. In the event of a failure of the energy source of the control transmission, it shall be possible to carry out at least 24 "figure of eight" manoeuvres, where each loop of the figure is 40 m diameter at 10 km/h speed and at the performance level given for an intact system in paragraph 6. The test manoeuvres shall begin at an energy storage level given in paragraph 5.3.3.5.

5.3.3.4. In the event of a failure within the energy transmission, with the exception of those parts listed in paragraph 5.3.1.1., there shall not be any immediate changes in steering angle. As long as the vehicle is capable of being driven at a speed greater than 10 km/h the requirements of paragraph 6. for the system with a failure shall be met after the completion of at least 25 "figure of eight" manoeuvres at 10 km/h minimum speed, where each loop of the figure is 40 m diameter.

The test manoeuvres shall begin at an energy storage level given in paragraph 5.3.3.5.

5.3.3.5. The energy level to be used for the tests referred to in paragraphs 5.3.3.3. and 5.3.3.4. shall be the energy storage level at which a failure is indicated to the driver.

In the case of electrically powered systems subject to Annex 6, this level shall be the worst case situation outlined by the manufacturer in the documentation submitted in connection with Annex 6 and shall take into account the effects of e.g. temperature and ageing on battery performance.

5.4. Warning signals

5.4.1. General provisions

5.4.1.1. Any fault which impairs the steering function and is not mechanical in nature shall be signalled clearly to the driver of the vehicle.

Despite the requirements of paragraph 5.1.2. the deliberate application of vibration in the steering system may be used as an additional indication of a fault condition in this system.

In the case of a motor vehicle, an increase in steering force is considered to be a warning indication; in the case of a trailer, a mechanical indicator is permitted.

5.4.1.2. Optical warning signals shall be visible, even by daylight and distinguishable from other alerts; the satisfactory condition of the signals shall be easily verifiable by the driver from the driver's seat; the failure of a component of the warning devices shall not entail any loss of the steering system's performance.

5.4.1.3. Acoustic warning signals shall be by continuous or intermittent sound signal or by vocal information. Where vocal information is employed, the manufacturer shall ensure that the alert uses the language(s) of the market into which the vehicle is sold.

Acoustic warning signals shall be easily recognized by the driver.

5.4.1.4. If the same energy source is used to supply the steering system and other systems, an acoustic or optical warning shall be given to the driver, when the stored energy/fluid in the energy/storage reservoir drops to a level liable to cause an increase in steering effort. This warning may be combined with a device provided to warn of brake failure if the brake system uses the same energy source. The satisfactory condition of the warning device shall be easily verifiable by the driver.

5.4.2. Special provisions for full-power steering equipment

5.4.2.1. Power-driven vehicles shall be capable of providing steering failure and defect warning signals, as follows:

5.4.2.1.1. A red warning signal, indicating failures defined in paragraph 5.3.1.3. within the main steering equipment;

5.4.2.1.2. Where applicable, a yellow warning signal indicating an electrically detected defect within the steering equipment, which is not indicated by the red warning signal;

5.4.2.1.3. If a symbol is used, it shall comply with symbol J 04, ISO/IEC registration number 7000-2441 as defined in ISO 2575:2000;

5.4.2.1.4. The warning signal(s) mentioned above shall light up when the electrical equipment of the vehicle (and the steering system) is energised. With the vehicle stationary, the steering system shall verify that none of the specified failures or defects is present before extinguishing the signal.

Specified failures or defects which should activate the warning signal mentioned above, but which are not detected under static conditions, shall be stored upon detection and be displayed at start-up and at all times when the ignition (start) switch is in the "on" (run) position, as long as the failure persists.

5.4.3. In the case where additional steering equipment is in operation and/or where the steering angle generated by that equipment has not been returned to normal driving position a warning signal shall be given to the driver.

5.5. Provisions for the periodic technical inspection of steering equipment

5.5.1. As far as practicable and subject to agreement between the vehicle manufacturer and the Type Approval Authority, the steering equipment and its installation shall be so designed that,

without disassembly, its operation can be checked with, if necessary, commonly used measuring instruments, methods or test equipment.

5.5.2. It shall be possible to verify in a simple way the correct operational status of those Electronic Systems, which have control over steering. If special information is needed, this shall be made freely available.

5.5.2.1. At the time of type approval the means implemented to protect against simple unauthorized modification to the operation of the verification means chosen by the manufacturer (e.g. warning signal) shall be confidentially outlined.

Alternatively this protection requirement is fulfilled when a secondary means of checking the correct operational status is available.

5.6. Provisions for ACSF

Any ACSF shall be subject to the requirements of Annex 6.

5.6.1. Special provisions for ACSF of Category A

Any ACSF of Category A shall fulfil the following requirements.

5.6.1.1. General

5.6.1.1.1. The system shall only operate until 10 km/h (+2 km/h tolerance)

5.6.1.1.2. The system shall be active only after a deliberate action of the driver and if the conditions for operation of the system are fulfilled (all associated functions – e.g. brakes, accelerator, steering, camera/radar/lidar – are working properly).

5.6.1.1.3. The system shall be able to be deactivated by the driver at any time.

5.6.1.1.4. In case the system includes accelerator and/or braking control of the vehicle, the vehicle shall be equipped with a means to detect an obstacle (e.g. vehicles, pedestrian) in the manoeuvring area and to bring the vehicle immediately to a stop to avoid a collision.[5]

5.6.1.1.5. Whenever the system becomes operational, this shall be indicated to the driver. Any termination of control shall produce a short but distinctive driver warning by an optical warning signal and either an acoustic warning signal or by imposing a haptic warning signal (except for the signal on the steering control in parking manoeuvring).

For RCP, the requirements for driver warning shown above shall be fulfilled by the provision of an optical warning signal at least at the remote control device.

5.6.1.2. Additional provisions for RCP

5.6.1.2.1. The parking manoeuvre shall be initiated by the driver but controlled by the system. A direct influence on steering angle, value of acceleration and deceleration via the remote control device shall not be possible.

5.6.1.2.2. A continuous actuation of the remote control device by the driver is required during the parking manoeuvre.

5.6.1.2.3. If the continuous actuation is interrupted or the distance between vehicle and remote control device exceeds the specified maximum RCP operating range (S_{RCPmax}) or the signal between remote control and vehicle is lost, the vehicle shall stop immediately.

[5] Until uniform test procedures have been agreed, the manufacturer shall provide the Technical Service the documentation and supporting evidence to demonstrate compliance with these provisions. This information shall be subject to discussion and agreement between the Technical Service and vehicle manufacturer.

5.6.1.2.4. If a door or trunk of the vehicle is opened during the parking manoeuvre, the vehicle shall stop immediately.

5.6.1.2.5. If the vehicle has reached its final parking position, either automatically or by confirmation from the driver, and the start/run switch is in the off position, the parking braking system shall be automatically engaged.

5.6.1.2.6 At any time during a parking manoeuvre that the vehicle becomes stationary, the RCP function shall prevent the vehicle from rolling away.

5.6.1.2.7. The specified maximum RCP operating range shall not exceed 6 m.

5.6.1.2.8. The system shall be designed to be protected against unauthorized activation or operation of the RCP systems and interventions into the system.

5.6.1.3. System information data

5.6.1.3.1. Following data shall be provided together with the documentation package required in Annex 6 of this Regulation to the Technical Service at the time of type approval :

5.6.1.3.1.1. The value for the specified maximum RCP operating range (S_{RCPmax});

5.6.1.3.1.2. The conditions under which the system can be activated, i. e. when the conditions for operation of the system are fulfilled;

5.6.1.3.1.3. For RCP systems the manufacturer shall provide the technical authorities with an explanation how the system is protected against unauthorized activation.

5.6.2. Special Provisions for ACSF of Category B1

Any ACSF of Category B1 shall fulfil the following requirements.

5.6.2.1. General

5.6.2.1.1. The activated system shall at any time, within the boundary conditions, ensure that the vehicle does not cross a lane marking for lateral accelerations below the maximum lateral acceleration specified by the manufacturer ay_{smax}.

It is recognised that the maximum lateral acceleration specified by the vehicle manufacturer ay_{smax} may not be achievable under all conditions (e.g. inclement weather, different tyres fitted to the vehicle, laterally sloped roads). The system shall not deactivate or unreasonably switch the control strategy in these other conditions.2.4.

The system may exceed the specified value ay_{smax} by not more than 0.3 m/s2, while not exceeding the maximum value specified in the table in paragraph 5.6.2.1.3. of this Regulation.

Notwithstanding the sentence above, for time periods of not more than 2 s the lateral acceleration of the system may exceed the specified value ay_{smax} by not more than 40 per cent, while not exceeding the maximum value specified in the table in paragraph 5.6.2.1.3. of this Regulation by more than 0.3 m/s2."

5.6.2.1.2. The vehicle shall be equipped with a means for the driver to activate (standby mode) and deactivate (off mode) the system. It shall be possible to deactivate the system at any time by a single action of the driver. Following this action, the system shall only become active again as a result of a deliberate action by the driver.

5.6.2.1.3. The system shall be designed so that excessive intervention of steering control is suppressed to ensure the steering operability by the driver and to avoid unexpected vehicle behaviour, during its operation. To ensure this, the following requirements shall be fulfilled:

(a) The steering control effort necessary to override the directional control provided by the system shall not exceed 50 N;

(b) The specified maximum lateral acceleration ay_{smax} shall be within the limits as defined in the following table:

(c) The moving average over half a second of the lateral jerk generated by the system shall not exceed 5 m/s³.

5.6.2.1.4. The requirements in paragraphs 5.6.2.1.1. and 5.6.2.1.3. of this Regulation shall be tested in accordance with relevant vehicle test(s) specified in Annex 8 of this Regulation.

5.6.2.2. ACSF of Category B1 operation

5.6.2.2.1. If the system is active an optical signal shall be provided to the driver.

5.6.2.2.2. When the system is in standby mode, an optical signal shall be provided to the driver.

5.6.2.2.3. When the system reaches its boundary conditions set out in paragraph 5.6.2.3.1.1. of this Regulation (e.g. the specified maximum lateral acceleration ay_{smax}) and both in the absence of any driver input to the steering control and when any front tyre of the vehicle starts to cross the lane marking, the system shall continue to provide assistance and shall clearly inform the driver about this system status by an optical warning signal and additionally by an acoustic or haptic warning signal.

Table 1

For vehicles of category M_1, N_1

Speed range	*10 - 60 km/h*	*> 60 - 100 km/h*	*> 100 - 130 km/h*	*> 130 km/h*
Maximum value for the specified maximum lateral acceleration	3 m/s²	3 m/s²	3 m/s²	3 m/s²
Minimum value for the specified maximum lateral acceleration	0 m/s²	0.5 m/s²	0.8 m/s²	0.3 m/s²

For vehicles of category M_2, M_3, N_2, N_3

Speed range	*10 - 30 km/h*	*> 30 - 60 km/h*	*> 60 km/h*
Maximum value for the specified maximum lateral acceleration	2.5 m/s²	2.5 m/s²	2.5 m/s²
Minimum value for the specified maximum lateral acceleration	0 m/s²	0.3 m/s²	0.5 m/s²

For vehicles of categories M_2 M_3 N_2 and N_3, the warning requirement above is deemed to be fulfilled if the vehicle is equipped with a Lane Departure Warning System (LDWS) fulfilling the technical requirements of UN Regulation No. 130.

5.6.2.2.4. A system failure shall be signalled to the driver by an optical warning signal. However, when the system is manually deactivated by the driver, the indication of the failure may be suppressed.

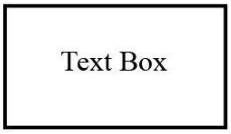
5.6.2.2.5. When the system is active and in the speed range between 10 km/h or V_{smin}, whichever is higher, and V_{smax}, it shall provide a means of detecting that the driver is holding the steering control.

If, after a period of no longer than 15 seconds the driver is not holding the steering control, an optical warning signal shall be provided. This signal may be the same as the signal specified below in this paragraph.

The optical warning signal shall indicate to the driver to place their hands on the steering control. It shall consist of pictorial information showing hands and the steering control and may be accompanied by additional explanatory text or warning symbols - see examples below:

Example 1.

Example 2.



If, after a period of no longer than 30 seconds the driver is not holding the steering control, at least the hands or steering control in the pictorial information provided as optical warning signal shall be shown in red and an acoustic warning signal shall be provided.

The warning signals shall be active until the driver is holding the steering control, or until the system is deactivated, either manually or automatically.

The system shall be automatically deactivated at the latest 30 seconds after the acoustic warning signal has started. After deactivation the system shall clearly inform the driver about the system status by an acoustic emergency signal which is different from the previous acoustic warning signal, for at least five seconds or until the driver holds the steering control again.

The above requirements shall be tested in accordance with the relevant vehicle test(s) specified in Annex 8 of this Regulation.

5.6.2.2.6. Unless otherwise specified, the optical signals described in paragraph 5.6.2.2. shall all be different from each other (e.g. different symbol, colour, blinking, text).

5.6.2.3. System information data

5.6.2.3.1. Following data shall be provided together with the documentation package required in Annex 6 of this regulation to the Technical Service at the time of type approval;

5.6.2.3.1.1. The conditions under which the system can be activated and the boundaries for operation (boundary conditions). The vehicle manufacturer shall provide values for V_{smax} , V_{smin} and ay_{smax} for every speed range as mentioned in the table of paragraph 5.6.2.1.3. of this Regulation;

5.6.2.3.1.2. Information about how the system detects that the driver is holding the steering control.

5.6.2.3.1.3. Information about inputs other than lane markings (e.g. road boundaries, infrastructural separation, surrounding traffic, map data) that the system uses to reliably determine the course of the lane

5.6.3. (Reserved for ACSF of Category B2)

5.6.4. Special Provisions for ACSF of Category C

Vehicles equipped with an ACSF system of Category C shall fulfil the following requirements.

5.6.4.1. General

5.6.4.1.1. A vehicle equipped with an ACSF of Category C shall also be equipped with an ACSF of Category B1 complying with the requirements of this Regulation.

5.6.4.1.2. When the ACSF of Category C is activated (standby) the ACSF of Category B1 shall aim to center the vehicle in the lane.

This shall be demonstrated to the Technical Service during type approval.

5.6.4.2. Activation/deactivation of the ACSF of Category C system

5.6.4.2.1. The default status of the system shall be off at the initiation of each new engine start/run cycle.

This requirement does not apply when a new engine start/run cycle is performed automatically, e.g. the operation of a stop/start system.

5.6.4.2.2. The vehicle shall be equipped with a means for the driver to activate (standby mode) and deactivate (off mode) the system. The same means as for an ACSF of Category B1 may be used.

5.6.4.2.3. The system shall only be activated (standby mode) after a deliberate action by the driver.

Activation by the driver shall only be possible on roads where pedestrians and cyclists are prohibited and which, by design, are equipped with a physical separation that divides the traffic moving in opposite directions and which have at least two lanes in the direction the vehicles are driving. These conditions shall be ensured by the use of at least two independent means.

In the case of a transition from a road type with a classification permitting an ACSF of Category C, to a type of road where an ACSF of Category C is not permitted, the system shall be deactivated automatically (off mode).

5.6.4.2.4. It shall be possible to deactivate the system (off mode) at any time by a single action of the driver. Following this action, the system shall only be able to be reactivated (standby mode) by a deliberate action of the driver.

5.6.4.2.5. Notwithstanding the requirements above it shall be possible to perform the corresponding tests in Annex 8 of this Regulation on a test track.

5.6.4.3. Overriding

A steering input by the driver shall override the steering action of the system. The steering control effort necessary to override the directional control provided by the system shall not exceed 50 N.

The system may remain activated (standby mode) provided that priority is given to the driver during the overriding period.

5.6.4.4. Lateral acceleration

The lateral acceleration induced by the system during the lane change manoeuvre:

(a) Shall not exceed 1 m/s^2 in addition to the lateral acceleration generated by the lane curvature, and

(b) Shall not cause the total vehicle lateral acceleration to exceed the maximum values indicated in tables of paragraph 5.6.2.1.3. above.

The moving average over half a second of the lateral jerk generated by the system shall not exceed 5 m/s^3.

5.6.4.5. Human Machine Interface (HMI)

5.6.4.5.1. Unless otherwise specified, the optical signals identified in paragraph 5.6.4.5. shall be easily distinguishable from each other (e.g. different symbol, colour, blinking, text).

5.6.4.5.2. When the system is in standby mode (i.e. ready to intervene), an optical signal shall be provided to the driver.

5.6.4.5.3. When the lane change procedure is ongoing an optical signal shall be provided to the driver.

5.6.4.5.4. When the lane change procedure is suppressed, in accordance with paragraph 5.6.4.6.8., the system shall clearly inform the driver about this system status by an optical warning signal and additionally by an acoustic or haptic warning signal. In case the suppression is initiated by the driver, an optical warning is sufficient.

5.6.4.5.5. A system failure shall be signalled immediately to the driver by an optical warning signal. However, when the system is manually deactivated by the driver, the indication of failure mode may be suppressed.

If a system failure occurs during a lane change manoeuvre, the failure shall be signalled to the driver by an optical, and an acoustic or haptic warning.

5.6.4.5.6. The system shall provide a means of detecting that the driver is holding the steering control and shall warn the driver in accordance with the warning strategy below:

If, after a period of no longer than 3s after the initiation of the lane change procedure and before the start of the lane change manoeuvre, the driver is not holding the steering control, an optical warning signal shall be provided. This signal shall be the same as the signal specified in paragraph 5.6.2.2.5. above.

The warning signal shall be active until the driver is holding the steering control, or until the system is deactivated, either manually or automatically according to 5.6.4.6.8.

5.6.4.6. Lane Change Procedure

5.6.4.6.1. The initiation of a lane change procedure of an ACSF of Category C shall only be possible if an ACSF of Category B1 is already active.

5.6.4.6.2. The lane change procedure requires, and shall start immediately after, a manual activation by the driver of the direction indicator to the intended side for the lane change.

5.6.4.6.3. When the lane change procedure starts, the ACSF of Category B1 shall be suspended and the ACSF of Category C shall carry on the lane keeping function of ACSF of category B1, until the lane change manoeuvre starts.

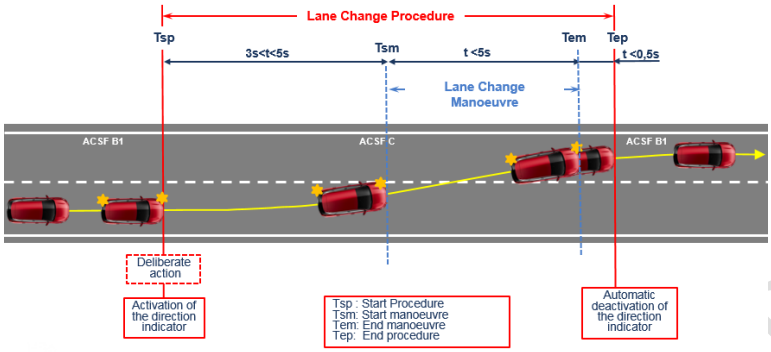
5.6.4.6.4. The lateral movement of the vehicle towards the intended lane shall not start earlier than 1.0 second after the start of the lane change procedure. Additionally, the lateral movement to approach the lane marking and the lateral movement necessary to complete the lane change manoeuvre shall be completed as one continuous movement.

