National Road Vehicle Standard (Australian Design Rule 107/00 – Lane Keeping Systems) 2022

I, KEVIN HOGAN, Assistant Minister to the Deputy Prime Minister, determine this National Road Vehicle Standard under section 12 of the *Road Vehicle Standards Act 2018*.

Dated

[NOT FOR SIGNING]

Kevin Hogan

Assistant Minister to the Deputy Prime Minister

CONTENTS

1. LEGISLATIVE PROVISIONS

1.1. Name of instrument

1.1.1. This Instrument is the National Road Vehicle Standard (Australian Design Rule 107/00 – Lane Keeping Systems) 2022.

1.1.2. This Instrument may also be cited as Australian Design Rule 107/00 – Lane Keeping Systems.

1.2. Commencement

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

2. FUNCTION

2.1. The function of this National Road Vehicle Standard is to require vehicles to be fitted with systems that provide warning to the driver and correct the vehicle trajectory when the driver is unintentionally leaving the lane. This standard includes technical requirements intended to ensure lane keeping systems function appropriately.

3. APPLICABILITY

3.1. This National Road Vehicle Standard applies to vehicles in MA, MB, MC and NA categories as defined in Vehicle Standard (Australian Design Rule – Definitions and Vehicle Categories) 2005 from the dates set out in clause 3.1.1 and clause 3.1.2 and in the applicability table under clause 3.3 below.

3.1.1. [1 March 2024] for all new model vehicles.

3.1.2. [1 March 2026] for all vehicles.

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	N/A	
Motor cycle	LC	L3	N/A	
Motor cycle and sidecar	LD	L4	N/A	
Motor tricycle	LE	L5		
	LEM		N/A	
	LEP		N/A	
	LEG		N/A	
Passenger car	MA	M1	[1 March 2024]	
Forward-control passenger vehicle	MB	M1	[1 March 2024]	
Off-road passenger vehicle	MC	M1	[1 March 2024]	
Light omnibus	MD	M2		
up to 3.5 tonnes *'GVM'* and up to 12 seats	MD1		N/A	
up to 3.5 tonnes *'GVM'* and more than 12 seats	MD2		N/A	
over 3.5 tonnes and up to 4.5 tonnes *'GVM'*	MD3		N/A	
over 4.5 tonnes and up to 5 tonnes *'GVM'*	MD4		N/A	
Heavy omnibus	ME	M3	N/A	
Light goods vehicle	NA	N1	[1 March 2024]	
Medium goods vehicle	NB	N2		
over 3.5 tonnes up to 4.5 tonnes *'GVM'*	NB1		N/A	
over 4.5 tonnes up to 12 tonnes *'GVM'*	NB2		N/A	
Heavy goods vehicle	NC	N3	N/A	
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	

* Note: The Australian Design Rule Vehicle Category Codes are broadly aligned with the category codes used by the United Nations – This column sets out the relationship between category codes.

** See clause 3.1.

4. REQUIREMENTS

4.1. Applicable vehicles must be fitted with a Lane keeping System (LKS) in accordance with this National Road Vehicle Standard.

Note: The requirements in this National Road Vehicle Standard have been adapted from EU Regulation EU 2021/646 Emergency Lane Keeping Systems (ELKS).

5. DEFINITIONS

5.1. For vehicle categories, definitions and meanings used in this National Road Vehicle Standard, refer to Vehicle Standard (Australian Design Rule Definitions and Vehicle Categories) 2005.

5.2. "AS 1742.2-2009" means the Australian Standard AS 1742.2-2009 Manual of uniform traffic control devices - Part 2: Traffic control devices for general use.

5.3. *"Corrective Directional Control Function (CDCF)"* means a control function within an *electronic control system* whereby, for a limited duration, changes to the steering angle of one or more wheels and/or braking of individual wheels may result from the automatic evaluation of signals initiated on-board the vehicle optionally enriched by data provided off-board the vehicle, in order to correct lane departure, e.g. to avoid crossing lane markings, leaving the road.