The lane change manoeuvre shall be initiated either automatically or by a second deliberate action of the driver. A vehicle shall not be equipped with both these means of initiation.

5.6.4.6.4.1. Automatic initiation of the lane change manoeuvre

In case of an automatic initiation the lane change manoeuvre shall commence between 3.0 seconds and 5.0 seconds after the manual activation of the procedure as described in paragraph 5.6.4.6.2. and shown in the Figure below.

ACSF C – Case where the lateral movement is initiated automatically (1 Step HMI)

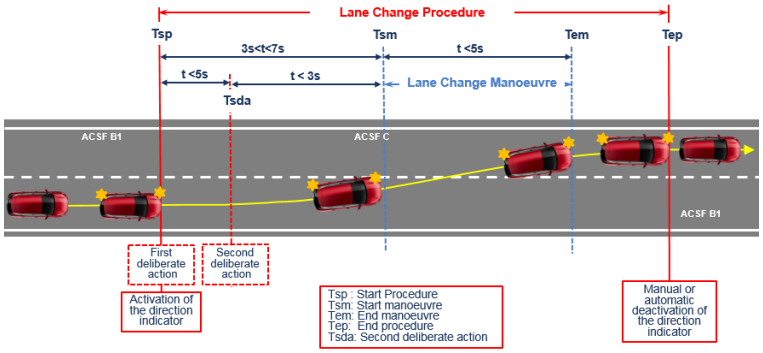


5.6.4.6.4.2. Initiation of the lane change manoeuvre by a second deliberate action

In case of an initiation by a second deliberate action the lane change manoeuvre shall commence between 3.0 and 7.0 seconds after the manual activation of the procedure as described in paragraph 5.6.4.6.2.

Additionally, the lane change manoeuvre shall commence at the latest 3.0 seconds after the second deliberate action as shown in the Figure below.

ACSF C – Case where the lateral movement is initiated by a second deliberate action by the driver (2 Step HMI)



The control to operate the second deliberate action shall be located in the steering control area.

5.6.4.6.5. The lane change manoeuvre shall be completed in less than:

(a) 5 seconds for M_1, N_1 vehicle categories;

(b) 10 seconds for M_2, M_3, N_2, N_3 vehicle categories.

5.6.4.6.6. Once the lane change manoeuvre has completed, ACSF of Category B1 lane keeping function shall resume automatically.

5.6.4.6.7. The direction indicator shall remain active throughout the whole period of the lane change manoeuvre and shall be automatically deactivated by the system no later than 0.5 seconds after the resumption of ACSF of Category B1 lane keeping function as described in paragraph

5.6.4.6.6. above. Automatic deactivation by the system of the direction indicator is required only if the lane change manoeuvre is initiated automatically, and if the direction indicator control is not fully engaged (latched position) during the lane change manoeuvre.

5.6.4.6.8. Suppression of the Lane Change Procedure

5.6.4.6.8.1. The lane change procedure shall be suppressed automatically by the system when at least one of the following situations occurs before the lane change manoeuvre has started:

(a) The system detects a critical situation (as defined in paragraph 5.6.4.7.),

(b) The system is overridden or switched off by the driver,

(c) The system reaches its boundaries (e.g., lane markings are no longer detected),

(d) The system has detected that the driver is not holding the steering control at the start of the lane change manoeuvre,

(e) The direction indicator lamps are manually deactivated by the driver,

(f) Following the deliberate action of the driver to start the procedure described in paragraph 5.6.4.6.2., the lane change manoeuvre has not commenced:

(i) At the latest after 5.0 seconds, in the case of an automatic initiation,

(ii) At the latest after 7.0 seconds, in the case of an initiation by a second deliberate action,

(iii) At the latest after 3.0 seconds after the second deliberate action, in the case of an initiation by a second deliberate action,

whatever is appropriate

(g) The system, with an initiation of the lane change manoeuvre by a second deliberate action, has not detected the second deliberate action at the latest 5.0 seconds after the start of the lane change procedure.

(h) The lateral movement described in paragraph 5.6.4.6.4. is not continuous.

5.6.4.6.8.2. Manual deactivation of the lane change procedure, using the manual control of the direction indicator, shall be possible for the driver at any time.

5.6.4.7. Critical situation

A situation is deemed to be critical when, at the time a lane change manoeuvre starts, an approaching vehicle in the target lane would have to decelerate at a higher level than 3m/s², 0.4 seconds after the lane change manoeuvre has started, to ensure the distance between the two vehicles is never less than that which the lane change vehicle travels in 1 second.

The resulting critical distance at the start of the lane change manoeuvre shall be calculated using the following formula:

$$S_{critical} = (v_{rear} - v_{ACSF}) * t_B + (v_{rear} - v_{ACSF})^2 / (2 * a) + v_{ACSF} * t_G$$

Where:

v_{rear} is The actual speed of the approaching vehicle or 130 km/h whatever value is lower

v_{ACSF} is The actual speed of the ACSF vehicle

a = 3 m/s² (Deceleration of the approaching vehicle)

t_B = 0.4 s (Time after the start of the lane change manoeuvre at which the deceleration of the approaching vehicle starts)

t_G = 1 s (Remaining gap of the vehicles after the deceleration of the approaching vehicle).

5.6.4.8. Minimum distance and minimum operation speed

5.6.4.8.1. The ACSF of Category C shall be able to detect vehicles approaching from the rear in an adjacent lane up to a distance S_{rear} as specified below:

The minimum distance S_{rear} shall be declared by the vehicle manufacturer. The declared value shall not be less than 55 m.

The declared distance shall be tested according to the relevant test in Annex 8 using a two-wheeled motor vehicle of Category L_3[1] as the approaching vehicle.

The minimum operation speed V_{smin} , down to which the ACSF of Category C is permitted to perform a lane change manoeuvre, shall be calculated with minimum distance S_{rear} using the following formula:

$$V_{Smin} = a * (t_B - t_G) + v_{app} - \sqrt{a^2 * (t_B - t_G)^2 - 2 * a * (v_{app} * t_G - S_{rear})}$$

Where:

S_{rear} is The minimum distance declared by the manufacturer in [m];

V_{app} = 36.1 m/s (The speed of the approaching vehicle is 130 km/h *i.e.* 36.1 m/s);

a = 3 m/s² (Deceleration of the approaching vehicle);

t_B = 0.4 s (Time after the start of the manoeuvre at which the deceleration of the approaching vehicle starts);

t_G = 1 s (Remaining gap of the vehicles after the deceleration of the approaching vehicle);

V_{smin} in [m/s] is The resulting minimum activation speed of the ACSF of Category C.

If the vehicle is operated in a country with a general maximum speed limit below 130 km/h, this speed limit may be used as an alternative for V_{app} in the above formula to calculate the minimum operation speed V_{smin}. In this case the vehicle shall be equipped with a means to detect the country of the operation and shall have information available on the general maximum speed limit of this country.

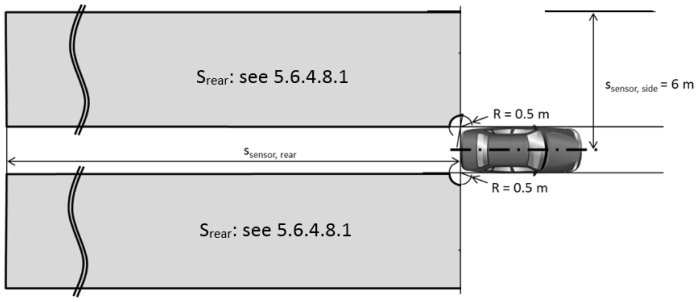
Notwithstanding the requirements above in this paragraph, the ACSF of Category C is permitted to perform a lane change manoeuvre at speeds lower than the calculated V_{smin} provided that the following conditions are met:

(a) The system has detected another vehicle in the adjacent lane into which the lane change is planned at a distance lower than S_{rear} ; and

(b) The situation is not deemed to be critical according to paragraph 5.6.4.7. (e.g. at low speed differences and V_{app}< 130 km/h);

(c) The declared value S_{rear} is greater than the calculated value $S_{critical}$ from paragraph 5.6.4.7. above.

5.6.4.8.2. The vehicle system detection area on ground level shall be at minimum as shown in the figure below.



5.6.4.8.3. After each vehicle new engine start/run cycle (other than when performed automatically, e.g. the operation of a stop/start systems), the ACSF of Category C function shall be prevented from performing a lane change manoeuvre until the system has detected, at least once, a moving object at a distance greater than the minimum distance S_{rear} declared by the manufacturer in paragraph 5.6.4.8.1. above.

5.6.4.8.4. The ACSF of Category C shall be able to detect blindness of the sensor (e.g. due to accumulation of dirt, ice or snow). The ACSF of Category C shall be prevented, upon detection of blindness, from performing the lane change manoeuvre. The status of the system shall be signalled to the driver no later than on the initiation of the lane change procedure. The same warning as the one specified in paragraph 5.6.4.5.5. (system failure warning) may be used.

5.6.4.9. System information data

5.6.4.9.1. The following data shall be provided, together with the documentation package required in Annex 6 of this Regulation, to the Technical Service at the time of type approval.

5.6.4.9.1.1. The conditions under which the system can be activated and the boundaries for operation (boundary conditions). The vehicle manufacturer shall provide values for V_{smax} , V_{smin} and ay_{smax} for every speed range as mentioned in the table of paragraph 5.6.2.1.3. of this Regulation.

5.6.4.9.1.2. Information about how the system detects that the driver is holding the steering control.

5.6.4.9.1.3. The means to override and to suppress or cancel.

5.6.4.9.1.4. Information about how the failure warning signal status and the confirmation of the valid software version related ACSF performance can be checked via the use of an electronic communication interface.[6]

5.6.4.9.1.5. Documentation about which system software version related ACSF performance is valid. This documentation shall be updated whenever a software version was amended. [6]

5.6.4.9.1.6. Information on the sensor range over lifetime. The sensor range shall be specified in such way that any influence on deterioration of the sensor shall not affect the fulfilment of paragraphs 5.6.4.8.3. and 5.6.4.8.4. of this Regulation.

5.6.4.10. The vehicle with ACSF of Category C shall be tested in accordance with relevant vehicle test(s) specified in Annex 8 to this Regulation. For driving situations not covered by the tests

[6] This paragraph shall be reviewed once the Task Force on Cyber Security and Over the Air issues (TF CS/OTA) reporting to the World Forum for the Harmonization of Vehicle Regulations (WP.29) Informal Working Group on Intelligent Transport Systems / Automated Driving has finalized its work on measures for software identification and, if necessary, amended accordingly.

of Annex 8, the safe operation of the ACSF shall be demonstrated by the vehicle manufacturer on the base of Annex 6 of this Regulation.

5.7. Provisions for RCM fitted to vehicles of category M1 and N1.

Any RCM shall be subject to the requirements of Annex 6.

5.7.1. Vehicles of category M1 and N1 meeting the requirements of Category G may be equipped with RCM provided the system fulfils the following requirements.

5.7.1.1. The RCM function shall consist of software and hardware on a vehicle that enables the vehicle to be manoeuvred remotely, and an actuator that operates the function located on a separate remote-control device.

5.7.1.2. The RCM function shall be active only after a deliberate action of the driver and if the conditions for operation of the system are fulfilled (all associated functions – e.g. brakes, accelerator, steering, camera/radar/lidar are working properly).

5.7.1.3. The RCM function shall only operate if there is a continuous actuation of a dedicated button/switch on the remote-control device by the driver. Another button/switch on the remote-control device may be used to control the manoeuvring of the vehicle.

5.7.1.4. Whenever the RCM function is operated, this shall be indicated to the driver by an optical signal at least at the remote-control device.

5.7.1.5. The RCM function shall only operate until 5 km/h (+1 km/h tolerance).

5.7.1.6. At any time during a manoeuvre that the vehicle becomes stationary, the RCM function shall prevent the vehicle from rolling away.

5.7.1.7. If the continuous actuation is interrupted or the distance between the vehicle and the remote control device exceeds the specified maximum RCM operating range (SRCMmax) or the secure connection between the remote control device and the vehicle is lost, the vehicle shall stop immediately.

5.7.1.8. The specified maximum RCM operating range (SRCMmax) shall not exceed 6 m.

5.7.1.9. It shall be possible for the driver to deactivate the RCM function at any time.

5.7.1.10. If a door or trunk of the vehicle is opened during the manoeuvre, the vehicle shall stop immediately, and the RCM function shall be deactivated.

5.7.1.11. Security

5.7.1.11.1 The RCM function shall be protected against unauthorized activation or operation of the RCM function and interventions into the function.

5.7.1.11.2 The connection between the remote-control device and the vehicle shall be secured and encrypted. It shall be ensured by technical means that the RCM function can only be operated by an authorised remote-control device.

5.7.1.12. System information data

The Following data shall be provided together with the documentation package required in Annex 6 of this Regulation to the Technical Service at the time of type approval:

5.7.1.12.1. The value for the specified maximum RCM operating range (S_{RCMmax});

5.7.1.12.2. The conditions under which the RCM function can be activated, i.e. when the conditions for operation of the system are fulfilled;

5.7.1.12.3. The Manufacturer shall provide the technical authorities with an explanation of how the function is protected against unauthorized activation or operation.

5.7.1.13. The RCM function shall be so designed that its activation can only be achieved provided the vehicle is not in any of the following locations:

(a) A public road/highway;

(b) A public car park;

(c) An area designated exclusively for use by pedestrians and/or pedal cyclists.

The vehicle shall be capable of confirming that it is not located in any of the above locations whilst the RCM function is active and this shall be achieved by at least two independent technical means. If navigation maps are used for this purpose, the RCM function shall be disabled if the map data has not been updated in the previous 12 months.

5.7.1.14. The vehicle shall be equipped with a means to detect an obstacle (e.g. vehicles, pedestrian) in the manoeuvring area and to bring the vehicle immediately to a stop to avoid a collision.

5.7.1.15. If the vehicle stops having detected an obstacle in the manoeuvring area, subsequent operation shall only be possible following confirmation from the driver. The vehicle shall respond to any subsequent objects detected in the manoeuvring area as prescribed in paragraph 5.7.1.14.

5.7.1.16. It shall only be possible to operate the RCM function when drive is provided to at least one front axle and one rear axle simultaneously.

5.7.1.17. The vehicle shall detect if, while the RCM function is active, the vehicle enters any of the locations listed under paragraph 5.7.1.13. In such a case, the vehicle shall stop immediately, and the RCM function shall be deactivated.

5.7.1.18. The RCM function shall only operate for a maximum total distance travelled of 100m. This distance may be reset if there is no input on the remote control device for at least 1 minute or if the system has been deactivated and a time period of at least 1 minute has elapsed. The distance shall be subsequently measured from the next point at which the RCM function is operated.

5.7.1.19. The driver shall be issued with a warning signal when the total distance travelled is 75m (+5m tolerance). This shall be fulfilled by the provision of an optical warning signal and either a haptic or acoustic warning signal at least at the remote control device.

5.7.1.20. If the vehicle reaches or exceeds the maximum total distance travelled defined in paragraph 5.7.1.18., the vehicle shall stop immediately and the RCM function shall be deactivated. It shall not be possible to subsequently activate the RCM function until a time period of at least 1 minute has elapsed. This shall be indicated to the driver at least at the remote control device.

5.7.1.21. The manufacturer shall provide the Technical Service with documentation and supporting evidence to demonstrate compliance with the provisions of paragraphs 5.7.1.13., 5.7.1.14., 5.7.1.15 and 5.7.1.17. This information shall be subject to discussion and agreement between the Technical Service and vehicle manufacturer.

6. Test provisions

6.1. General provisions

6.1.1. The test shall be conducted on a level surface affording good adhesion.

6.1.2. During the test(s), the vehicle shall be loaded to its technically permissible maximum mass and its technically permissible maximum load on the steered axle(s).

In the case of axles fitted with ASE, this test shall be repeated with the vehicle loaded to its technically permissible maximum mass and the axle equipped with ASE loaded to its maximum permissible mass.

6.1.3. Before the test begins, the tyre pressures shall be as prescribed by the manufacturer for the mass specified in paragraph 6.1.2. when the vehicle is stationary.

6.1.4. In the case of any systems that use electrical energy for part or all of the energy supply, all performance tests shall be carried out under conditions of actual or simulated electrical load of all essential systems or systems components which share the same energy supply. Essential systems shall comprise at least lighting systems, windscreen wipers, engine management and braking systems.

6.2. Provisions for motor vehicles

6.2.1. It shall be possible to leave a curve with a radius of 50 m at a tangent without unusual vibration in the steering equipment at the following speed:

Category M_1 vehicles: 50 km/h;

Category M_2, M_3, N_1, N_2 and N_3 vehicles: 40 km/h or the maximum design speed if this is below the speeds given above.

6.2.2. When the vehicle is driven in a circle with its steered wheels at approximately half lock and a constant speed of at least 10 km/h, the turning circle shall remain the same or become larger if the steering control is released.

6.2.3. During the measurement of control effort, forces with a duration of less than 0.2 seconds shall not be taken into account.

6.2.4. The measurement of steering efforts on motor vehicles with intact steering equipment.

6.2.4.1. The vehicle shall be driven from straight ahead into a spiral at a speed of 10 km/h. The steering wheel control effort shall be measured at the nominal radius of the steering control until the position of the steering control corresponds to turning radius given in the table below for the particular category of vehicle with intact steering. One steering movement shall be made to the right and one to the left.

6.2.4.2. The maximum permitted steering time and the maximum permitted steering control effort with intact steering equipment are given in the table below for each category of vehicle.

6.2.5. The measurement of steering efforts on motor vehicles with a failure in the steering equipment.

6.2.5.1. The test described in paragraph 6.2.4. shall be repeated with a failure in the steering equipment. The steering effort shall be measured until the position of the steering control corresponds to the turning radius given in the table below for the particular category of vehicle with a failure in the steering equipment.

6.2.5.2. The maximum permitted steering time and the maximum permitted steering control effort with a failure in the steering equipment are given in the table below for each category of vehicle.

Table 2
Steering control effort requirements

Vehicle Category	*INTACT*	*WITH A FAILURE*

	Maximum effort (daN)	*Time(s)*	*Turning radius (m)*	*Maximum Effort (daN)*	*Time(s)*	*Turning Radius (m)*
M_1	15	4	12	30	4	20
M_2	15	4	12	30	4	20
M_3	20	4	12 **	45 *	6	20
N_1	20	4	12	30	4	20
N_2	25	4	12	40	4	20
N_3	20	4	12 **	45 *	6	20

* 50 for rigid vehicles with 2 or more steered axles excluding self tracking equipment
** or full lock if 12 m radius is not attainable.

6.3. Provisions for trailers

6.3.1. The trailer shall travel without excessive deviation or unusual vibration in its steering equipment when the towing vehicle is travelling in a straight line on a flat and horizontal road at a speed of 80 km/h or the technically permissible maximum speed indicated by the trailer manufacturer if this is less than 80 km/h.

6.3.2. With the towing vehicle and trailer having adopted a steady state turn corresponding to a turning circle radius of 25 m (see paragraph 2.4.6.) at a constant speed of 5 km/h, the circle described by the rearmost outer edge of the trailer shall be measured. This manoeuvre shall be repeated under the same conditions but at a speed of 25 km/h ±1 km/h. During these manoeuvres, the rearmost outer edge of the trailer travelling at a speed of 25 km/h ±1 km/h shall not move outside the circle described at a constant speed of 5 km/h by more than 0.7 m.

6.3.3. No part of the trailer shall move more than 0.5 m beyond the tangent to a circle with a radius of 25 m when towed by a vehicle leaving the circular path described in paragraph 6.3.2. along the tangent and travelling at a speed of 25 km/h. This requirement shall be met from the point the tangent meets the circle to a point 40 m along the tangent. After that point the trailer shall fulfil the condition specified in paragraph 6.3.1.

6.3.4. The annular ground area swept by the towing vehicle/trailer combination with an intact steering system, driving at no more than 5 km/h in a constant radius circle with the front outer corner of the towing vehicle describing a radius of 0.67 x vehicle combination length but not less than 12.5 m is to be measured.

6.3.4.1. If, with a fault in the steering system, the measured swept annular width is > 8.3 m, then this shall not be an increase of more than 15 per cent compared with the corresponding value measured with the intact steering system. There shall not be any increase in the outer radius of the swept annular width.

6.3.5. The tests described in paragraphs 6.3.2., 6.3.3. and 6.3.4. shall be conducted in both clockwise and anti-clockwise directions.

7. Conformity of production

The Conformity of Production Procedures shall comply with those set out in the 1958 Agreement, Schedule 1 (E/ECE/TRANS/505/Rev.3) with the following requirements:

7.1. The holder of the approval shall ensure that results of the conformity of production tests are recorded and that the annexed documents remain available for a period determined in

agreement with the Type Approval Authority or Technical Service. This period shall not exceed 10 years counted from the time when production is definitively discontinued;

7.2. The Type Approval Authority or Technical Service which has granted type approval may at any time verify the conformity control methods applied in each production facility. The normal frequency of these verifications shall be once every two years.

8. Penalties for non-conformity of production

8.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirement laid down in paragraph 7.1. is not complied with or if sample vehicles fail to comply with the requirements of paragraph 6. of this Regulation.

8.2. If a Contracting Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 1 to this Regulation.

9. Modification and extension of approval of the vehicle type

9.1. Every modification of the vehicle type shall be notified to the Type Approval Authority which granted the approval. The Type Approval Authority may then either:

9.1.1. Consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle still complies with the requirements; or

9.1.2. Require a further test report from the Technical Service responsible for conducting the tests.

9.2. Confirmation or extension or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 4.3. to the Parties to this Regulation.

9.3. The Type Approval Authority issuing the extension of approval shall assign a series number for such an extension and inform there of the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

10. Production definitively discontinued

If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the Type Approval Authority which granted the approval. Upon receiving the relevant communication that Type Approval Authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

11. Names and addresses of technical series responsible for conducting approval tests and of Type Approval Authorities

The Parties to the 1958 Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to

which forms certifying approval or extension or refusal or withdrawal of approval, issued in other countries, are to be sent.

12. Transitional provisions

12.1. Transitional Provisions applicable to the 02 series of amendments:

12.1.1. As from the official date of entry into force of the 02 series of amendments, no Contracting Party applying this Regulation shall refuse to grant or refuse to accept UN type approvals under this Regulation as amended by the 02 series of amendments unless otherwise specified below.

12.1.2. As from 1 April 2018, Contracting Parties applying this Regulation shall not be obliged to accept UN type approvals to any preceding series of amendments, first issued after 1 April 2018.

12.1.3. Until 1 April 2021, Contracting Parties applying this Regulation shall continue to accept UN type approvals to the preceding series (01) of amendments to this Regulation, first issued before 1 April 2018.

12.1.4. As from 1 April 2021, Contracting Parties applying this Regulation shall not be obliged to accept UN type approvals issued to the preceding series of amendments to this Regulation.

12.1.5. Notwithstanding paragraph 12.1.4., UN type approvals to the preceding series of amendments to this Regulation, which are not affected by the 02 series of amendments shall remain valid and Contracting Parties applying this Regulation shall continue to accept them.

12.1.6. Until 1 April 2020, type approvals according to the 02 series of amendment to this Regulation may be granted to new vehicle types not complying with the red colour for the hands-off warning signal, mandated in paragraph 5.6.2.2.5., and having multi information displays installed in the instrument cluster not capable of indicating red waning signals or using standalone tell-tales only.

12.2. Transitional Provisions applicable to the 03 series of amendments:

12.2.1. As from the official date of entry into force of the 03 series of amendments, no Contracting Party applying this Regulation shall refuse to grant or refuse to accept UN type approvals under this Regulation as amended by the 03 series of amendments.

12.2.2. As from 1 September 2019, Contracting Parties applying this Regulation shall not be obliged to accept UN type approvals to the preceding series (02) of amendments, first issued after 1 September 2019.

12.2.3. Until 1 September 2021, Contracting Parties applying this Regulation shall continue to accept UN type approvals to the preceding series (02) of amendments to this Regulation, first issued before 1 September 2019.

12.2.4. As from 1 September 2021, Contracting Parties applying this Regulation shall not be obliged to accept type approval issued to the preceding series of amendments to this Regulation.

12.2.5. Notwithstanding paragraph and 12.2.4., Contracting Parties applying this Regulation shall continue to accept UN type approvals issued according to a preceding series of amendments to this Regulation, for vehicles which are not affected by the provisions introduced with the 03 series of amendments.

12.3. General transitional provisions:

12.3.1. Contracting Parties applying this Regulation shall not refuse to grant UN type approvals according to any preceding series of amendments to this Regulation or extension thereof.

Annex 1

Communication

(Maximum format: A4 (210 x 297 mm)

issued by: Name of administration:
.....
.....
.....

Concerning:[2] Approval granted
Approval extended
Approval refused
Approval withdrawn
Production definitively discontinued

of a vehicle type with regard to steering equipment pursuant to UN Regulation No. 79

Approval No. ..... Extension No. .....

1. Trade name or mark of vehicle .....
2. Vehicle type .....
3. Manufacturer's name and address .....
4. If applicable, name and address of manufacturer's representative .....
5. Brief description of the steering equipment .....
5.1. Type of steering equipment .....
5.2. Steering control .....
5.3. Steering transmission .....
5.4. Steered wheels .....
5.5. Energy source .....
6. Results of tests, vehicle characteristics .....
6.1. Steering effort required to achieve a turning circle of 12 m radius with an intact system and 20 m radius with a system in the failed condition .....

[1] Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in this Regulation).
[2] Strike out what does not apply.

6.1.1. Under normal conditions .....

6.1.2. After failure of special equipment .....

6.2. Other tests required by this Regulation..... pass/fail[2]

6.3. Adequate documentation in accordance with Annex 6 was supplied in respect of the following parts of the steering system: .....

7. Applicable only to towing vehicles

7.1. The towing vehicle is/is not[2] equipped with an electrical connector fulfilling the relevant requirements of Annex 7

7.2. The maximum current available is .....A[3]

8. Applicable only to trailers

8.1. The steering system of the trailer fulfils the relevant provisions of Annex 7 to UN Regulation No. 79 ..... Yes/No[2]

8.2. The maximum current required for the trailer steering system is .....A[3]

8.3. The trailer steering system is/is not[2] able to supply auxiliary equipment on the trailer with electrical energy.

9. Vehicle submitted for approval on .....

10. Technical Service responsible for conducting approval tests .....

11. Date of report issued by that service.....

12. Number of report issued by that service .....

13. Approval granted/extended/refused/withdrawn[2]

14. Position of approval mark on vehicle .....

15. Place .....

16. Date .....

17. Signature.....

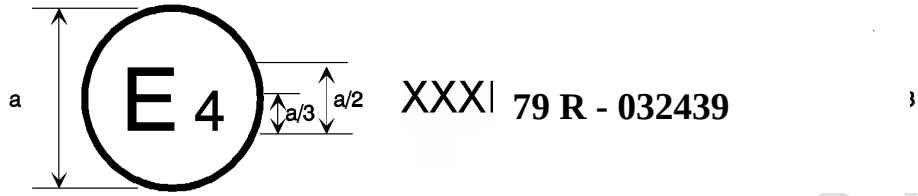
18. Annexed to this communication is a list of documents in the approval file deposited at the administration services having delivered the approval and which can be obtained upon request.

[3] As defined by the vehicle manufacturer – see paragraphs 2.3. and 3.1. of Annex 7 as appropriate.

Annex 2

Arrangements of approval marks

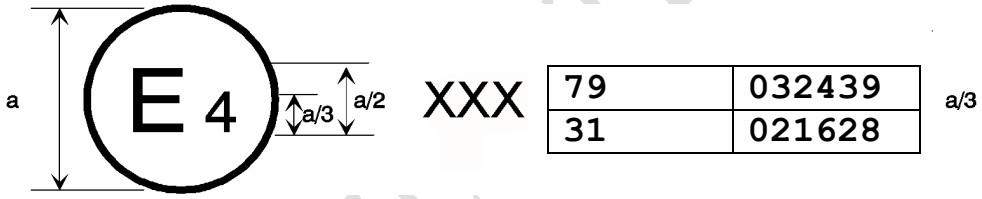
Model A
(See paragraph 4.4. of this Regulation)



a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to steering equipment, been approved in the Netherlands (E 4) pursuant to UN Regulation No. 79 under approval No. 032439. The approval number indicates that the approval was granted in accordance with the requirements of UN Regulation No. 79 incorporating the 03 series of amendments.

Model B
(See paragraph 4.5. of this Regulation)



a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 79 and 31.[1] The approval numbers indicate that, at the dates when the respective approvals were given, UN Regulation No. 79 incorporating the 03 series of amendments and UN Regulation No. 31 included the 02 series of amendments.

[1] The second number is given merely as an example.

Annex 3

Braking performance for vehicles using the same energy source to supply steering equipment and braking device

1. For tests carried out in accordance with this annex the following vehicle conditions shall be met:

1.1. The vehicle shall be loaded to its technically permissible maximum mass distributed between the axles as declared by the vehicle manufacturer. Where provision is made for several arrangements of the mass on the axles, the distribution of the maximum mass between the axles shall be such that the mass on each axle is proportional to the maximum permissible mass for each axle. In the case of tractors for semi-trailers, the mass may be repositioned approximately half way between the kingpin position resulting from the above loading conditions and the centreline of the rear axle(s);

1.2. The tyres shall be inflated to the cold inflation pressure prescribed for the mass to be borne by the tyres when the vehicle is stationary;

1.3. Before the start of the tests the brakes shall be cold, that is, with a disc or outer brake drum surface temperature less than 100 °C.

2. If an energy source failure occurs, service braking performance on the first brake application shall achieve the values given in the table below.

Table 3

Category		*V (km/h)*	*Service braking (m/s²)*	*F (daN)*
M_1		100	6.43	50
M_2 *and* M_3		60	5.0	70
N_1 [a, b]	*(i)*	80	5.0	70
	(ii)	100	6.43	50
N_2 *and* N_3		60	5.0	70

[a] The applicant shall select the appropriate row (i) or (ii) and this choice shall be subject to the agreement of the Technical Service.

[b] Information: The values in row (i) are aligned with the corresponding provisions in UN Regulation No. 13, the values in row (ii) are aligned with the corresponding provisions in UN Regulation No. 13-H.

3. After any failure in the steering equipment, or the energy supply, it shall be possible after eight full stroke actuations of the service brake control, to achieve at the ninth application, at least the performance prescribed for the secondary (emergency) braking system (see table below).

In the case where secondary performance requiring the use of stored energy is achieved by a separate control, it shall still be possible after eight full stroke actuations of the service brake control to achieve at the ninth application, the residual performance (see table below).

Table 4
Secondary and residual efficiency

Category		*V (km/h)*	*Secondary braking (m/s²)*	*Residual braking (m/s²)*
M_1		100	2.44	-
M_2 *and* M_3		60	2.5	1.5
N_1 [a, b]	*(i)*	70	2.2	1.3
	(ii)	100	2.44	-
N_2		50	2.2	1.3
N_3		40	2.2	1.3

[a] The applicant shall select the appropriate row (i) or (ii) and this choice shall be subject to the agreement of the Technical Service.

[b] Information: The values in row (i) are aligned with the corresponding provisions in UN Regulation No. 13, the values in row (ii) are aligned with the corresponding provisions in UN Regulation No. 13-H.

Annex 4

Additional provisions for vehicles equipped with Auxiliary Steering Equipment

1. General Provisions

Vehicles fitted with Auxiliary Steering Equipment (ASE) in addition to the requirements given in the body of this Regulation shall also comply with the provisions of this annex.

2. Specific Provisions

2.1. Transmission

2.1.1. Mechanical steering transmissions

Paragraph 5.3.1.1. of this Regulation applies.

2.1.2. Hydraulic steering transmissions

The hydraulic steering transmission shall be protected from exceeding the maximum permitted service pressure T.

2.1.3. Electric steering transmissions

The electric steering transmission shall be protected from excess energy supply.

2.1.4. Combination of steering transmissions

A combination of mechanical, hydraulic and electric transmissions shall comply with the requirements specified in paragraphs 2.1.1., 2.1.2. and 2.1.3. above.

2.2. Testing requirements for failure

2.2.1. Malfunction or failure of any part of the ASE (except for parts not considered to the susceptible to breakdown as specified in paragraph 5.3.1.1. of this Regulation) shall not result in a sudden significant change in vehicle behaviour and the relevant requirements of paragraph 6. of this Regulation shall still be met. Furthermore, it shall be possible to control the vehicle without abnormal steering correction. This shall be verified by the following tests:

2.2.1.1. Circular test

The vehicle shall be driven into a test circle with a radius "R" m and a speed "v" km/h corresponding to its category and the values given in the table below:

Table 5

Vehicle category	*R* [3]	*v* [1, 2]
M_1 and N_1	100	80
M_2 and N_2	50	50
M_3 and N_3	50	45

[1] If the ASE is in a mechanically locked position at this specified speed, the test speed will be modified to correspond to the maximum speed where the system is functioning. Maximum speed means the speed when the ASE becomes locked minus 5 km/h.

[2] If the dimensional characteristics of the vehicle imply an overturning risk, the manufacturer shall provide to the Technical Service behaviour simulation data demonstrating a lower maximum safe speed for conducting the test. Then the Technical Service will choose this test speed.

[3] If, due to the configuration of the test site, the values of the radii cannot be observed, the tests may be carried out on tracks with other radii, (maximum variation: ± 25 per cent) provided that the speed is varied to obtain the transverse acceleration resulting from the radius and speed indicated in the table for the particular category of vehicle.

The failure shall be introduced when the specified test speed has been reached. The test shall include driving in a clockwise direction, and in a counter-clockwise direction.

2.2.1.2. Transient test

2.2.1.2.1. Until uniform test procedures have been agreed, the vehicle manufacturer shall provide the Technical Services with their test procedures and results for transient behaviour of the vehicle in the case of failure.

2.3. Warning signals in case of failure.

2.3.1. Except for parts of ASE not considered susceptible to breakdown as specified in paragraph 5.3.1.1. of this Regulation, the following failure of ASE shall be clearly brought to the attention of the driver.

2.3.1.1. A general cut-off of the ASE electrical or hydraulic control.

2.3.1.2. Failure of the ASE energy supply.

2.3.1.3. A break in the external wiring of the electrical control if fitted.

Annex 5

Provisions for trailers having hydraulic steering transmissions

1. General provisions

Vehicles fitted with hydraulic steering transmission, in addition to the requirements given in the body of this Regulation shall also comply with the provisions of this annex.

2. Specific provisions

2.1. Performance of hydraulic lines and hose assemblies.

2.1.1. The hydraulic lines of hydraulic transmission shall be capable of a burst pressure at least four times the maximum normal service pressure (T) specified by the vehicle manufacturer. Hose assemblies shall comply with ISO Standards 1402:1994, 6605:1986 and 7751:1991.

2.2. In systems dependent on an energy supply;

2.2.1. The energy supply shall be protected from excess pressure by a pressure limiting valve which operates at the pressure T.

2.3. Protection of steering transmission;

2.3.1. The steering transmission shall be protected from excess pressure by a pressure limiting valve which operates at between 1.1 T and 2.2 T. The operating pressure of the pressure limiting valve shall be of a value that is compatible with the operating characteristics of the steering system installed on the vehicle. This shall be confirmed by the vehicle manufacturer at the time of type approval.

Annex 6

Special requirements to be applied to the safety aspects of electronic control systems

1. General

This annex defines the special requirements for documentation, fault strategy and verification with respect to the safety aspects of Electronic System(s) (paragraph 2.3.) and Complex Electronic Vehicle Control System(s) (paragraph 2.4. below) as far as this Regulation is concerned.

This annex does not specify the performance criteria for "The System" but covers the methodology applied to the design process and the information which must be disclosed to the Technical Service, for type approval purposes.

This information shall show that "The System" respects, under non-fault and fault conditions, all the appropriate performance requirements specified elsewhere in this Regulation and that it is designed to operate in such a way that it does not induce safety critical risks.

The applicant (e.g. the manufacturer) may provide evidence that an Auxiliary Steering Equipment (ASE) (if fitted) has previously been assessed as part of an approval in accordance with the requirements of Annex 4 of this Regulation (as required under the original version of this Regulation, its 01 or its 02 series of amendments). In this case, the requirements of this Annex shall not be applied to that ASE for the purposes of an approval in accordance with the 03 series of amendments.

2. Definitions

For the purposes of this annex,

2.1. "*The System*" means an electronic control system or complex electronic control system that provides or forms part of the control transmission of a function to which this Regulation applies. This also includes any other system covered in the scope of this Regulation, as well as transmission links to or from other systems that are outside the scope of this Regulation, that acts on a function to which this Regulation applies."

2.2. "*Safety Concept*" is a description of the measures designed into the system, for example within the electronic units, so as to address system integrity and thereby ensure safe operation under fault and non-fault conditions, including in the event of an electrical failure. The possibility of a fall-back to partial operation or even to a back-up system for vital vehicle functions may be a part of the safety concept.

2.3. "*Electronic control system*" means a combination of units, designed to co-operate in the production of the stated vehicle control function by electronic data processing. Such systems, commonly controlled by software, are built from discrete functional components such as sensors, electronic control units and actuators and connected by transmission links. They may include mechanical, electro-pneumatic or electro-hydraulic elements."