5.4. *"subject vehicle"* means the vehicle being tested;

5.5. *"Distance To Lane Marking (DTLM)"* means the remaining lateral distance (perpendicular to the lane marking) between the inner side of the lane marking and most outer edge of the tyre before the *subject vehicle* crosses the inner side of the lane marking.

5.6. *"flat road"* means a road with a slope less than 1 % in the longitudinal direction and for the lateral direction, less than 3 % for the lane width.

5.7. *"the system"* means the *electronic control system* and complex *electronic control systems* that provide or form part of the control transmission of the LKS, including the *transmission links* to or from other vehicle systems that act on the LKS.

5.8. *"units"* means the smallest divisions of system components which will be considered, since these combinations of components will be treated as single entities for purposes of identification, analysis or replacement.

5.9. *"transmission links"* means any electric, mechanic, pneumatic or hydraulic equipment used for inter-connecting distributed *units* for the purpose of conveying signals, operating data or energy supply.

5.10. *"electronic control system"* means a combination of *units*, designed to cooperate in the production of a vehicle control function by electronic data processing.

5.11. *"control strategy"* means a strategy to ensure robust and safe operation of the function(s) of an *electronic control 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.), which may include the automatic deactivation of a function or temporary performance restrictions (e.g. a reduction in the maximum operating speed, etc.).

5.12. *"safety concept"* means a description of the measures designed into *the system*, for instance within the electronic *units*, so as to address system integrity and ensure safe operation under fault and non-fault conditions, including in the event of an electrical

failure. The possibility of a fallback to partial operation or even to a back-up system for vital vehicle functions may be a part of the *safety concept*.

6. GENERAL REQUIREMENTS

6.1. A LKS must comprise a Lane Departure Warning System (LDWS) and a CDCF.

6.1.1. The LDWS must meet the requirements of subsections 7.1, 7.2, 7.3 and 7.4.

6.1.2. The CDCF must meet the requirements of subsections 7.1, 7.2, 7.3 and 7.5.

6.2. LKS lane departure warnings and interventions

Subject to specific requirements below *the system* must be designed to minimise warnings and interventions for driver intended manoeuvres.

7. SPECIFIC REQUIREMENTS

7.1. LKS failure warning

A warning must be provided when there is a failure in the LKS that prevents the requirements of this National Road Vehicle Standard being met.

7.1.1. The failure warning must be a constant visual warning signal.

7.1.1.1. There must not be an appreciable time interval between each LKS self-check (an integrated function that checks for a system failure on a continuous basis at least while *the system* is active), and subsequently there must not be a delay in illuminating the warning signal, in the case of an electrically detectable failure.

7.1.1.2. Upon detection of any non-electrical failure condition (e.g. sensor misalignment), the warning signal as defined in clause 7.1.1 must be activated.

7.1.2. If the vehicle is equipped with a means to deactivate the LKS a warning must be given when *the system* is deactivated according to subsection 7.2. This must be a constant visual warning signal. The failure warning signal specified in clause 7.1.1. may be used for this purpose.

7.2. LKS deactivation

7.2.1. Manual deactivation

When a vehicle is equipped with a means to manually deactivate the LKS function, either partially or fully, the following conditions must apply as appropriate:

7.2.1.1. The full LKS function must be automatically and fully reinstated upon each activation of the vehicle master control switch.

7.2.1.2. The manual deactivation of the full LKS must not be possible with less than two deliberate actions, e.g. press and hold on a button, or select and confirm on menu option. It must be possible to easily suppress acoustic warnings of the LDWS, but such action must not at the same time deactivate the LDWS or the CDCF.

7.2.1.3. The manual deactivation capability must be tested in accordance with the relevant vehicle test(s) specified in section 8.

7.2.2. Automatic deactivation

If the vehicle is equipped with a means to automatically deactivate the LKS function, either partially or fully, for instance in situations such as off-road use, being towed, a trailer being hitched to the vehicle or the electronic stability control (ESC) being deactivated, the following conditions must apply as appropriate:

7.2.2.1. For testing, the vehicle manufacturer must provide a list of situations and corresponding criteria where the LKS function is automatically deactivated which must be annexed to the test report.