2.4. "*Complex Electronic Vehicle Control Systems*" are those electronic control systems in which a function controlled by an electronic system or the driver may be over-ridden by a higher level electronic control system/function. A function which is over-ridden becomes part of the complex system, as well as any overriding system/function within the scope of this

Regulation. The transmission links to and from overriding systems/function outside of the scope of this Regulation shall also be included.

2.5. "*Higher-Level Electronic Control*" systems/functions are those which employ additional processing and/or sensing provisions to modify vehicle behaviour by commanding variations in the function(s) of the vehicle control system. This allows complex systems to automatically change their objectives with a priority which depends on the sensed circumstances.

2.6. "*Units*" are the smallest divisions of system components which will be considered in this annex, since these combinations of components will be treated as single entities for purposes of identification, analysis or replacement.

2.7. "*Transmission links*" are the means used for inter-connecting distributed units for the purpose of conveying signals, operating data or an energy supply. This equipment is generally electrical but may, in some part, be mechanical, pneumatic or hydraulic.

2.8. "*Range of control*" refers to an output variable and defines the range over which the system is likely to exercise control.

2.9. "*Boundary of functional operation*" defines the boundaries of the external physical limits within which the system is able to maintain control.

2.10. "*Safety Related Function*" means a function of "The System" that is capable of changing the dynamic behaviour of the vehicle. "The System" may be capable of performing more than one safety related function.

2.11. "*Control strategy*" means a strategy to ensure robust and safe operation of the function(s) of "The System" in response to a specific set of ambient and/or operating conditions (such as road surface condition, traffic intensity and other road users, adverse weather conditions, etc.). This may include the automatic deactivation of a function or temporary performance restrictions (e.g. a reduction in the maximum operating speed, etc.).

3. Documentation

3.1. Requirements

The manufacturer shall provide a documentation package which gives access to the basic design of "The System" and the means by which it is linked to other vehicle systems or by which it directly controls output variables. The function(s) of "The System", including the control strategies, and the safety concept, as laid down by the manufacturer, shall be explained. Documentation shall be brief, yet provide evidence that the design and development has had the benefit of expertise from all the system fields which are involved. For periodic technical inspections, the documentation shall describe how the current operational status of "The System" can be checked.

The Technical Service shall assess the documentation package to show that "The System":

(a) Is designed to operate, under non-fault and fault conditions, in such a way that it does not induce safety critical risks;

(b) Respects, under non-fault and fault conditions, all the appropriate performance requirements specified elsewhere in this Regulation; and

(c) Was developed according to the development process/method declared by the manufacturer and that this includes at least the steps listed in paragraph 3.4.4.

3.1.1. Documentation shall be made available in two parts:

(a) The formal documentation package for the approval, containing the material listed in paragraph 3. (with the exception of that of paragraph 3.4.4.) which shall be supplied to the Technical Service at the time of submission of the type approval application. This documentation package shall be used by the Technical Service as the basic reference for the verification process set out in paragraph 4. of this annex. The Technical Service shall ensure that this documentation package remains available for a period determined in agreement with the Approval Authority. This period shall be at least 10 years counted from the time when production of the vehicle is definitely discontinued.

(b) Additional material and analysis data of paragraph 3.4.4. which shall be retained by the manufacturer, but made open for inspection at the time of type approval. The manufacturer shall ensure that this material and analysis data remains available for a period of 10 years counted from the time when production of the vehicle is definitely discontinued."

3.2. Description of the functions of "The System" including control strategies

A description shall be provided which gives a simple explanation of all the functions including control strategies of "The System" and the methods employed to achieve the objectives, including a statement of the mechanism(s) by which control is exercised.

Any described function that can be over-ridden shall be identified and a further description of the changed rationale of the function's operation provided.

Any enabled or disabled safety related functions providing assistance to the driver as defined in paragraph 2.3.4. of this Regulation, when the hardware and software are present in the vehicle at the time of production, shall be declared and are subject to the requirements of this annex, prior to their use in the vehicle.

3.2.1. A list of all input and sensed variables shall be provided and the working range of these defined, along with a description of how each variable affects system behaviour.

3.2.2. A list of all output variables which are controlled by "The System" shall be provided and an indication given, in each case, of whether the control is direct or via another vehicle system. The range of control (paragraph 2.7.) exercised on each such variable shall be defined.

3.2.3. Limits defining the boundaries of functional operation (paragraph 2.8.) shall be stated where appropriate to system performance.

3.3. System layout and schematics

3.3.1. Inventory of components.

A list shall be provided, collating all the units of "The System" and mentioning the other vehicle systems which are needed to achieve the control function in question.

An outline schematic showing these units in combination, shall be provided with both the equipment distribution and the interconnections made clear.

3.3.2. Functions of the units

The function of each unit of "The System" shall be outlined and the signals linking it with other units or with other vehicle systems shall be shown. This may be provided by a labelled block diagram or other schematic, or by a description aided by such a diagram.

3.3.3. Interconnections

Interconnections within "The System" shall be shown by a circuit diagram for the electric transmission links, by a piping diagram for pneumatic or hydraulic transmission equipment

and by a simplified diagrammatic layout for mechanical linkages. The transmission links both to and from other systems shall also be shown

3.3.4. Signal flow, operating data and priorities

There shall be a clear correspondence between these transmission links and the signals and/or operating data carried between Units. Priorities of signals and/or operating data on multiplexed data paths shall be stated wherever priority may be an issue affecting performance or safety as far as this Regulation is concerned.

3.3.5. Identification of units

Each unit shall be clearly and unambiguously identifiable (e.g. by marking for hardware and marking or software output for software content) to provide corresponding hardware and documentation association.

Where functions are combined within a single unit or indeed within a single computer, but shown in multiple blocks in the block diagram for clarity and ease of explanation, only a single hardware identification marking shall be used. The manufacturer shall, by the use of this identification, affirm that the equipment supplied conforms to the corresponding document.

3.3.5.1. The identification defines the hardware and software version and, where the latter changes such as to alter the function of the Unit as far as this Regulation is concerned, this identification shall also be changed.

3.4. Safety concept of the manufacturer

3.4.1. The Manufacturer shall provide a statement which affirms that the strategy chosen to achieve "The System" objectives will not, under non-fault conditions, prejudice the safe operation of the vehicle.

3.4.2. In respect of software employed in "The System", the outline architecture shall be explained and the design methods and tools used shall be identified. The manufacturer shall show evidence of the means by which they determined the realisation of the system logic, during the design and development process.

3.4.3. The Manufacturer shall provide the Technical Service with an explanation of the design provisions built into "The System" so as to generate safe operation under fault conditions. Possible design provisions for failure in "The System" are for example:

(a) Fall-back to operation using a partial system.

(b) Change-over to a separate back-up system.

(c) Removal of the high level function.

In case of a failure, the driver shall be warned for example by warning signal or message display. When the system is not deactivated by the driver, e.g. by turning the ignition (run) switch to "off", or by switching off that particular function if a special switch is provided for that purpose, the warning shall be present as long as the fault condition persists.

3.4.3.1. If the chosen provision selects a partial performance mode of operation under certain fault conditions, then these conditions shall be stated and the resulting limits of effectiveness defined.

3.4.3.2. If the chosen provision selects a second (back-up) means to realise the vehicle control system objective, the principles of the change-over mechanism, the logic and level of redundancy

and any built in back-up checking features shall be explained and the resulting limits of back-up effectiveness defined.

3.4.3.3. If the chosen provision selects the removal of the Higher Level Function, all the corresponding output control signals associated with this function shall be inhibited, and in such a manner as to limit the transition disturbance.

3.4.4. The documentation shall be supported, by an analysis which shows, in overall terms, how the system will behave on the occurrence of any of those hazards or faults which will have a bearing on vehicle control performance or safety.

The chosen analytical approach(es) shall be established and maintained by the Manufacturer and shall be made open for inspection by the Technical Service at the time of the type approval.

The Technical Service shall perform an assessment of the application of the analytical approach(es). The assessment shall include:

(a) Inspection of the safety approach at the concept (vehicle) level with confirmation that it includes consideration of:

(i) Interactions with other vehicle systems;

(ii) Malfunctions of the system, within the scope of this Regulation;

(iii) For functions defined in paragraph 2.3.4. of this Regulation:

a. Situations when a system free from faults may create safety critical risks (e.g. due to a lack of or wrong comprehension of the vehicle environment);

b. Reasonably foreseeable misuse by the driver;

c. Intentional modification of the system.

This approach shall be based on a Hazard / Risk analysis appropriate to system safety.

(b) Inspection of the safety approach at the system level. This may be based on a Failure Mode and Effect Analysis (FMEA), a Fault Tree Analysis (FTA) or any similar process appropriate to system safety.

(c) Inspection of the validation plans and results. This shall include validation testing appropriate for validation, for example, Hardware in the Loop (HIL) testing, vehicle on-road operational testing, or any other testing appropriate for validation.

The assessment shall consist of spot checks of selected hazards and faults to establish that argumentation supporting the safety concept is understandable and logical and validation plans are suitable and have been completed.

The Technical Service may perform or may require to perform tests as specified in paragraph 4. to verify the safety concept.

3.4.4.1. This documentation shall itemize the parameters being monitored and shall set out, for each fault condition of the type defined in paragraph 3.4.4. of this annex, the warning signal to be given to the driver and/or to service/technical inspection personnel.

3.4.4.2. This documentation shall describe the measures in place to ensure the "The System" does not prejudice the safe operation of the vehicle when the performance of "The System" is affected

by environmental conditions e.g. climatic, temperature, dust ingress, water ingress, ice packing.

4. Verification and test

4.1. The functional operation of "The System", as laid out in the documents required in paragraph 3., shall be tested as follows:

4.1.1. Verification of the function of "“The System"

The Technical Service shall verify "The System" under non-fault conditions by testing a number of selected functions from those described by the manufacturer in paragraph 3.2. above.

For complex electronic systems, these tests shall include scenarios whereby a declared function is overridden.

4.1.1.1. The verification results shall correspond with the description, including the control strategies, provided by the manufacturer in paragraph 3.2.

4.1.2. Verification of the safety concept of paragraph 3.4.

The reaction of "The System" shall be checked under the influence of a failure in any individual unit by applying corresponding output signals to electrical units or mechanical elements in order to simulate the effects of internal faults within the unit. The Technical Service shall conduct this check for at least one individual unit, but shall not check the reaction of "The System" to multiple simultaneous failures of individual units.

The Technical Service shall verify that these tests include aspects that may have an impact on vehicle controllability and user information (HMI aspects)."

4.1.2.1. The verification results shall correspond with the documented summary of the failure analysis, to a level of overall effect such that the safety concept and execution are confirmed as being adequate.

5. Reporting by Technical Service

Reporting of the assessment by the Technical Service shall be performed in such a manner that allows traceability, e.g. versions of documents inspected are coded and listed in the records of the Technical Service.

An example of a possible layout for the assessment form from the Technical Service to the Type Approval Authority is given in Appendix 1 to this Annex.

Annex 6 - Appendix 1

Model assessment form for electronic systems

Test report No: .....

1. Identification

1.1. Vehicle make: .....

1.2. Type: .....

1.3. Means of identification of type if marked on the vehicle: .....

1.4. Location of that marking: .....

1.5. Manufacturer's name and address: .....

1.6. If applicable, name and address of manufacturer's representative: .....

1.7. Manufacturer's formal documentation package:

Documentation reference No: .....
Date of original issue: .....
Date of latest update: .....

2. Test vehicle(s)/system(s) description

2.1. General description: .....

2.2. Description of all the control functions of "The System", and methods of operation: ..

2.3. Description of the components and diagrams of the interconnections within "The System": .....

2.4. General description: .....

2.5. Description of all the control functions of "The System", and methods of operation: ..

2.6. Description of the components and diagrams of the interconnections within "The System": .....

3. Manufacturer's safety concept

3.1. Description of signal flow and operating data and their priorities: .....

3.2. Manufacturer's declaration:

The manufacturer(s) ..... affirm(s) that the strategy chosen to achieve "The System", objectives will not, under non-fault conditions, prejudice the safe operation of the vehicle.

3.3. Software outline architecture and the design methods and tools used: .....

3.4. Explanation of design provisions built into "The System" under fault conditions: .....

3.5. Documented analyses of the behaviour of "The System" under individual hazard or fault conditions: .....

3.6. Description of the measures in place for environmental conditions: .....

3.7. Provisions for the periodic technical inspection of "The System": .....

3.8. Results of "The System" verification test, as per para. 4.1.1. of Annex 6 to UN Regulation No. 79: .....

3.9. Results of safety concept verification test, as per para. 4.1.2. of Annex 6 to UN Regulation No. 79: .....

3.10. Date of test: .....

3.11. This test has been carried out and the results reported in accordance with ….. to UN Regulation No. 79 as last amended by the ..... series of amendments.

Technical Service carrying out the test
Signed: ..... Date: .....

3.12. Comments: .....

Annex 7

Special provisions for the powering of trailer steering systems from the towing vehicle

1. General

The requirements of this annex shall apply to towing vehicles and trailers where electrical energy is supplied from the towing vehicle to facilitate operation of the steering system installed on the trailer.

2. Requirements for towing vehicles

2.1. Energy Supply

2.1.1. The vehicle manufacturer shall define the capacity of the energy source that will enable the current defined in paragraph 2.3. below to be available for the trailer during normal operation of the vehicle.

2.1.2. The driver's manual shall include information to advise the driver on the electrical energy available for the trailer steering system and that the electrical interface shall not be connected when the current requirement marked on the trailer exceeds that which can be supplied by the towing vehicle.

2.1.3. The power supply provided by the connector referenced in paragraph 2.5. below shall be used for the powering of the trailer steering system. However, in all cases the provisions of paragraph 3.3. below shall apply.

2.2. The nominal operating voltage is 24V.

2.3. The maximum current supply available at the connector referenced in paragraph 2.5.2. below shall be defined by the towing vehicle manufacturer.

2.4. Protection of the electrical system

2.4.1. The electrical system of the towing vehicle shall be protected from an overload or short circuit in the supply to the trailer steering system.

2.5. Wiring and Connectors

2.5.1. The cables used to supply the trailer electrical energy shall have a conductor cross-sectional area compatible with the continuous current defined in paragraph 2.3. above.

2.5.2. Until a uniform standard has been defined the connector used to connect to the trailer shall fulfil the following:

(a) The pins shall have a current carrying capacity compatible with the maximum continuous current defined in paragraph 2.3. above;

(b) Until uniform standards have been agreed the environmental protection of the connector shall be appropriate to the application and included in the Annex 6 assessment; and

(c) The connector shall not be interchangeable with an existing electrical connector currently used on the towing vehicle i.e. ISO 7638, ISO 12098, etc.

2.6. Marking

2.6.1. The towing vehicle shall be marked to indicate the maximum current available for the trailer as defined in paragraph 2.3. above.

The marking shall be indelible and positioned so that it is visible when connecting the electrical interface referenced in paragraph 2.5.2. above.

3. Requirements for trailers

3.1. The maximum current requirement of the trailer steering system shall be defined by the vehicle manufacturer.

3.2. The nominal operating voltage is 24V.

3.3. The electrical energy available from the towing vehicle shall only be used as follows:

(a) Exclusively for use by the trailer steering system;

or

(b) For the trailer steering system and to power auxiliary systems on the trailer provided the steering system has priority and is protected from an overload external to the steering system. This protection shall be a function of the trailer steering system.

3.4. Wiring and Connectors

3.4.1. The cables used to supply the trailer steering system with electrical energy shall have a conductor cross sectional area compatible with the energy requirements of the steering system installed on the trailer.

3.4.2. Until a uniform standard has been defined the connector used to connect to the trailer shall fulfil the following:

(a) The pins shall have a current carrying capacity compatible with the maximum current defined by the vehicle manufacturer in paragraph 3.1. above;

(b) Until uniform standards have been agreed the environmental protection of the connector shall be appropriate to the application and included in the Annex 6 assessment;

(c) The connector shall not be interchangeable with an existing electrical connector currently used on the towing vehicle, i.e. ISO 7638, ISO 12098, etc.

3.5. Failure warning:

Failures within the electric control transmission of the steering system shall be directly displayed to the driver.

3.6. Demonstration of the operation of the steering system

3.6.1. At the time of type approval the trailer manufacturer shall demonstrate to the Technical Service the functionality of the steering system by fulfilling the relevant performance requirements specified within the Regulation.

3.6.2. Failure Conditions:

3.6.2.1. Under steady state conditions:

In the event of the trailer being coupled to a towing vehicle that does not have an electrical supply for the trailer steering system, or there is a break in the electrical supply to the trailer steering system or there is a failure in the electric control transmission of the trailer steering control system it shall be demonstrated that the trailer fulfils all relevant requirements of paragraph 6.3. of the Regulation for the intact system.

3.6.2.2. Under transient conditions

The transient behaviour of the vehicle in the case of failure within the electric control transmission of the steering system shall be evaluated to ensure vehicle stability is maintained during the transition following the failure and shall be assessed by fulfilling the following:

(a) By applying the test procedure and requirements defined within paragraph 6.3.1. of the Regulation.[1]

(b) By applying the test procedure and requirements defined within paragraph 6.3.3. of the Regulation.[1]

3.6.3. If the trailer steering system utilises hydraulic transmission to operate the steering, the requirements of Annex 5 shall apply.

3.7. Marking

3.8.1. Trailers equipped with a connector for the supply of electrical energy to the trailer steering system shall be marked to include the following information:

(a) The maximum current requirement for the trailer steering system as defined in paragraph 3.1. above.

(b) The functionality of the trailer steering system including the impact on manoeuvrability when the connector is connected and disconnected.

The marking shall be in indelible form and positioned so that it is visible when connecting to the electrical interface referenced in paragraph 3.3.2. above.

[1] The Technical Service may accept the test results supplied by the trailer manufacturer to demonstrate compliance with the transient tests

Annex 8

Test requirements for corrective and automatically commanded steering functions

1. General provisions

Vehicles fitted with CSF and/or ACSF systems shall fulfil the appropriate tests requirements of this annex.

2. Testing conditions

The tests shall be performed on a flat, dry asphalt or concrete surface affording good adhesion. The ambient temperature shall be between 0 °C and 45 °C.

2.1. Lane markings

The lane markings on the road used for the tests shall be in line with one of those described in Annex 3 of UN Regulation No. 130. The markings shall be in good condition and of a material conforming to the standard for visible lane markings. The lane-marking layout used for the tests shall be recorded in the test report.

The width of the lane shall be minimum 3.5 m, for the purpose of the tests of this annex. At the manufacturer's discretion and with the agreement of the Technical Service, a lane with a width of less than 3.5 m may be used, if the correct function of the system on roads with wider lanes can be demonstrated.

The test shall be performed under visibility conditions that allow safe driving at the required test speed.

The vehicle manufacturer shall demonstrate, through the use of documentation, compliance with all other lane markings identified in Annex 3 of UN Regulation No. 130. Any of such documentation shall be appended to the test report.

2.2. Tolerances

All vehicle speeds specified for the tests described in this annex shall be met within a tolerance of ±2 km/h.

2.3. Vehicle conditions

2.3.1. Test mass

The vehicle shall be tested in a load condition agreed between the manufacturer and the Technical Service. No load alteration shall be made once the test procedure has begun. The vehicle manufacturer shall demonstrate, through the use of documentation, that the system works at all load conditions.

2.3.2. The vehicle shall be tested at the tyre pressures recommended by the vehicle manufacturer.

2.4. Lateral acceleration

The lateral acceleration and the lateral jerk at vehicle's center of gravity shall be determined. The raw lateral acceleration data shall be measured closest as possible to the position of the vehicle's center of gravity. The position at which the lateral acceleration is measured and the centre of gravity of the vehicle shall be identified in the test report. The sampling rate shall be at least 100 Hz.

To determine the lateral acceleration, the raw data shall be filtered by applying a fourth order Butterworth filter with a cut-off frequency of 0.5 Hz.

To determine the lateral jerk, the 500ms moving average of the time derivation of the filtered lateral acceleration shall be considered.

The lateral acceleration data at the vehicle center of gravity shall be determined by removing additional effects due to the movements of the vehicle body (e.g. roll of sprung mass) and by correcting for sensor placement via the use of coordinate transformation. As reference, the intermediate axis system as described in ISO 8855:2011 shall be used.

2.5. Overriding force

The measurement of the overriding force during the test can be performed by two methods: either through the internal driver torque signal or by an external measurement device fitted, which doesn't induce any deactivation of the system.

Prior to performing the overriding force test by the internal driver torque signal, it shall be verified by an external measurement device that there are no relevant differences between the both measured values. Differences shall be less than or equal to 3 N. This requirement is deemed to be fulfilled if the correlation between the values of the internal driver torque signal and the external measurement device was determined and is applied in the overriding force test.

3. Tests procedures

3.1. Tests for CSF

The following test applies to CSF functions defined in subparagraph (c) of CSF definition in paragraph 2.3.4.2. of this Regulation.

3.1.1. Warning test for CSF

3.1.1.1. The vehicle shall be driven with an activated CSF on a road with lane markings on each side of the lane. In case of a CSF whose interventions are solely based on the evaluation of the presence and location of lane boundaries, the vehicle shall be driven on a road delimited by the boundaries as declared by the manufacturer (e.g. road edge).

The test conditions and the vehicle test speed shall be within the operating range of the system.

During the test, the duration of the CSF interventions and of the optical and acoustic or haptic warning signal, as relevant, shall be recorded.

In the case of paragraph 5.1.6.1.2.1. of this Regulation, the vehicle shall be driven such that it attempts to leave the lane and causes CSF intervention to be maintained for a period longer than 10s (for M1, N1) or 30s (for M2, M3, N2, N3). If such a test cannot be practically achieved due to e.g. the limitations of the test facilities, with the consent of the type approval authority this requirement may be fulfilled through the use of documentation.

The test requirements are fulfilled if:

(a) The acoustic or haptic warning, as relevant, is provided no later than 10s (for M1, N1) or 30s (for M2, M3, N2, N3) after the beginning of the intervention.

In the case of paragraph 5.1.6.1.2.2. of this Regulation, the vehicle shall be driven such that it attempts to leave the lane and causes at least three interventions of the system within a rolling interval of 180 s.

The test requirements are fulfilled if:

(a) An optical warning signal is provided for each intervention, as long as the intervention exists, and

(b) An acoustic or haptic warning signal, as relevant, is provided at the second and third intervention

and

(c) The acoustic or haptic warning signal, as relevant, at the third intervention is at least 10s longer than the one at the second intervention.

3.1.1.2. In addition, the manufacturer shall demonstrate to the satisfaction of the Technical Service that the requirements defined in paragraphs 5.1.6.1.1. and 5.1.6.1.2. are fulfilled in the whole range of CSF operation. This may be achieved on the basis of appropriate documentation appended to the test report.

3.1.2 Overriding force test

3.1.2.1. The vehicle shall be driven with an activated CSF on a road with lane markings on each side of the lane.

The test conditions and the vehicle test speed shall be within the operating range of the system.

The vehicle shall be driven such that it attempts to leave the lane and causes CSF intervention. During the intervention, the driver shall apply a force on the steering control to override the intervention.

The force applied by the driver on the steering control to override the intervention shall be recorded.

3.1.2.2. The test requirements are fulfilled if the force applied by the driver on the steering control to override the intervention does not exceed 50 N.

3.1.2.3 In addition, the manufacturer shall demonstrate to the satisfaction of the Technical Service that the requirements defined in paragraph 5.1.6.1.3. are fulfilled in the whole range of CSF operation. This may be achieved on the basis of appropriate documentation appended to the test report.

3.2. Tests for ACSF Category B1 Systems

3.2.1. Lane keeping functional test

3.2.1.1. The vehicle speed shall remain in the range from V_{smin} up to V_{smax}.

The test shall be carried out for each speed range specified in paragraph 5.6.2.1.3. of this Regulation separately or within contiguous speed ranges where the aysmax is identical.

The vehicle shall be driven without any force applied by the driver on the steering control (e.g. by removing the hands from the steering control) with a constant speed or with a predefined initial speed when using an embedded vehicle speed control system (e.g. for vehicles automatically decelerating in curves) on a curved track with lane markings at each side.

The necessary lateral acceleration to follow the curve shall be between 80 and 90 per cent of the maximum lateral acceleration specified by the vehicle manufacturer ay_{smax}. The measured lateral acceleration during the test execution can be outside of the above-mentioned limits.

The lateral acceleration and the lateral jerk shall be recorded during the test.

3.2.1.2. The test requirements are fulfilled if:

No outside edge of the tyre tread of the vehicle's front wheel does cross the outside edge of any lane marking.

The moving average over half a second of the lateral jerk does not exceed 5 m/s^3.

3.2.1.3. The vehicle manufacturer shall demonstrate to the satisfaction of the Technical Service that the requirements for the whole lateral acceleration and speed range are fulfilled. This may be achieved on the basis of appropriate documentation appended to the test report.

3.2.2. Maximum lateral acceleration test

3.2.2.1. The vehicle speed shall remain in the range from Vsmin up to Vsmax

[…] The vehicle shall be driven without any force applied by the driver on the steering control (e.g. by removing the hands from the steering control) with a constant speed on a curved track with lane markings at each side.

If an embedded vehicle speed control system will automatically decelerate the vehicle in the curve, it shall be inhibited.

[…]

3.2.2.2. The test requirements are fulfilled if:

The recorded acceleration is within the limits specified in paragraph 5.6.2.1.1. of this Regulation.

The moving average over half a second of the lateral jerk does not exceed 5 m/s^3.

3.2.3. Overriding force test

3.2.3.1. The vehicle speed shall remain in the range from Vsmin up to Vsmax.

The vehicle shall be driven without any force applied by the driver on the steering control (e.g. by removing the hands from the steering control) with a constant speed on a curved track with lane markings at each side.

The necessary lateral acceleration to follow the curve shall be between 80 and 90 per cent of the maximum lateral acceleration specified by the vehicle manufacturer ay_{smax}.

The driver shall then apply a force on the steering control to override the system intervention and leave the lane.

The force applied by the driver on the steering control during the overriding manoeuvre shall be recorded.

3.2.3.2. The test requirements are fulfilled if the force applied by the driver on the steering control during the overriding manoeuvre is less than 50N.

The manufacturer shall demonstrate through appropriate documentation that this condition is fulfilled throughout the ACSF operation range.

3.2.4. Transition test; hands-on test

3.2.4.1. The vehicle shall be driven with activated ACSF with a vehicle test speed between Vsmin + 10 km/h and Vsmin + 20 km/h on a track with lane markings at each side of the lane.

The driver shall release the steering control and continue to drive until the ACSF is deactivated by the system. The track shall be selected such that it allows driving with activated ACSF for at least 65 s without any driver intervention.

The test shall be repeated with a vehicle test speed between Vsmax – 20 km/h and Vsmax - 10 km/h or 130 km/h whichever is lower and may be stopped upon the start of the optical warning.

Additionally, the vehicle manufacturer shall demonstrate to the satisfaction of the Technical Service that the requirements for the whole speed range are fulfilled. This may be achieved on the basis of appropriate documentation appended to the test report.

3.2.4.2. The test requirements are fulfilled if:

During both tests, the optical warning signal was given at the latest 15 s after the steering control has been released and remains until ACSF is deactivated.

During the lower speed test the acoustic warning signal was given at the latest 30 s after the steering control has been released and remains until ACSF is deactivated.

During the lower speed test the ACSF is deactivated at the latest 30 s after the acoustic warning signal has started, with an acoustic emergency signal of at least 5 s, which is different from the previous acoustic warning signal.

3.2.5. Lane Crossing Warning Test for M1 N1 and for M2 M3 N2 and N3, if not equipped with a Lane Departure Warning System (LDWS) fulfilling the technical requirements of UN Regulation No. 130.

3.2.5.1. The vehicle shall be driven with activated ACSF with a vehicle test speed between V_{smin} and V_{smax}.

The vehicle shall be driven without any force applied by the driver on the steering control (e.g. by removing the hands from the steering control) on a curved track with lane markings at each side.

The technical service defines a test speed and a radius which would provoke a lane crossing. The test speed and radius shall be defined such that the necessary lateral acceleration to follow the curve is in between ay_{smax} + 0.1 m/s² and ay_{smax} + 0.4 m/s².

3.2.5.2. The test requirements are fulfilled if:

The optical warning signal and additionally the acoustic or haptic warning signal was given at the latest when the outside edge of the tyre tread of the vehicle's front wheel has crossed the outside edge of the lane marking.

The system continues to provide assistance as required in paragraph 5.6.2.2.3.

3.3. Tests for ESF

The vehicle shall be driven with an activated ESF on a road with lane markings on each side and positioned within those lane markings.

The test conditions and the vehicle speeds shall be within the operating range of the system as declared by the manufacturer.

Specific details of the mandatory tests described below shall be discussed and agreed between the vehicle manufacturer and the Technical Service to adapt the required testing to the declared use case(s) for which the ESF is designed to operate.

In addition, the manufacturer shall demonstrate to the satisfaction of the Technical Service that the requirements defined in paragraph 5.1.6.2.1. to 5.1.6.2.6. are fulfilled in the whole range of the ESF operation (specified by the vehicle manufacturer in the system information data) This may be achieved on the basis of appropriate documentation appended to the test report.

3.3.1. Test for ESF Type a i/ii: (unintentional lateral manoeuvre)

A target vehicle driving in the adjacent lane shall approach the vehicle under test and one of the vehicles shall minimize their lateral separation distance until an ESF intervention is started.

The tests requirements are fulfilled if:

(a) The warnings specified in paragraph 5.1.6.2.6. of this UN Regulation are provided no later than the ESF intervention starts, and

(b) The ESF intervention does not lead the vehicle to leave its original lane.

3.3.2. Test for ESF Type a iii: (intentional lateral manoeuvre)

The vehicle under test starts a lane change while another vehicle is driving in the adjacent lane such that no intervention of the ESF system would lead to a collision.

The test requirements are fulfilled if:

(a) An ESF intervention is started, and

(b) The warnings specified in paragraph 5.1.6.2.6. of this Regulation are provided no later than the ESF intervention starts, and

(c) The ESF intervention does not lead the vehicle to leave its original lane.

3.3.3. Test for ESF Type b:

The vehicle under test shall approach an object positioned within its trajectory. The object shall be of such size and positioned in a way that the vehicle can pass the object without crossing the lane markings.

The tests requirements are fulfilled if:

(a) The ESF intervention avoids or mitigates the collision, and

(b) The warnings specified in paragraph 5.1.6.2.6. of this UN Regulation are provided no later than the ESF intervention starts, and

(c) The ESF intervention does not lead the vehicle to leave its lane.

3.3.4. Tests for systems able to operate in the absence of lane markings

In case any system works in absence of lane markings the corresponding tests from paragraphs 3.3.1. to 3.3.3. need to be repeated on a test track without lane markings.

These test requirements are fulfilled if,

(a) An ESF intervention is started; and

(b) The warnings specified in paragraph 5.1.6.2.6. of this UN Regulation are provided no later than the ESF intervention starts; and

(c) The lateral offset during the manoeuvre is 0.75 m, as specified in paragraph 5.1.6.2.2., at maximum; and

(d) The vehicle has not left the road due to the ESF intervention.

3.3.5. False reaction test for ESF Type b

The vehicle under test shall approach a plastic sheet having a colour contrast to the road surface, a thickness less than 3 mm, a width of 0.8 m and a length of 2 m positioned between the lane markings in the trajectory of the vehicle. The plastic sheet shall be positioned in a way that the vehicle could pass the sheet without crossing the lane markings.

The test requirements are fulfilled, if the ESF does not start any intervention.

3.4. (Reserved for ACSF of Category B2)

3.5. Tests for ACSF of Category C Systems

If not specified otherwise all vehicle test speeds shall be based on V_{app} = 130 km/h.

If not specified otherwise, the approaching vehicle shall be a type-approved high volume series production vehicle.

The vehicle manufacturer shall demonstrate to the satisfaction of the Technical Service that the requirements are fulfilled for the whole speed range. This may be achieved on the basis of appropriate documentation appended to the test report.

3.5.1. Lane change functional test

3.5.1.1. The test vehicle shall be driven in a lane of a straight test track, which has at least two lanes in the same direction of travel, with road markings on each side of the lanes. The vehicle speed shall be: V_{smin} + 10km/h.

The ACSF of Category C shall be activated (standby mode) and another vehicle shall approach from the rear in order to enable the system as specified in paragraph 5.6.4.8.3. above.

The approaching vehicle shall then pass the vehicle under test entirely.

A lane change into the adjacent lane shall then be initiated by the driver.

The lateral acceleration and the lateral jerk shall be recorded during the test.

3.5.1.2. The requirements of the test are fulfilled if:

(a) The lateral movement towards the marking does not start earlier than 1 second after the lane change procedure was initiated,

(b) The lateral movement to approach the lane marking and the lateral movement necessary to complete the lane change manoeuvre are completed as one continuous movement,

(c) The recorded lateral acceleration does not exceed 1m/s^2,

(d) The moving average over half a second of the lateral jerk does not exceed 5 m/s^3,

(e) The measured time between the start of the lane change procedure and the start of the lane change manoeuvre is not less than 3.0 s and not more than:

(i) 5.0 seconds in the case of an automatic initiation,

(ii) 7.0 seconds in the case of an initiation by a second deliberate action

whatever is appropriate.

(f) For systems with an initiation of the lane change manoeuvre by a second deliberate action,

(i) The measured time between the start of the lane change procedure and the second deliberate action is not more than 5.0 seconds, and

(ii) The measured time between the second deliberate action and the start of the lane change manoeuvre is not more than 3.0 seconds.

(g) The system provides an information to the driver to indicate that the lane change procedure is on-going,

(h) The lane change manoeuvre is completed in less than 5 s for M1, N1 vehicle categories and less than 10 s for M2, M3, N2, N3 vehicle categories,

(i) ACSF of Category B1 automatically resumes after the lane change procedure is completed, and

(j) The direction indicator is deactivated not before the end of the lane change manoeuvre and no later than 0.5 seconds after B1 has resumed, in case the lateral movement is initiated automatically.

3.5.1.3. The test according to paragraph 3.5.1.1. shall be repeated with a lane change in the opposite direction.

3.5.2. Minimum activation speed test $V_{smin.}$

3.5.2.1. Minimum activation speed test V_{smin} based on V_{app} = 130 km/h.

The test vehicle shall be driven within a lane of a straight track which has at least two lanes in the same direction of travel and road markings on each side of the lane.

The vehicle speed shall be: V_{smin} - 10km/h.

The ACSF of Category C shall be activated (standby mode) and another vehicle shall approach from the rear in order to enable the system as specified in paragraph 5.6.4.8.3. above.

The approaching vehicle shall then pass the vehicle under test entirely.

A lane change procedure shall then be initiated by the driver.

The requirements of the test are fulfilled if the lane change manoeuvre is not performed.

3.5.2.2. Minimum activation speed test V_{smin} based on country specific general maximum speed limit below 130 km/h.

In case V_{smin} is calculated, based on a country specific general maximum speed limit instead of V_{app} =130 km/h as specified in paragraph 5.6.4.8.1., the tests described below shall be

performed. For this purpose it is allowed to simulate the country of operation in agreement between the vehicle manufacturer and the Technical Service.

3.5.2.2.1. The test vehicle shall be driven within a lane of a straight track which has at least two lanes in the same direction of travel and road markings on each side of the lane.

The vehicle speed shall be: V_{smin} - 10km/h.

The ACSF of Category C shall be activated (standby mode) and another vehicle shall approach from the rear in order to enable the system as specified in paragraph 5.6.4.8.3. above.

The approaching vehicle shall then pass the vehicle under test entirely.

A lane change procedure shall then be initiated by the driver.

The requirements of the test are fulfilled if the lane change manoeuvre is not performed.

3.5.2.2.2. The test vehicle shall be driven within a lane of a straight track which has at least two lanes in the same direction of travel and road markings oneach side of the lane.

The vehicle speed shall be: V_{smin} + 10km/h.

The ACSF of Category C shall be activated (standby mode) and another vehicle shall approach from the rear in order to enable the system as specified in paragraph 5.6.4.8.3. above.

The approaching vehicle shall then pass the vehicle under test entirely.

A lane change procedure shall then be initiated by the driver.

The requirements of the test are fulfilled if the lane change manoeuvre is performed.

3.5.2.2.3. The manufacturer shall demonstrate to the satisfaction of the Technical Service that the vehicle is able to detect the country of operation and that the general maximum speed limit of this country is known.

3.5.3. Overriding test

3.5.3.1. The test vehicle shall be driven in a lane of a straight test track, which has at least two lanes in the same direction of travel, with road markings on each side of the lanes.

The vehicle speed shall be: V_{smin} + 10km/h.

The ACSF of Category C shall be activated (standby mode) and another vehicle shall approach from the rear in order to enable the system as specified in paragraph 5.6.4.8.3. above.

The approaching vehicle shall then pass the vehicle under test entirely.

A lane change into the adjacent lane shall then be initiated by the driver.

The steering control shall be firmly controlled by the driver to maintain the vehicle in the straight direction.

The force applied by the driver on the steering control during the overriding manoeuver shall be recorded.

3.5.3.2. The test requirements are fulfilled if the measured overriding force does not exceed 50 N, as specified in paragraph 5.6.4.3. above.

3.5.3.3. The test according to paragraph 3.5.3.1. shall be repeated with a lane change in the opposite direction.

3.5.4. Lane Change Procedure suppression test

3.5.4.1. The test vehicle shall be driven in a lane of a straight test track, which has at least two lanes in the same direction of travel, with road markings on each side of the lanes.

The vehicle speed shall be: Vsmin + 10km/h.

The ACSF of Category C shall be activated (standby mode) and another vehicle shall approach from the rear in order to enable the system as specified in paragraph 5.6.4.8.3. above.