7.2.2.2. The LKS function must be automatically and fully reactivated as soon as the conditions that led to the automatic deactivation are not present anymore.

7.2.3. A constant visual warning signal must inform the driver that the LKS function has been deactivated. The failure warning signal specified in clause 7.1.1 above may be used for this purpose.

7.3. Automatic suppression

7.3.1. For driver intended manoeuvres

For testing, the manufacturer must provide a documentation package which gives access to the basic design and logic of *the system* for detection of likely driver intended manoeuvres and automatic suppression of the LKS. This package must include a list of parameters detected and a basic description of the method used to decide that *the system* should be suppressed, including limit values where possible. For both the CDCF and LDWS, the Testing Facility must assess the documentation package to show that driver unintentional manoeuvres, within the scope of the lane keep test parameters (in particular lateral departure velocity), will not result in automatic suppression of *the system*.

7.3.2. Automatic suppression of the LKS is also permitted in situations when other driver assist or automated steering functions, (i.e. Automatically commanded steering function, emergency steering function or automated lane keeping), are controlling the lateral movement of the vehicle or other safety related functions (i.e. that is capable of changing the dynamic behaviour of the vehicle such as AEBS, ESC, etc.) are intervening. These situations must be declared by the manufacturer.

7.4. LDWS requirements

7.4.1. Speed range

The LDWS must be active at least within the vehicle speed range between 65 km/h and 130 km/h (or the maximum vehicle speed if it is lower than 130 km/h) and at all vehicle load conditions, unless deactivated as per clause 7.2.

7.4.2. Lane departure warning

When activated and operated within the prescribed speed range, the LDWS must be able to warn the driver at the latest if the vehicle crosses over a visible lane marking for the lane in which it is running by more than a DTLM of – 0,3 m:

(a) for lateral departure velocities in the range of the 0,1 m/s to 0,5 m/s;

(b) on straight, flat and dry roads;

(c) for solid line and dashed lane markings in line with one of those described in AS 1742.2-2009;

(d) with the markings being in good condition;

(e) in all illumination conditions without blinding of the sensors (e.g. direct blinding due to sunlight) and with activated passing-beam (dipped-beam) headlamps if necessary;

(f) in absence of weather conditions affecting the visibility of lane markings (e.g. no fog).

It is recognised that the performance required may not be fully achieved in other conditions than those listed above. However, *the system* must not unreasonably switch the *control strategy* in these other conditions.

The lane departure warning capability must be tested in accordance with the relevant vehicle test(s) specified in section 8.

7.4.3. LDWS warning indication

7.4.3.1. The lane departure warning referred to in clause 7.4.2 must be noticeable by the driver and be provided by:

(a) at least two warning means out of visual, acoustic and haptic; or

(b) one warning means out of haptic and acoustic, with spatial indication about the direction of unintended drift of the vehicle.

The warning mentioned above may be suppressed when there is a driver action which indicates an intention to depart from the lane;

7.4.3.1.1. Where a visual signal is used for the lane departure warning, it may use the failure warning signal as specified in clause 7.1.1 above in a flashing mode.

7.4.3.1.2. When there is a lane keep intervention by the CDCF, this must be considered a haptic warning according to clause 7.4.3.1.

7.4.3.2. The LDWS visual warning signal must be activated following a vehicle master control switch ‘power-ON’. This requirement does not apply to warning signals shown in a common space.

7.4.3.3. The LDWS visual warning signals must be visible even by daylight; the satisfactory condition of the signals must be easily verifiable by the driver from the driver’s seat.

7.4.4. The visual warning signal must be tested in accordance with the relevant vehicle test(s) specified in section 8.

7.5. CDCF performance requirements

7.5.1. Speed range

The CDCF must be active at least between 70 km/h and 130 km/h (or the maximum vehicle speed if it is below 130 km/h) and at all vehicle load conditions, unless deactivated as per subsection 7.2. However, in the case that the vehicle reduces its speed from above 70 km/h to below 70 km/h, *the system* must be active at least until the vehicle speed reduces below 65 km/h.

7.5.2. Lane keep

In the absence of conditions leading to deactivation or suppression of *the system*, the CDCF must be able to prevent lane departure by crossing of visible lane markings in the scenarios shown in the following table by more than a DTLM of – 0,3 m:

(a) for lateral departure velocities in the range of the 0,2 m/s to 0,5 m/s for vehicle speeds up 100 km/h and for lateral departure velocities in the range of 0,2 m/s to 0,3 m/s for vehicle speeds greater than 100 km/h and up to 130 km/h (or the maximum vehicle speed if it is below 130 km/h);

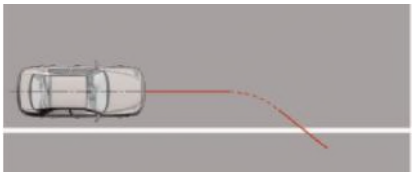
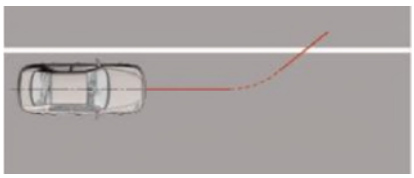
(b) on straight, flat and dry roads;

(c) for solid line and dashed lane markings in line with one of those described in AS 1742.2-2009;

(d) with the markings being in good condition;

(e) in all illumination conditions without blinding of the sensors (e.g. direct blinding sunlight) and with activated passing-beam (dipped-beam) headlamps if necessary;

(f) in absence of weather conditions affecting the dynamic performance of the vehicle (e.g. no storm, not below 5 °C) or the visibility of lane markings (e.g. no fog).

No.	Scenario description
1.	Solid line – departure to right side of vehicle 
2.	Solid Line – Departure to left of vehicle 

It is recognised that the performances required for the scenarios in this table may not be fully achieved in other conditions than those listed above. However, *the system* must not unreasonably switch the *control strategy* in these other conditions. This must be demonstrated in accordance with the testing requirements.

The lane keep capability must be tested in accordance with the relevant vehicle test(s) specified in section 9.

7.5.3. Steering override

7.5.3.1. The steering control effort necessary to override the directional control provided by *the system* must not exceed 50 N. Significant loss of steering support once overridden must not happen suddenly.

7.5.3.2. For CDCF systems which do not act on the steering itself (e.g. differential braking type CDCF), the steering input must not exceed 25 degrees.

7.5.3.3. The steering override control effort must be tested in accordance with the relevant vehicle test(s) specified in section 9.

7.5.4. CDCF warning indication

7.5.4.1. Every CDCF intervention must immediately be indicated to the driver by a visual warning signal which is displayed for at least 1 second or as long as the intervention exists, whichever is longer. The visual signal may be the flashing of the failure warning signal specified in clause 7.1.1.

7.5.4.1.1. In the case of an intervention longer than 10 seconds, an acoustic warning signal must be provided until the end of the intervention unless there is a driver action which indicates an intention to depart from the lane.

7.5.4.1.2. 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 this intervention, an acoustic warning signal must 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 must continue for at least 10 seconds longer than the previous warning signal.

7.5.4.2. The requirements in clauses 7.5.4.1.1 and 7.5.4.1.2 must be tested in accordance with the relevant vehicle test(s) specified in section 9.

8. TEST REQUIREMENTS FOR LDWS

8.1. General provisions

Vehicles fitted with LDWS must fulfil the appropriate tests requirements of this section

8.2. Testing conditions

The tests must be performed:

(a) On a flat and dry asphalt or concrete road type surface, which may not contain any irregularities (e.g. large dips or cracks, manhole covers or reflective studs) within a lateral distance of 3,0 m to either side of the centre of the test lane and with a longitudinal distance of 30 m ahead of the *subject vehicle* from the point after the test is complete.

(b) In ambient illumination conditions of at least 2 000 lux without blinding of the sensors (e.g. direct blinding sunlight) and with activated low beam head lamps if necessary.