The approaching vehicle shall then pass the vehicle under test entirely.

A Lane Change Procedure shall then be initiated by the driver.

The test shall be repeated for each of the following conditions, which shall occur before the lane change manoeuvre has started:

(a) The system is overridden by the driver;

(b) The system is switched off by the driver;

(c) The vehicle speed is reduced to: Vsmin-10 km/h;

(d) The driver has removed his hands from the steering control and the hands-off warning has been initiated;

(e) The direction indicator lamps are manually deactivated by the driver;

(f) The lane change manoeuvre has not commenced within 5.0 s following the initiation of the lane change procedure. (e.g., another vehicle is driving in the adjacent lane in a critical situation as described in 5.6.4.7.) or 7.0 seconds if initiated by a second deliberate action.

(g) The second deliberate action for an appropriate system is performed later than 5.0 seconds after the initiation of the lane change procedure.

3.5.4.2. The requirements of the test are fulfilled if the lane change procedure is suppressed, for each of the test cases above.

3.5.5. Sensor performance test

3.5.5.1. The test vehicle shall be driven in a lane of a straight test track, which has at least two lanes in the same direction of travel, with road markings on each side of the lanes.

The vehicle speed shall be: V_{smin} + 10km/h.

The ACSF of Category C shall be activated (standby mode).

Another vehicle shall approach from the rear on the adjacent lane, with a speed of 120 km/h.

The approaching vehicle shall be a type approved high volume series production motorcycle of category L_3[1] with an engine capacity not exceeding 600 cm3 without front fairing or windshield and shall aim to drive in the middle of the lane.

The distance between the rear end of the test vehicle and the front end of the approaching vehicle shall be measured (e.g. with a Differential Global Positioning System), and the value when the system detects the approaching vehicle shall be recorded.

3.5.5.2. The requirements of the test are fulfilled if the system detects the approaching vehicle no later than at the distance declared by the vehicle manufacturer (S_{rear}), as specified in 5.6.4.8.1. above.

3.5.6. Sensor blindness test

3.5.6.1. The test vehicle shall be driven in a lane of a straight test track, which has at least two lanes in the same direction of travel, with road markings on each side of the lanes.

The vehicle speed shall be: V_{smin} + 10km/h.

The ACSF of Category C shall be activated (standby mode) and another vehicle shall approach from the rear in order to enable the system as specified in paragraph 5.6.4.8.3. above.

The approaching vehicle shall then pass the vehicle under test entirely.

The rear sensor(s) shall be made blind, with means agreed between the vehicle manufacturer and the Technical Service, which shall be recorded in the test report. This operation may be carried out at standstill, provided no new engine start /run cycle is performed.

The vehicle shall be driven to a speed of V_{smin} + 10km/h, and a lane change procedure shall be initiated by the driver.

3.5.6.2. The requirements of the test are fulfilled if the system:

(a) Detects the sensor blindness,

(b) Provides a warning to the driver as defined in para. 5.6.4.8.4., and

(c) Is prevented from performing the lane change manoeuvre.

In addition to the above mentioned test, the manufacturer shall demonstrate to the satisfaction of the Technical Service that the requirements defined in paragraph 5.6.4.8.4. are also fulfilled under different driving scenarios. This may be achieved on the basis of appropriate documentation appended to the test report.

3.5.7. Engine start/run cycle test

The test is divided in 3 consecutive phases as specified below.

The vehicle speed shall be: V_{smin} + 10km/h.

3.5.7.1. Phase 1 – Default-off test

3.5.7.1.1. Following a new engine start /run cycle performed by the driver, the test vehicle shall be driven in a lane of a straight test track, which has at least two lanes in the same direction of travel, with road markings on each side of the lanes.

The ACSF of Category C shall not be activated (off mode) and another vehicle shall approach from the rear and the approaching vehicle shall pass the vehicle entirely.

A lane change procedure and manoeuvre shall then be initiated by the driver with the appropriate deliberate action(s).

3.5.7.1.2. The requirements of the test phase 1 are fulfilled if the lane change manoeuvre is not initiated.

3.5.7.2. Phase 2

The objective of the test is to check that the lane change manoeuvre is prevented if the system has not detected any moving object at a distance equal or greater than the distance Srear (as specified in paragraph 5.6.4.8.3.).

3.5.7.2.1. Following a new engine start / run cycle performed by the driver, the test vehicle shall be driven in a lane of a straight test track, which has at least two lanes in the same direction of travel, with road markings on each side of the lanes.

The ACSF of Category C shall be manually activated (standby mode).

A lane change procedure and manoeuvre shall then be initiated by the driver with the appropriate deliberate action(s).

3.5.7.2.2. The requirements of the test phase 2 are fulfilled if the lane change manoeuvre has not started (as the pre-condition specified in 5.6.4.8.3. is not fulfilled).

3.5.7.3. Phase 3 – Lane change enabling conditions test

The objective of the test is to check that the lane change manoeuvre is only possible once the system has detected a moving object at a distance equal or greater than the distance S_{rear} (as specified in paragraph 5.6.4.8.3.).

3.5.7.3.1. Following the completion of the test phase 2, another vehicle shall approach from the rear on the adjacent lane in order to enable the system as specified in paragraph 5.6.4.8.3.

The approaching vehicle shall be a type approved high volume series production vehicle.

The distance between the rear end of the test vehicle and the front end of the approaching vehicle shall be measured (e.g. with a differential GPS), and the value when the system detects the approaching vehicle be recorded.

After the rear coming vehicle has entirely passed the vehicle under test, a lane change procedure and manoeuvre shall be initiated by the driver with the appropriate deliberate action(s).

3.5.7.3.2. The requirements of the test phase 3 are fulfilled if:

(a) The lane change manoeuver is executed;

(b) The approaching vehicle is detected no later than at the distance declared by the vehicle manufacturer (S_{rear}).

APPENDIX B
Statement of Compliance for Automated Vehicles

1. Definitions

1.1. *"Advanced Emergency Braking (AEB)"* means a system that enables automatic activation of the brakes (without driver input) in order to mitigate or avoid a collision.

1.2. *"Automated Driving System (ADS)"* means the hardware and software that are collectively capable of performing the entire *DDT* on a sustained basis, regardless of whether functionality is limited to a specific *ODD*. This term is used in this appendix to denote a *Level of Automation* of 3 to 5 and includes vehicles equipped with any steering system exhibiting the functionality defined as an *ACSF* of Category B2, D or E as defined in Appendix A.

1.3. *"Automated Driving System Entity (ADSE)"* means the holder of a *Granted Type Approval* for a road vehicle that complies with Australian Design Rule (ADR) 90/01 for an *ADS*.

1.4. *"Brake Assist System (BAS)"* as defined in Vehicle Standard (Australian Design Rule 31/04 – Brake Systems for Passenger Cars) 2017.

1.5. *"Corrective Steering Function (CSF)"* means a control function within an electronic control system whereby, for a limited duration, changes to the steering angle of one or more wheels may result from the automatic evaluation of signals initiated on-board the vehicle, in order to:

(a) compensate a sudden, unexpected change in the side force of the vehicle; or,

(b) improve vehicle stability (e.g. side wind, differing adhesion road conditions "μ-split"); or,

(c) correct lane departure. (e.g. to avoid crossing lane markings, leaving the road).

1.6. *"Cybersecurity"* is the condition in which road vehicles and their functions are protected against threats to and manipulation of electrical or electronic components, or as otherwise defined in UN Regulation No. 155 (Cyber security and cyber security management system).

1.7. *"Dynamic Driving Task (DDT)"* is the set of real-time operational and tactical functions required to operate a road vehicle in road traffic, excluding the strategic functions such as trip scheduling and selection of destinations and waypoints, as defined by SAE International J3016.

1.8. *"DDT Fallback"* means a response by the *Operator* to a *Request to Intervene* where the *Operator* begins to conduct the *DDT*.

1.9. *"DDT Performance-Relevant System Failure"* means a malfunction in an *ADS* or other vehicle system that compromises *DDT* performance (partial or complete), including:

(a) compromised sensor performance, field of view or range;

(b) compromised control actuation;

(c) algorithmic or processing failure;

(d) de-calibration; and

(e) vehicle or *ADS* component damage, including to any essential chassis and running gear such as brakes, mechanical steering connections and tyres.

1.10. *"Design Life"* means the duration in years, from the issue of a *Granted Type Approval*, which the *ADSE* supports the in-service operation of the *ADS* according to this appendix.

1.11. *"Digital Storage Systems for Automated Driving (DSSAD)"* is a system compliant with [Draft UN Regulation DSSAD].

1.12. *"Disengage"* means an integrated function where the *ADS* ceases to conduct the *DDT*.

1.13. *"Electronic Stability Control (ESC)"* as defined in Vehicle Standard (Australian Design Rule 31/04 – Brake Systems for Passenger Cars) 2017.

1.14. *"Emergency Manoeuvre"* means an urgent limited duration manoeuvre conducted with the purpose of avoiding or mitigating a collision or minimising *Safety Risk* where there is insufficient time to complete *DDT Fallback* and which is not a *MRM*.

1.15. *"Engage"* means an integrated function where the *ADS* begins to conduct the *DDT*.

1.16. *"Event Data Recorder"* means a system solely designed for the purpose of indelibly recording and retaining, for authorised access only, critical *ADS* status information prior to, during, and after a *Safety Risk Event*, or as otherwise defined in UN Regulation No. 160.

1.17. *"Fallback-Ready User"* means the *Operator* responsible for *DDT Fallback*.

1.18. *"Granted Type Approval"* means the Type Approval granted under the RVSA to an *ADSE* for an *ADS*.

1.19. *"Human-Machine Interface (HMI)"* is the set of information and control interfaces between an *ADS* and *Operator*.

1.20. *"Lane Keeping Assist (LKA)"* as defined for *"ACSF of Category B1"* in Annex A Paragraph 2.3.4.1.2.

1.21. *"Level of Automation"* means the categorisation of an automated system according to its capability to conduct the *DDT* without *Operator* involvement, given by a numerical value of 0 to 5 as defined by SAE International J3016.

1.22. *"Minimal Risk Condition"* means a stationary condition to which an *ADS* brings the vehicle in order to minimise *Safety Risk*. The vehicle must stop in a legally permissible position on or next to the roadway, as far as practicable.

1.23. *"Monitor"* is a general term referencing a range of functions involving real-time human or machine sensing and processing of data used to operate a vehicle, or to support its operation.

1.24. *"Minimum Risk Manoeuvre (MRM)"* means a manoeuvre that brings the vehicle to a *Minimal Risk Condition* in a manner that minimises *Safety Risk* and discomfort to occupants.

1.25. *"Non-Permitted Activities"* means the activities that an *Operator* is not permitted to conduct while the *ADS* is engaged.

1.26. *"Object and Event Detection and Response (OEDR)"* means the subtasks of the *DDT* that include *Monitoring* the driving environment (detecting, recognizing, and classifying objects, events and *Safety Risks* and preparing to respond as needed) and executing an appropriate response.

1.27. *"Operational Design Domain (ODD)"* means the specific conditions under which a given *ADS* or feature thereof is designed to function, including, but not limited to, driving modes and as additionally set out in SAE International J3016 as amended from time to time.

1.28. *"Operator"* means a person capable of *Engaging* and *Disengaging* the *ADS*, and/or is the *Fallback-Ready User* who is receptive to *Requests to Intervene*, and is capable of interacting with *ADS HMI*. The *Operator* performs the *DDT* (with or without support from *Level of Automation* 1 or 2 features) when the *ADS* is *Disengaged*.

1.29. *"Operator Availability Recognition System (OARS)"* means a system that is capable of determining if the *Operator* is available to perform the tasks required of an *Operator*.

1.30. *"Override"* means the *Operator's* ability to *Disengage* or influence the *ADS* via driving controls or other *HMI*.

1.31. *"Redundancies"* means a system that integrates redundant computing module(s) and provides backup for critical pieces of equipment or logical processes, allowing the *ADS* to continue to function in the event of a *DDT Performance-Relevant System Failure*.

1.32. *"Request to Intervene"* means a notification issued by an *ADS* to an *Operator* after occurrence of a *DDT Performance-Relevant System Failure* or upon *ODD* exit, indicating that the *Operator* should promptly conduct *DDT Fallback* [based on SAE J3016].

1.33. *"Safety Critical Function"* any function that if it fails can result in a *DDT Performance-Relevant System Failure*.

1.34. *"Safety Risk"* means any risk to the wellbeing of vehicle occupants or persons in the vicinity of the operating vehicle, including *Safety Risk Events*.

1.35. *"Safety Risk Events"* means any event that involves a *Safety Risk*, including:

(a) contact or collision with vehicles, infrastructure, road users, animals or objects;

(b) *DDT Performance-Relevant System Failures*;

(c) *HMI* failures;

(d) false *OEDR*;

(e) compromised performance in adverse conditions including inclement weather and poor road or infrastructure quality;

(f) *MRM*s;

(g) *Emergency Manoeuvres*;

(h) undertaking non-permitted activities;

(i) unnecessary and/or excessively aggressive manoeuvres such as those causing loss of traction or skidding;

(j) illegal operation; and,

(k) misuse.

1.36. *"Secondary Activities"* means the non-*DDT* activities that an *Operator* is permitted to conduct while the *ADS* is *Engaged*.

1.37. *"Self-Check"* means an integrated *ADS* function that checks *Safety Critical Functions* upon *Operator* request, prior to *Engagement*, and on a semi-continuous basis at least while the *ADS* is *Engaged*.

1.38. *"Vulnerable Road User (VRU)"* means a road user using a one or multiple-wheel powered vehicle without protective bodywork, or a non-motorised road user such as a cyclist or a pedestrian.

2. Requirements

2.1. All **Safety Assurance** requirements of Section 3 and all **Documentation Requirements** of Section 4 must be met; or

2.2. the vehicle must be approved to UN Regulation No. 157 (Automated Lane Keeping Systems) and meet the requirements of:

(a) Section 3.2.32 to 3.2.38; and,

(b) Section 3.3; and,

(c) Section 4.2.5 to 4.2.29.

3. Safety Assurance

3.1. General

This section sets out safety assurance requirements that an *ADSE* must address in the development, operation and support of a road vehicle fitted with an *ADS*. It is intended to ensure that thorough consideration of functional and operational safety has been performed by the *ADSE* during design and development processes and will continue to be considered throughout the *ADS' Design Life* (design, development, production, operation and decommissioning).

In general, when *Engaged* within the *ODD*, the *ADS* must perform the *DDT* instead of the *Operator*, i.e., manage all situations including failures, and must not endanger the safety of road

vehicle occupants or other road users. There must always be the possibility for the *Operator* to *Override* the *ADS* at any time.

Safety assurance requirements include *ADSE* design/development requirements and *ADS* performance and behavioural requirements. In addressing these, the *ADSE* must adopt processes that identify and mitigate *Safety Risks*. Through meeting the **Documentation Requirements** of Section 4 of This Standard, the *ADSE* must identify residual *Safety Risks* and justify that any residual *Safety Risk* does not compromise that the *ADS* is fit for purpose. As such, the safety, performance and support of the *ADS* over its *Design Life* remains the responsibility of the *ADSE*.

3.2. *ADSE* Requirements

Safe Design

3.2.1. The *ADSE* must design, validate and verify the *ADS* according to processes that identify and mitigate *Safety Risks* that may arise when the *ADS* is Engaged in its *ODD*.

3.2.2. The *ADSE* must design the *ADS* to operate in a manner that is free from unreasonable risks to occupants and other road users when Engaged over the duration of its *Design Life*.

3.2.3. The *ADSE* must design *ADS* components to be consistent with Annex 6 - Special requirements to be applied to the safety aspects of complex electronic vehicle control systems, of 03 or later series of UN Regulation No. 79 (Steering equipment).

3.2.4. The *ADSE* must design the *ADS* to be consistent with Annex 5 - Design principles for Control Systems of Advanced Driver Assistance System (ADAS), UNECE Consolidated Resolution on the Construction of Vehicles (R.E.3).

3.2.5. The *ADSE* must design *ADS HMI* according to a process that considers safe and efficient operation. For example, consistent with Annex 5 – Appendix Human-Machine Interaction (HMI) - Considerations for control systems of ADAS, UNECE Consolidated Resolution on the Construction of Vehicles (R.E.3).

3.2.6. The *ADSE* must design *ADS Safety Critical Functions* to be consistent with relevant guidance, industry best practices, design principles and standards as developed by established standards organisations, for example, ISO 26262, ASIL, SPICE standards, or equivalent.

3.2.7. The *ADSE* must design the *ADS* such that it is not adversely affected by magnetic or electrical fields. This may be demonstrated by compliance with the 05 or later series of UN Regulation No. 10 (Electromagnetic compatibility).

3.2.8. The *ADSE* must design the *ADS* such that *OEDR*, including sensor range and resolution, enables safe *DDT* performance in the *ODD*.

3.2.9. The *ADSE* must take measures to protect the *ADS* against reasonably foreseeable misuse and tampering.

3.2.10. The *ADSE* must design the *ADS* to recognise all situations in which it needs to transition *DDT* control back to the *Operator*.

3.2.11. The *ADSE* must adopt design processes that identify the need for redundancies and/or failsafe support in all *Safety Critical Functions*.

3.2.12. The *ADSE* must maintain records of all design processes and design decisions related to meeting the **Documentation Requirements** of Section 4 of This Standard. Records must be maintained according to an auditable management system satisfying the requirements of ISO 9001:2015 quality management systems, or equivalent.

3.2.12.1 The *ADSE* must notify the Administrator of changes to the design of the *ADS*, its components, or its *ODD*, where they vary from the documentation provided or retained according to the **Documentation Requirements** of Section 4 of This Standard.

Operational Safety

3.2.13. The *ADSE* must verify operation of each *Safety Critical Function* of the *ADS* by real world test drives, physical tests and/or simulations. Simulations by themselves may be used for verifying *Emergency Manoeuvres*.

3.2.14. The *ADSE* must ensure that any perception malfunction (such as a detection failure without other system failure) does not induce a hazardous event.

3.2.15. The *ADSE* must develop *ADS* failsafe responses which include consideration of how the *DDT* is safely handed over from the *ADS* to the *Operator*, including the capability for the *ADS* to come to a stop in the case the *Operator* does not respond appropriately.

3.2.16. In mitigating severe vehicle or *ADS* failures, the *ADSE* may design the *ADS* to employ different strategies with regard to *Override* of the *ADS*. These strategies must be designed, and their effectiveness verified, with regard to ensuring a safe transition of control from the *ADS* to the *Operator*.

Operational Design Domain (*ODD*)

3.2.17. The *ADSE* must declare the *ODD* limits for the *ADS.*

3.2.18. The *ADSE* must not expand the *ODD.*

3.2.19. The *ADSE* must advise the vehicle owner of any reduction of the *ODD* or change in allowed *Secondary Activities* while the vehicle is in service for at least the *Design Life* of the *ADS.*

3.2.20. The *ADSE* must ensure that the *ADS* safely interacts with the *Operator* when *ODD* limits are reached, including consideration of all situations in which the *ADS* generates a *Request to Intervene*.