(c) In ambient air temperatures between 5 °C and 45 °C.

(d) In the absence of weather conditions affecting the visibility of lane markings, e.g. fog.

8.2.1. Lane markings

The solid line and dashed lane markings on the road used for the tests must be in line with one of those described in AS 1742.2-2009. The markings must be in good condition. The lane-marking layout used for the tests must be recorded in the test report.

The width of the lane (measured between the lane markings) must be a minimum of 3.5 m for the purpose of the tests of this section. The vehicle manufacturer must demonstrate, through the use of documentation, compliance with all other lane markings identified in AS 1742.2-2009. Any of such documentation must be appended to the test report.

8.2.2. *Subject vehicle* conditions

8.2.2.1. Test mass

The *subject vehicle* must be tested at its GVM. The vehicle manufacturer must demonstrate, through the use of documentation, that *the system* works at all load conditions.

8.2.2.2. The *subject vehicle* must be tested at the tyre pressures recommended by the vehicle manufacturer.

8.2.2.3. Where the LDWS is equipped with a user-adjustable warning threshold, the tests specified in subsection 8.3 must be performed with the warning threshold set at its maximum lane departure setting. No alteration must be made once the test procedure has begun.

8.2.2.4. Pre-test conditioning

If requested by the vehicle manufacturer the vehicle can be driven to calibrate the sensor system up to a maximum of 100 km on a mixture of urban and rural roads with other traffic and roadside furniture.

8.3. Test procedures

8.3.1. Visual warning signal verification test

With the vehicle stationary, check that the visual warning signal(s) comply with the requirements of clause 7.4.3.2.

8.3.2. Lane departure warning test

8.3.2.1. Drive the vehicle at a speed of 70 km/h +/– 3 km/h into the centre of the test lane in a smooth manner so that the attitude of the vehicle is stable.

Maintaining the prescribed speed, gently drift the vehicle, either to the left or the right, with a lateral departure velocity of between 0,1 and 0,5 m/s so that the vehicle crosses the lane marking.

Repeat the test at a different rate of departure within the range 0,1 and 0,5 m/s. Repeat the above tests drifting in the opposite direction.

8.3.2.2. The test requirements are fulfilled if the LDWS provides the lane departure warning indication mentioned in subsection 7.4.3.1 above at the latest when the DLTM is – 0,3 m.

8.3.2.3. In addition, the vehicle manufacturer must demonstrate to the satisfaction of the Testing Facility that the requirements for the whole speed range and lateral departure velocity range are fulfilled. This may be achieved on the basis of appropriate documentation appended to the test report.

8.3.3. Manual deactivation test

8.3.3.1. If the vehicle is equipped with means to manually deactivate the LDWS, turn the vehicle master control switch to the ‘Power ON’ position and deactivate the LDWS. The warning signal specified in clause 7.2.3 must be activated.

Turn the master control switch to the ‘Power OFF’ position. Turn the vehicle master control switch to the ‘Power ON’ position and verify that the previously activated warning signal is not reactivated, thereby indicating that the LDWS has been reinstated as specified in clause 7.2.1.1.

9. TEST REQUIREMENTS FOR CDCF

9.1. General provisions

Vehicles fitted with CDCF must fulfil the appropriate tests requirements of this section.

9.2. Testing conditions

The tests must be performed:

(a) On a flat and dry asphalt or concrete road type surface, which may not contain any irregularities (e.g. large dips or cracks, manhole covers or reflective studs) within a lateral distance of 3,0 m to either side of the centre of the test lane and with a longitudinal distance of 30 m ahead of the *subject vehicle* from the point after the test is complete.

(b) In ambient illumination conditions of at least 2 000 lux without blinding of the sensors (e.g. direct blinding sunlight) and with activated low beam head lamps if necessary.

(c) In ambient air temperatures between 5 °C and 45 °C.

(d) In the absence of weather conditions affecting the dynamic performance of the vehicle (e.g. no storm, not below 5 °C) or the visibility of lane markings (e.g. fog).