3.2.21. The *ADSE* must declare the scope of *Secondary Activities* that the *Operator* is permitted to conduct while the *ADS* is *Engage*d in the *ODD.*

Design Life

3.2.22. The *Design Life* must be at least equal to the period of validity of the *Granted Type Approval*.

3.2.23. The *ADSE* must ensure that the requirements of This Standard continue to be met while the vehicle is in service for at least the *Design Life* of the *ADS.*

3.2.24. The *ADSE* must notify vehicle owners that the *Design Life* of an *ADS* has been exceeded.

3.2.25. The *ADSE* must ensure that the effects of wear and ageing do not reduce *ADS* performance below the requirements of This Standard over the *Design Life* of the *ADS.*

Installation of System Updates

3.2.26. The *ADSE* must implement a process to manage the safety and continued compliance of the *ADS* with the requirements of This Standard over its *Design Life*.

3.2.27. The *ADSE* must notify vehicle owners of the availability and nature of updates.

3.2.28. The *ADSE* must ensure that update procedures are as simple and automatic as practicable.

Education

3.2.29. The *ADSE* must have a process to deliver education and training to owners, *Operators*, repairers and all other relevant parties that will minimise the *Safety Risks* of operating the *ADS*. This must explain the reasons for the education and training chosen and how it will facilitate proper and safe use of the *ADS*. The process must cover the duration of the *Design Life* of the *ADS.*

3.2.30. The education and training process must provide clear, comprehensive and consumer-friendly information covering the functioning of the *ADS* and *ADS*-related systems and features, as applicable to the vehicle type and vehicle users.

3.2.31. The education and training process must take into consideration, but is not limited to:

(a) training *Operators* to safely *Engage*, *Override* or *Disengage* the *ADS*, as well as the means by which the *ADS* prevents unintentional disengagement, identifies *Operator* attentiveness and detects that the *Operator* is available to take over the *DDT*;

(b) informing *Operators* of their obligations and responsibilities;

(c) informing owners and *Operators* of the *ADS*' capabilities by clearly describing its automated capability, its *ODD*, its *Level of Automation*, its use limitations, and restrictions on modifications;

(d) communicating the importance of software updates;

(e) facilitating the maintenance and repair of the *ADS*, including post-crash before it is put back in service;

(f) facilitating employee, dealer and distributor understanding of the *ADS* and its operation so relevant information can be accurately conveyed to owners and *Operators;* and,

(g) ongoing education and training for owners and *Operators* who may not be the original vehicle owner or *Operator*.

Compliance with Road Rules

3.2.32. The *ADSE* must ensure that, when *Engaged*, the *ADS* operates in compliance with all applicable Australian state and territory road traffic laws and where there is no contradiction, the Australian road rules.

3.2.33. The *ADSE* must implement a process to ensure continued compliance with any amendments to relevant road traffic laws when they come into force.

Interaction with Enforcement and Emergency Services

3.2.34. The *ADSE* must implement a process to provide enforcement personnel and/or agencies with immediate access to the following recorded data, where those personnel and/or agencies are authorised to request it:

(a) *ADS* software versions;

(b) *ADS Engagement* and *Level of Automation* history;

(c) *Self Check* history;

(d) *Requests to Intervene* history;

(e) *DSSAD* history; and,

(f) [the identity of the vehicle].

3.2.35. Authorised access to recorded data must be available at the roadside for at least the *Design Life* of the *ADS*. The *ADSE* must support authorised access to recorded data either digitally, through the vehicle *HMI*, or via immediate contact with the *ADSE*.

On-road Behavioural Competency

3.2.36. The *ADSE* must implement processes to maintain the *ADS*' on-road behavioural competency. The process must identify any potential or residual need for the *ADS* to *Disengage* once *Engaged*. Competencies that must be considered include the *ADS*':

(a) *OEDR;*

(b) crash avoidance strategies;

(c) ability to respond to unusual events;

(d) ability to interact with other road users including *VRUs*;

(e) ability to recognise and manage accordingly temporary speed zones, construction zones, and variable speed signs;

(f) operation of *Requests to Intervene*; and,

(g) operation of *MRMs* and any *Emergency Manoeuvres*.

Verifying for the Australian Road Environment

3.2.37. The *ADSE* must implement a process to verify the functionality of the *ADS* in the Australian road environment, including changeable environments, within its *ODD*, such as:

(a) interaction with road signs and other infrastructure in all Australian states and territories;

(b) interaction with Australian flora and fauna;

(c) weather conditions; and,

(d) variable illumination levels.

3.2.38. Verification processes must include on-road test drives and/or simulations as practicable. Simulations by themselves must only be used for verifying performance in situations where collisions occur.

3.3. *ADS* Performance Requirements

Operational Design Domain (ODD)

3.3.1. When approaching *ODD* limits, the *ADS* must issue a warning and a *Request to Intervene* through *HMI*.

Operational Safety

3.3.2. When the requirements of This Standard are not met, it must not be possible to *Engage* the *ADS*.

3.3.3. When *Engaged*, the *ADS* must perform the *DDT*, must manage all situations including failures, and shall be free of unreasonable risks for the vehicle occupants or any other road users.

3.3.4. The *ADS* must incorporate redundancies and/or failsafe modes for *Safety Critical Function*s, including where the following has occurred:

(a) unsafe maintenance, repair or physical modification;

(b) *OEDR* failure;

(c) *DDT Performance-Relevant System Failure*; or,

(d) *Cybersecurity* intrusion.

3.3.5. The *ADS* must suspend, or request the *Operator* to suspend, *Secondary Activities* (such as the use of on-board displays) as soon as *Override*, a *Request to Intervene*, a *MRM*, *Emergency Manoevure*, or any system warning occurs, or if the *Operator Disengages* the *ADS*.

Engagement

3.3.6. The vehicle must be equipped with dedicated means for the *Operator* to *Engage* and *Disengage* the *ADS*. When the *ADS* is *Engaged*, the means to *Disengage* the *ADS* shall be permanently visible to the *Operator*.

3.3.7. The default status of the *ADS* must be *Disengaged* at the initiation of each new vehicle start/run cycle. This requirement does not apply when a new start/run cycle is performed automatically, e.g. by the operation of a stop/start system.

3.3.8. The *ADS* must not *Engage* if:

(a) the *Operator* is not wearing a seatbelt, or not available for *DDT Fallback;*

(b) there is a *Safety Risk*, or *Self-Check* failure prior to or during *Engagement*;

(c) outside of its *ODD; or,*

(d) its *Design Life* is exceeded.

3.3.9. The *ADS* may only become *Engaged*

(a) upon a deliberate action by the *Operator;* and,

(b) when *DSSAD* is operational.

3.3.10. When *Engaged*, all *Level of Automation* 1 or 2 safety systems fitted to the vehicle, such as *AEB*, *ESC* or *BAS* must continue to be active.

Disengagement

3.3.11. It must be possible to manually *Disengage* the *ADS* by an intentional action of the *Operator* using the same means as to *Engage* the *ADS*, or by deliberate *Operator Override*.

3.3.12. The means of *Disengagement* must provide protection against unintentional manual *Disengagement*, for example by requiring a single input exceeding a certain threshold of time or a double press, or two separate but simultaneous inputs.

3.3.13. When *Disengaging*, the *ADS* must ensure the *Operator* has control of the vehicle at the time of the *Disengagement*, for example by placing the *Disengagement* means on the steering control or confirming the *Operator* is holding the steering control.

3.3.14. When *Disengaging*, there must not be an automatic transition to any *Level of Automation* 3 or 4 *ADS* function, for instance those which provide continuous longitudinal and/or lateral control of the vehicle.

3.3.15. The *ADS* must *Disengage* if:

(a) the *Operator* is not wearing a seatbelt, or not available for *DDT Fallback;*

(b) there is a *Safety Risk*, system failure, or *Self-Check* failure during *Engagement*;

(c) outside of its *ODD;*

(d) its *Design Life* is exceeded; or,

(e) involved in a *Safety Risk Event.*

3.3.16. The *ADS* must only *Disengage* if *Overridden* by the *Operator* or by completing a *Request to Intervene* or a *MRM*.

3.3.17. In case of a severe vehicle or *ADS* failure, different Disengagement strategies may be employed.

3.3.18. After *Disengaging*, all *Level of Automation* 1 or 2 safety systems fitted to the vehicle, such as *AEB, ESC, LKA* or *BAS* must continue to be active.

3.3.19. After *Disengaging*, *CSFs* may be active with the aim to accustom the *Operator* to execute *DDT*, for instance through a gradual transition of steering support.

Override

3.3.20. It must be possible for the *Operator* to easily and at any time *Override* the *ADS*.

3.3.21. *Operator* steering must *Override* the lateral control function of an *Engaged ADS*.

3.3.22. *Operator* input to the brake and accelerator controls must *Override* the longitudinal control functions of an *Engaged ADS*.

3.3.23. *Override* may be reduced or suppressed by the *ADS* in case that an imminent collision risk is detected.

Request to Intervene

3.3.24. *Requests to Intervene* must provide sufficient lead time for the *Operator* to undertake *DDT Fallback*. Where sufficient lead time is not possible, the *ADS* may perform an *Emergency Manoeuvre*, but must perform a *MRM* and must notify the *Operator* through *HMI* that the manoeuvre(s) was/were initiated due to insufficient lead time.

3.3.25. Where an *Operator* has not undertaken *DDT Fallback* within 10 seconds of a *Request to Intervene*, the *ADS* must execute a *MRM*.

3.3.26. Until the *Operator* has undertaken *DDT Fallback*, the *ADS* must continue to handle *DDT*. The *ADS* may reduce the speed of the vehicle if it improves safety, but must not bring it to standstill unless required by the situation (e.g. due to vehicles or obstacles obstructing the path of the vehicle).

3.3.27. In case of any failure affecting the operation of the *ADS*, a *Request to Intervene* must be initiated immediately.

3.3.28. The *ADS* must exercise control over systems required to support the *Operator* in resuming manual control at any time (e.g. demister, windscreen wipers and lights).

Minimum Risk Manoeuvre (MRM)

3.3.29. During a *MRM*, the *ADS* must minimise risks to safety of vehicle occupants and other road users.

3.3.30. During a *MRM*, the vehicle must be slowed inside the lane or on the road shoulder; or, in the case that lane markings are not present, remain on an appropriate trajectory taking into account surrounding traffic and road infrastructure.

3.3.31. In slowing the vehicle, the *MRM* should aim to achieve a deceleration demand not greater than 4.0 m/s^2. Higher deceleration demand values are permissible for very short durations, e.g. as haptic warning to stimulate the *Operator's* attention, or in case of a severe *ADS* or vehicle failure.

3.3.32. The *ADS* must advise the *Operator* through *HMI* that a *MRM* is occurring.

3.3.33. The *MRM* must bring the vehicle to a standstill unless the *ADS* is deactivated by the *Operator* during the manoeuvre.

3.3.34. When at standstill, the vehicle may remain in this condition and must generate the signal to activate the hazard warning lights within 5 seconds.

3.3.35. A *MRM* may be initiated immediately in case of a severe *ADS* or vehicle failure. In this case the *ADS* may no longer be capable of fulfilling the requirements of This Standard, but it shall aim at enabling a safe transition of control back to the *Operator*. Additionally, the signal to activate the hazard warning lights must be generated with the start of the *MRM*.

3.3.36. The *ADS* must *Disengage* upon completion of a *MRM*.

3.3.37. The hazard warning lights must remain activated unless deactivated by the *Operator*.

Self-Check

3.3.38. The *ADS* must incorporate a *Self-Check* function.

3.3.39. The *Self-Check* function must detect the occurrence of failures and confirm *ADS* performance at all times.

3.3.40. The *ADS* must *Disengage* if a *Safety Critical Function* failure is detected by the *Self-Check* function.

3.3.41. The *ADS* must immediately inform the *Operator* through *HMI* of any *Self-Check* failure.

Design Life

3.3.42. The *ADS* must immediately *Disengage* if *Engaged* when the *Design Life* is exceeded.

3.3.43. The *ADS* must indicate to the *Operator* through *HMI* if the *Design Life* has been exceeded.

Human-Machine Interface (HMI)

3.3.44. The *HMI* must be able to detect the presence or absence of the *Operator*.

3.3.45. The *HMI* must indicate to the *Operator* by at least an optical signal that the *ADS* is *Engage*d, and may inform the *Operator* whether the *ADS* can be *Engaged.*

3.3.46. When *Engaged*, the *HMI* must indicate to the *Operator* by at least an optical signal and either an acoustic or haptic signal:

(a) *Requests to Intervene*;

(b) *MRMs*;

(c) *Emergency Manoeuvres*;

(d) Interactions with enforcement agencies and emergency services; and,

(e) Detected *Safety Risk Events*.

3.3.47. Where the *Engaged ADS HMI* detects that the *Operator* is no longer conducting permitted *Secondary Activities*, the *HMI* must warn the *Operator*. If the *Operator* is not detected to have resumed permitted *Secondary Activities* within 10 seconds, a *Request to Intervene* must be issued.

3.3.48. When the *ADS* is *Engage*d, *HMI* must only allow display of video content if it forms part of an allowable *Secondary Activity*, or as otherwise permitted in Section 13 (Television and Visual Display Units) of Vehicle Standard (Australian Design Rule 42/05 – General Safety Requirements) 2018, where 'the driver' is the *Operator*.

3.3.49. *HMI* must not startle, distract, confuse or overwhelm an *Operator* who is conducting the *DDT*.

Prioritization of warnings

3.3.50. When the *ADS* is *Engaged*, *HMI* should prioritise warnings for *Requests to Intervene*, *MRM* and *Emergency Manoeuvres* where they conflict with other vehicle notifications.

Operator Availability Recognition

3.3.51. In order to issue a *Request to Intervene*, the *ADS* must incorporate an *OARS* that detects if the *Operator* is available to conduct *DDT* and that the safety belt of the *Operator* is fastened.

3.3.52. When the *ADS* is *Engaged*, the *OARS* must issue a *Request to Intervene* if the *Operator* is not present or their seatbelt is unbuckled.

3.3.53. The *Operator* is deemed to be unavailable unless at least two availability criteria (e.g. input to *Operator*-exclusive vehicle control, eye blinking, eye closure, conscious head or body movement) have individually determined that the *Operator* is available in the last 30 seconds.

3.3.54. The *OARS* shall detect if the *Operator* is attentive. The *Operator* is deemed to be attentive when at least one of the following criteria is met:

(a) *Operator* gaze direction is confirmed as primarily looking at the road ahead;

(b) *Operator* gaze direction is being confirmed as looking at the rear-view mirrors; or,

(c) *Operator* head movement is confirmed as primarily directed towards the *DDT*.

3.3.55. In case of a severe *ADS* or vehicle failure, different strategies with regard to *Override* may be employed.

Cybersecurity

3.3.56. The effectiveness of the *ADS* must not be adversely affected by cyber-attacks, cyber threats/ vulnerabilities.

3.3.57. The effectiveness of cyber security measures must be demonstrated by compliance with UN Regulation No. 155 (Cyber security and cyber security management system).

System Updates

3.3.58. The effectiveness of software update procedures and processes must be demonstrated by compliance with UN Regulation No. 156 (Software update and software update management system).

3.3.59. For the purpose of ensuring *ADS* software can be identified, an R156SWIN as defined by UN Regulation No. 156 (Software update and software update management system) may be implemented by the *ADSE*. If R156SWIN is not implemented, an alternative software identification system (i.e. software version) must be implemented.

3.3.60. If the *ADSE* implements an R156WIN, the *ADSE* must have a valid approval to UN Regulation No. 156 (Software update and software update management system).

3.3.61. The *ADS* must notify the *Operator*, through *HMI*, of the availability of any update, its nature and effect on *ADS* operation.

3.3.62. Until an available update has been successfully installed, the *ADS* must alert *Operator*s to any update failure and of any pending update through *HMI* at each subsequent ignition cycle.

3.3.63. The *ADS* must not *Engage* if updates to *Safety Critical Functions* become available but have not been successfully installed.

3.3.64. After successfully installing any update and before subsequent *Engagement* of the *ADS:*

(a) a successful *Self-Check* must be conducted; and,

(b) the *HMI* must clearly convey to, and receive acknowledgement from, the *Operator* of any variation to operational procedures, permissible *Secondary Activities* and the *ODD*.

3.3.65. Where a software version can be changed without requiring replacement of the marking or component, the software identification must be by software output only.

3.3.66. Where functions are combined within a single unit or within a single computer, only a single hardware identification marking must be used.

3.3.67. The *ADSE* must, by the use of equipment and software identifications that define hardware and software versions, affirm that the equipment and software supplied conforms to those approved and documented to This Standard.

Education

3.3.68. The vehicle owner's manual must provide information about the *ADS* and related systems and features and explain how to use them. Information must be clear, comprehensive and consumer-friendly.

3.3.69. The *HMI* must, while the vehicle is stationary, provide the opportunity for an *Operator* to become familiar with at least:

(a) the *ODD*;

(b) the *Request to Intervene* procedure; and,

(c) *Override* procedures.

3.3.70. The vehicle owner's manual or *HMI* must inform the *Operator* about the *Secondary Activities* that an *Operator* is permitted to conduct.

3.4. *ADS* Behaviour Requirements

Compliance with Road Rules

3.4.1. Except as allowed for in Clause 3.4.2 below, the *ADS* must operate in compliance with all applicable Australian state and territory road traffic laws and where there is no contradiction, the Australian road rules, that fall within the *ODD*.

3.4.2. The *ADS* may temporarily operate not in compliance with all applicable state and territory road traffic laws or Australian road rules where strict compliance is not possible due to a road environment related hazard or *DDT*-related emergency. [The *ADS* must retain a record of any instances of this through the *DSSAD*].

Collision Avoidance

3.4.3. The *ADS* must adapt the vehicle speed to infrastructure and environmental conditions (e.g. narrow curve radii, inclement weather).

3.4.4. When *Engaged*, the *ADS* must not cause any collisions that are reasonably foreseeable and preventable. If a collision can be safely avoided without causing another one, it must be avoided.

3.4.5. When *Engaged*, if the vehicle is involved in a detectable collision the *ADS* must bring the vehicle to a standstill.

Emergency Manoeuvres

3.4.6. An *Emergency Manoeuvre* must be carried out in case of an imminent collision risk.

3.4.7. Any *Emergency Manoeuvre* must not compromise safety critical systems such as *AEB*, *ESC*, and *ABS*.

3.4.8. If failures are affecting the braking or steering performance of the *ADS*, the *Emergency Manoeuvre* must be carried out with consideration of the remaining performance.

3.4.9. An *Emergency Manoeuvre* must not be terminated unless the imminent collision risk has disappeared, or the *Operator Disengages* the *ADS*.

3.4.10. Any deceleration demand of more than 5.0 m/s² is considered to be an *Emergency Manoeuvre*.

3.4.11. The *Emergency Manoeuvre* must decelerate the vehicle up to its full braking performance if necessary and/or may include evasive steering when appropriate. After any evasive steering, the *ADS* must attempt to resume stable vehicle control.