9.2.1. Lane markings

The solid line and dashed lane markings on the road used for the tests must be in line with one of those described in AS 1742.2-2009. The marking must be in good condition. The lane-marking used for the tests must be recorded in the test report.

The solid lane marking must be a minimum of 3,5 m distance from any other lane markings, for the purpose of the tests of this section. The vehicle manufacturer must demonstrate, through the use of documentation, compliance with all other solid lane markings identified in AS 1742.2-2009. Any of such documentation must be appended to the test report.

9.2.2. *Subject vehicle* conditions

9.2.2.1. Test mass

The *subject vehicle* must be tested at its GVM. The vehicle manufacturer must demonstrate, through the use of documentation, that *the system* works at all load conditions.

9.2.2.2. The *subject vehicle* must be tested at the tyre pressures recommended by the vehicle manufacturer.

9.2.2.3. Where the CDCF is equipped with a user-adjustable timing threshold, the test specified in subsection 9.3.3 must be performed with the timing threshold set at its latest setting for system intervention. No alteration must be made once the test procedure has begun.

9.2.2.4. Pre-test conditioning

If requested by the vehicle manufacturer the vehicle can be driven to calibrate the sensor system up to a maximum of 100 km on a mixture of urban and rural roads with other traffic and roadside furniture.

9.3. Tests procedures

9.3.1. Warning Indication test

9.3.1.1. The *subject vehicle* must be driven with an activated CDCF on a road with solid lane markings on at least one side of the lane.

The test conditions and the *subject vehicle* test speed must be within the operating range of *the system*.

During the test, the duration of the CDCF interventions and of the visual and acoustic warning signals must be recorded.

In the case referred to in clause 7.5.4.1.1, the *subject vehicle* must be driven such that it attempts to leave the lane and causes CDCF intervention to be maintained for a period longer than 10 seconds.

The test requirements are fulfilled if the acoustic warning is provided no later than 10 seconds after the beginning of the intervention.

In the case referred to in clause 7.5.4.1.2, the *subject vehicle* must be driven in such a way that it attempts to leave the lane and causes at least three interventions of *the system* within a rolling interval of 180 seconds.

The test requirements are fulfilled if all the following conditions are met:

(a) a visual warning signal is provided for each intervention, as long as the intervention exists;

(b) an acoustic warning signal is provided at the second and third intervention;

(c) the acoustic warning signal at the third intervention is at least 10 s longer than the one at the second intervention.

9.3.1.2. In addition, the manufacturer must demonstrate to the satisfaction of the Testing Facility that the requirements defined in clauses 7.5.4.1.1 and 7.5.4.1.2 are fulfilled in the whole range of CDCF operation. This may be achieved on the basis of appropriate documentation appended to the test report.

9.3.2. Steering override test

9.3.2.1. The *subject vehicle* must be driven with an activated CDCF on a road with solid lane markings on each side of the lane.

The test conditions and the *subject vehicle* test speed must be within the operating range of *the system*.

The vehicle must be driven such that it attempts to leave the lane and causes CDCF intervention. During the intervention, the driver must apply the steering control effort necessary to override the intervention.

The force and steering input applied by the driver on the steering control to override the intervention must be recorded.

The test requirements are fulfilled if:

(a) The force applied by the driver on the steering control to override the intervention does not exceed 50 N.

(b) There is no sudden loss of significant steering support once CDCF is overridden.

(c) For LKS that do not act on the steering itself (e.g. differential braking type CDCF), the steering input does not exceed 25 degrees.

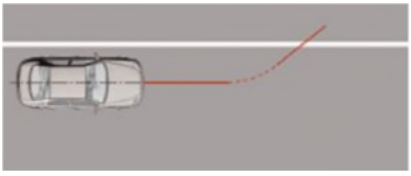
9.3.2.2. In addition, the manufacturer must demonstrate to the satisfaction of the Testing Facility that the requirements defined in subsection 7.5.4 are fulfilled in the whole range of CDCF operation. This may be achieved on the basis of appropriate documentation appended to the test report.