3.4.12. After an E*mergency Manoeuvre* is terminated the *ADS* must remain *Engaged*.

3.4.13. If the *Emergency Manoeuvre* results in the vehicle being at standstill, the signal to activate the hazard warning lights must be generated. If the vehicle automatically resumes *DDT*, the signal to deactivate the hazard warning lights must be generated automatically.

Interaction with Enforcement and Emergency Services

3.4.14. The *ADS* must notify the *Operator* through *HMI* upon detecting enforcement or emergency vehicles or personnel, and must *Disengage* if interacting with these vehicles or personnel is outside of its *ODD*.

On-road Behavioural Competency

3.4.15. *ADS* driving behaviours must avoid confusing other road users.

3.4.16. The *ADS* must have sufficient *OEDR* capabilities and other on-road behavioural competencies to minimise the need for the *ADS* to *Disengage* once *Engaged*.

3.4.17. A *Level of Automation 3 ADS* must have on-road behavioural competency for the *DDT* within the *ODD*, otherwise it must *Disengage* using a *Request to Intervene*.

3.4.18. A *Level of Automation 4 or 5 ADS* must have on-road behavioural competency for the *DDT* within the *ODD*, otherwise it must *Disengage* using a *MRM*.

4. Documentation Requirements

4.1. Purpose and Suitability

This section covers the documentation which the *ADSE* must provide at time of approval and/or retain in accordance with record keeping requirements under the RVSA.

The documentation must:

(a) disclose *ADSE* processes;

(b) establish that the *ADS* has been developed according to the *ADSE* processes;

(c) demonstrate that the *ADS* meets performance requirements ;

(d) identify residual *Safety Risks*; and,

(e) assure that residual *Safety Risks* are acceptable for the safe operation of the *ADS*.

Documentation is used to verify, through audit in part or full, that *ADSE* argumentation provided is strong enough and that the design and processes described in documentation are actually implemented by the *ADSE*.

Documentation must be brief, yet provide evidence that the design and development has had the benefit of expertise from all the system fields which are involved.

4.2. Documentation of *ADSE* Requirements

Safe Design

4.2.1. The *ADSE* must provide a description of its design, validation and verification processes, with an explanation of how these ensure that the *ADS* mitigates *Safety Risks* when *Engaged* for the duration of its *Design Life*. Design methods and tools used must be identified.

4.2.2. The *ADSE* must retain documentation that ensures the *ADS* has been designed to operate in a manner that is free from unreasonable risks to occupants and other road users when *Engaged* over the duration of its *Design Life.*

4.2.3. The *ADSE* must provide a completed assessment report from Appendix 1- Model assessment form for electronic systems, Annex 6 (Special requirements to be applied to the safety aspects of electronic control systems) of 03 or later series of UN Regulation No. 79 (Steering equipment).

4.2.4. The *ADSE* must provide documentation demonstrating the *ADS* has been designed to be consistent with the requirements of Annex 5 – Design Principles for Control Systems of Advanced Driver Assistance System (ADAS), of UNECE Consolidated Resolution on the Construction of Vehicles (R.E.3).

4.2.5. The *ADSE* must provide documentation demonstrating the *ADS HMI* has been designed according to a process that considers safe and efficient operation. It is recommended the documentation is consistent with Annex 5 – Appendix: Human-Machine Interaction (HMI) - Considerations for control systems of ADAS, of UNECE Consolidated Resolution on the Construction of Vehicles (R.E.3).

4.2.6. The *ADSE* must provide documentation demonstrating the design of the *ADS Safety Critical Functions* is consistent with relevant guidance, industry best practices, design principles and standards as developed by established standards organisations, for example ISO 26262, ASIL, SPICE standards or equivalent.

4.2.7. The *ADSE* must retain documentation demonstrating the *ADS* has been designed such that it is not adversely affected by magnetic or electrical fields. This may be through compliance with the 05 or later series of UN Regulation No. 10 (Electromagnetic Compatibility).

4.2.8. The *ADSE* must provide documentation demonstrating the *ADS* has been designed such that the *OEDR*, including the sensor range and resolution, enables safe *DDT* performance in the declared *ODD*.

4.2.9. The *ADSE* must retain documentation demonstrating measures taken to prevent reasonably foreseeable misuse by the *Operator* (e.g. *OARS*, and an explanation on how the availability criteria were established), mistakes or misunderstanding by the *Operator* (e.g. unintentional *Override*) and intentional tampering of the system.

4.2.10. The *ADSE* must retain documentation describing how the *ADS* interacts with the *Operator* when *ODD* limits are reached. The documentation must include a list of all the types of situations in which the *ADS* will generate a transition demand to the *Operator*.

4.2.11. The *ADSE* must retain documentation demonstrating a quality assurance system established upon the principles of international standard ISO 9001:2015 or similar recording all design processes and design decisions related to meeting the technical requirements of This Standard. The ISO 9001 series provides the quality assurance framework for the design and manufacturing processes within an organisation to operate effectively and ensure that all *ADSs* are manufactured according to the documentation retained or provided by the *ADSE*.

Operational Safety

4.2.12. The *ADSE* must provide documentation verifying each *Safety Critical Function* of the *ADS* by real world test drives, physical tests and/or simulations. An example of a possible layout for the assessment form from the *ADSE* is given in Appendix 1- Model assessment form for Automated Lane Keeping System, Annex 4 (Special requirements to be applied to the functional and operational safety aspects of Automated Lane Keeping Systems (ALKS) of UN Regulation No. 157 (Automated Lane Keeping Systems),.

4.2.13. The *ADSE* must provide documentation identifying and outlining redundancies and/or failsafe modes that have been designed into all *Safety Critical Function*s.

Operational Design Domain (ODD)

4.2.14. The *ADSE* must provide documentation declaring the *ODD* limits for the ADS.

4.2.15. The *ADSE* must provide documentation declaring the scope of *Secondary Activities* that the *Operator* is permitted to conduct while the *ADS* is *Engaged* in the *ODD*.

Design Life

4.2.16. The *ADSE* must provide documentation declaring the *Design Life* of the *ADS*.

4.2.17. The *ADSE* must retain documentation describing processes with regard to the *Design Life* of the *ADS*. This must include:

(a) ensuring the *Design Life* is at least equal to the period of validity of the *Granted Type Approval*;

(b) ensuring the requirements of This Standard continue to be met while the vehicle is in service for at least the *Design Life* of the *ADS*; and,

(c) notifying vehicle owners/*Operators* that the *Design Life* of an *ADS* has been exceeded.

Installation of System Updates

4.2.18. The *ADSE* must retain documentation in respect of software and hardware employed in the *ADS*.

4.2.19. The *ADSE* must provide the approval number to UN Regulation No. 156 (Software update and software update management system) if the *ADSE* implements an R156SWIN.

4.2.19.1 The *ADSE* must provide information on how to read the R156SWIN or software version(s) in case the R156SWIN is not held on the vehicle.

4.2.19.2 The *ADSE* may provide a list of the relevant parameters that will allow the identification of those vehicles that can be updated with the software represented by the R156SWIN.

4.2.20. If a R156SWIN has not been provided,

4.2.20.1 The *ADSE* must retain documentation on software updates to the *ADS* ensuring that the technical requirements of This Standard continue to be met while the vehicle is in service and for at least the *Design Life* of the *ADS*.

4.2.20.2 The *ADSE* must provide a description of its update arrangements for the *Design Life* of the *ADS*. This must include the process:

(a) to ensure updates are securely distributed to remote *ADS'*;

(b) to ensure updates are securely and successfully installed;

(c) to notify *Operators* of the availability of an update; and

(d) to detect and respond to any *ADS* failures following the installation of updates.

Education

4.2.21. The *ADSE* must provide documentation describing processes to provide information to the vehicle owner, *Operator*, repairers and all other relevant parties that will minimise the *Safety Risks* of operating the *ADS* for the duration of the *Design Life* of the *ADS*. This must include:

(a) an explanation of the reasons for the education and training chosen; and,

(b) how the education and training will facilitate safe and proper use of the *ADS*.

4.2.22. The education and training processes of the documentation provided must take into consideration, but is not limited to:

(a) informing *Operators* of their obligations and responsibilities, including how to safely *Engage*, *Override* or *Disengage* the *ADS*, as well as the means by which the *ADS* prevents unintentional *Disengagement*, identifies *Operato*r attentiveness and detects that the *Operator* is available to take over the *DDT*;

(b) communicating the importance of software updates;

(c) facilitating the maintenance and repair of the *ADS*, including post-crash before it is put back in service;

(d) facilitating employee, dealer and distributor understanding of the *ADS* and its operation so relevant information can be accurately conveyed to owners and *Operators*; and,

(e) ongoing education and training for owners and *Operators* who may not be the original vehicle owner or *Operator*.

Compliance with Road Rules

4.2.23. The *ADSE* must provide documentation ensuring that, when *Engaged*, the *ADS* operates in compliance with all applicable Australian state and territory road traffic laws, and where there is no contradiction, the Australian road rules.

4.2.24. The *ADSE* must provide documentation describing the process to ensure continued compliance with any amendments to relevant road traffic laws when they come into force.

Interaction with Enforcement and Emergency Services

4.2.25. The *ADSE* must provide a description of the functionality of the *ADS* relating to its interaction with enforcement agencies and emergency services as well as provision of information in real time at the roadside.

On-road Behavioural Competency

4.2.26. The *ADSE* must provide a description of how it will maintain on-road behavioural competency by minimising the need for the *ADS* to *Disengage* once *Engaged*. Capabilities that must be considered include:

(a) *OEDR*;

(b) crash avoidance;

(c) ability to respond to unusual events;

(d) ability to interact with other road users including *VRUs*;

(e) ability to recognise and manage accordingly temporary speed zones, construction zones, and variable speed signs; and,

(f) the operation of *Requests to Intervene*, of *MRMs* and any *Emergency Manoeuvres*.

Verifying for the Australian Road Environment

4.2.27. The *ADSE* must provide a description of how it has verified the functionality of an *ADS* in the Australian road environment, such as its interaction with road signs in all states and territories within its *ODD* and its interaction with Australian flora and fauna.

4.2.28. The *ADSE* must provide a description of how it has ensured that the *ADS* functions under changeable road environments (such as changes to road infrastructure) within its *ODD*.

Cybersecurity

4.2.29. The *ADSE* must provide the approval number to UN Regulation No. 155 (Cyber security and cyber security management system).

4.3. Documentation of *ADS*

ADS Architecture

4.3.1. The *ADSE* must provide documentation covering the basic design and components of the *ADS*.

4.3.2. The *ADSE* must provide documentation declaring any enabled or disabled *ADS* functions for which the hardware and software are present in the vehicle at the time of production (and which remain subject to the requirements of This Standard).

4.3.3. The *ADSE* must provide an inventory that identifies all components of the *ADS* which are used to achieve the *DDT*.

4.3.4. The *ADSE* must provide an outline schematic showing all *ADS* components and interconnections to other vehicle equipment.

4.3.5. The *ADSE* must provide outline schematics and/or flowcharts showing *OEDR* function, including:

(a) perception, including object detection and vehicle positioning within the environment;

(b) decision-making processes and priorities;

(c) *DDT* response; and,

(d) *DSSAD* record-making logic.

4.3.5.1 A list of all input and sensed variables must be retained with the working range of these variables defined, along with a description of how each variable affects *ADS* performance.

4.3.5.2 A list of all output variables which are controlled by the *ADS* must be retained and an explanation given, in each case, of whether the control is direct or via another vehicle system. The range of control exercised on each such variable must be defined.

4.3.6. The *ADSE* must retain documentation covering data processing in the case that continuous learning algorithms are implemented.

4.3.7. The *ADSE* must retain documentation regarding the installation options that will be employed for the individual components that comprise the *ADS*. These options must include, but are not limited to, the location of the component in/on the vehicle, the material(s) surrounding the component, the dimensioning and geometry of the material surrounding the component, and the surface finish of the materials surrounding the component, once installed in the vehicle. The information must also include installation specifications that are critical to the system's performance, e.g. tolerances on installation angle.

Operational Safety

4.3.8. The *ADSE* must provide a statement which affirms that the *ADS* is free from unreasonable risks for the driver, *Operator*, passengers and other road users.

4.3.9. The *ADSE* must retain documentation with an explanation of the design provisions built into the *ADS* so as to ensure functional and operational safety. Possible design provisions in the *ADS* may include but are not limited to:

(a) fall-back to operation using a partial system;

(b) redundancy with a separate system; and,

(c) removal of the automated driving function(s).

4.3.9.1 If the chosen provision selects a partial performance mode of operation under certain fault conditions (e.g. in case of severe failures), then these conditions shall be stated (e.g. type of severe failure) and the resulting limits of effectiveness defined (e.g. initiation of a *MRM* immediately) as well as the warning strategy to the *Operator*.

4.3.9.2 If the chosen provision selects a second (back-up) means to realise the performance of the *DDT*, the principles of the change-over mechanism, the logic and level of redundancy and any built-in back-up checking features shall be explained and the resulting limits of back-up effectiveness defined.

4.3.9.3 If the chosen provision selects the removal of the automated driving function, this shall be done in compliance with the relevant provisions of This Standard. All the corresponding output control signals associated with this function shall be inhibited.

4.3.10. The *ADSE* must provide documentation on which shows how the *ADS* will behave to mitigate or avoid hazards which can have a bearing on the safety of the *Operator*, passengers and other road users. The documentation must confirm that at least each of the following items is covered where applicable:

(a) issues linked to interactions with other vehicle systems (e.g. braking, steering);

(b) failures of the *ADS* and system risk mitigation reactions;

(c) situations within the *ODD* when a system may create unreasonable safety risks for the *Operator*, passengers and other road users due to operational disturbances (e.g. lack of or

wrong comprehension of the vehicle environment, lack of understanding of the reaction from the *Operator*, passenger or other road users, inadequate control, challenging scenarios);

(d) identification of the relevant scenarios within the boundary conditions and management method used to select scenarios and validation tool chosen;

(e) decision making process resulting in the performance of the *DDT* (e.g. emergency manoeuvres), for the interaction with other road users and in compliance with traffic rules;

(f) reasonably foreseeable misuse by the *Operator* (e.g. an explanation on how the *OARS* reacts to misuse), mistakes or misunderstanding by the *Operator* (e.g. unintentional override) and intentional tampering of the system; and,

(g) cyber-attacks having an impact on the safety of the vehicle.

4.3.10.1 The *ADSE* must provide documentation itemising operational safety parameters being monitored and must set out, for each failure condition, the warning signal to be given to the *Operator*/ occupants/other road users and/or to service personnel.

Minimum Risk Manoeuvre (MRM)

4.3.11. The *ADSE* must provide a description of how the *ADS* will detect that there is a *Safety Risk* and the steps it will take to perform a *MRM*.

4.3.12. The *ADSE* must provide a description of the set of *MRMs* that the *ADS* will use and how the most appropriate option is selected according to system operating state and environmental conditions.

4.3.13. The *ADSE* must provide documentation declaring the types of severe vehicle failures and severe *ADS* failures that will lead the *ADS* to initiate a *MRM* immediately.

Self-Check

4.3.14. The *ADSE* must provide documentation describing the *Self-Check* function of the *ADS*.

4.3.15. The *ADSE* must retain documentation covering how *ADS* failure warning signal status can be readable in a standardised way via the use of an electronic communication interface, at least be the standard interface (OBD port).

Human-Machine Interface (HMI)

4.3.16. The *ADSE* must provide a description of the functionality of the *HMI* of the *ADS*.

4.3.17. The *ADSE* must provide documentation explaining the interaction concept with the *Operator* when *ODD* limits are reached, including the list of types of situations in which the *ADS* will generate a transition demand to the *Operator*. *Override* actions, for instance minimum steering force and duration, designed to prevent unintentional *Override* and their rational must documented. Types of situations in which the *ADS* will generate a *Request to Intervene* to the *Operator* must be described.

4.3.18. The *ADSE* must provide documentation declaring the prioritization of different acoustic and optical warnings during the *ADS* operation.

4.3.19. The *ADSE* must provide documentation describing, in the case of a severe *ADS* or vehicle failure, any different strategies with regard to *ADS Override* that are employed. The description must include consideration of ensuring a safe transition of control from the *ADS* to the *Operator*.

4.3.20. The *ADSE* must provide documentation describing how the current operational status of the *ADS* can be checked.

4.3.21. The *ADSE* must provide documentation describing prioritization of warnings.

4.3.22. The *ADSE* must provide documentation describing the functionality of the *OARS*.

Installation of System Updates

4.3.23. The *ADSE* must retain documentation describing how each component of the *ADS* is clearly and unambiguously identifiable (e.g. by marking for hardware, and by marking or software output for software content) to provide corresponding documentation association.

4.3.24. The *ADSE* must provide information about how the software version(s) can be accessed.

4.3.25. The *ADSE* must provide information about how software can be updated in service.

Education and Training

4.3.26. The *ADSE* must provide a description of the functionality of the *ADS* and *ADS*-related systems and features, as applicable to the vehicle type and vehicle *Operators*, salespersons and maintainers.

4.4. Documentation of *ADS* behaviour

Safe Driving Behaviours

4.4.1. The *ADSE* must provide a statement which affirms that the *ADS* handles *DDT* in a manner that is free from unreasonable risks for the *Operator*, passengers and other road users.

4.4.2. The *ADSE* must provide documentation which gives a simple explanation of the methods employed to perform the *DDT* within the *ODD* and the boundaries under which the *ADS* is designed to operate, including a statement of the mechanism(s) by which control is exercised. This documentation must describe the interactions expected between the *ADS* and the *Operator*, vehicle occupants, other road users, infrastructure, roadworks and roadworkers, and flora and fauna. Corresponding *HMI* aspects must be described.

Compliance with Road Rules

4.4.3. The *ADSE* must provide documentation describing how the *ADS* will operate in compliance with all applicable Australian state and territory road traffic laws and where there is no contradiction, the Australian road rules, which fall within the *ODD*. This documentation must explain

(a) how any variations between each Australian state and territory are accounted for; and,

(b) any circumstances in which the *ADS* may temporarily operate not in compliance with all applicable state and territory road traffic laws or Australian road rules where strict compliance is not possible due to a road environment related hazard or road related emergency.

Interaction with Enforcement and Emergency Services

4.4.4. The *ADSE* must provide documentation describing the functionality of the *ADS* relating to its interaction with enforcement agents and vehicles and emergency services agents and vehicles

4.4.5. The *ADSE* must provide documentation describing the real-time provision of *ADS* information to authorised enforcement agents at the roadside.

Verification for Australian Environment

4.4.6. The *ADSE* must provide documentation describing the measures in place to ensure the *ADS* is free from unreasonable risks for the *Operator*, vehicle occupants, and other road users when the performance of *ADS* is affected by environmental conditions e.g. climatic, temperature, dust ingress, water ingress, ice.