9.3.3. Lane keep test

9.3.3.1. The CDCF must be tested for test scenarios No 1 and No 2 described in clause 7.5.2.

9.3.3.1.1. Tests for all scenarios must be performed with lateral velocities of 0,2 m/s and 0,5 m/s.

9.3.3.1.2. A test path must be driven which consists of an initial straight path parallel to the solid lane marking being tested, followed by a fixed radius curve to apply a known lateral velocity and yaw to the *subject vehicle*, followed again by a straight path without any force applied on the steering control (e.g. by removing the hands from the steering control).



9.3.3.1.3. The *subject vehicle* speed during the test up to the point of system intervention must be 72 km/h +/– 1 km/h.

The curve of fixed radius driven to apply the lateral velocity required must have a radius 1 200 m or more.

The lateral velocity required must be achieved to a tolerance of +/– 0,05 m/s.

The vehicle manufacturer must provide information describing the radius of the curve to be driven and the location when the closed loop path and/or speed control must be ended so as to ensure a free drifting in order not to interfere an automatic suppression according to clause 7.3.1.

9.3.3.2. The test requirements are fulfilled if the *subject vehicle* does not cross the lane marking by a DTLM of more than – 0,3 m.

9.3.3.3. In addition, the vehicle manufacturer must demonstrate to the satisfaction of the Testing Facility that the requirements for the whole speed range and lateral departure velocity range are fulfilled. This may be achieved on the basis of appropriate documentation appended to the test report.

10. DOCUMENTATION

10.1. Requirements

The manufacturer must 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, must be explained. 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.

The Testing Facility must 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 subsection 10.4.4.

10.1.1. Documentation of testing and technical documents required to support the approval of this National Road Vehicle Standard must be maintained in such a manner that allows traceability.

10.2. A description must 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 must be identified and a further description of the changed rationale of the function's operation provided.

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

10.2.2. A list of all output variables which are controlled by *the system* must be provided and an indication given, in each case, of whether the control is direct or via another vehicle system. The range over which *the system* is likely to exercise control on each output variable must be defined.

10.2.3. Limits defining the boundaries of functional operation (i.e. the external physical limits within which *the system* is able to maintain control) must be stated where appropriate to system performance.

10.3. System layout and schematics.

10.3.1. Inventory of components.

A list must 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, must be provided with both the equipment distribution and the interconnections made clear.

10.3.2. Functions of the *units*

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

10.3.3. Interconnections within *the system* must 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 must also be shown.

10.3.4. There must be a clear correspondence between *transmission links* and the signals carried between *units*. Priorities of signals on multiplexed data paths must be stated wherever priority may be an issue affecting performance or safety.

10.3.5. Identification of *units*

Each unit must 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 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 must be used. The manufacturer must, by the use of this identification, affirm that the equipment supplied conforms to the corresponding document.

10.3.5.1. 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 National Road Vehicle Standard is concerned, this identification must also be changed.

10.4. *Safety concept* of the manufacturer

10.4.1. The manufacturer must 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.

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

10.4.3. The manufacturer must provide the Testing Facility 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 must 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 must be present as long as the fault condition persists.

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

10.4.3.2. 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 must be explained and the resulting limits of back-up effectiveness defined.

10.4.3.3. If the chosen provision selects the removal of the higher level electronic control function, all the corresponding output control signals associated with this function must be inhibited, and in such a manner as to limit the transition disturbance.

10.4.4. The documentation must 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) must be established and maintained by the Manufacturer and must be inspected by the Testing Facility.

The Testing Facility must perform an assessment of the application of the analytical approach(es). The assessment must 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 the functions referred to in subsection 10.2:

— 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),

— reasonably foreseeable misuse by the driver,

— intentional modification of *the system*.

This approach must 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 must 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 must 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 Testing Facility may perform or may require to perform tests as specified in section 11 to verify the *safety concept*.

10.4.4.1. This documentation must itemise the parameters being monitored and must set out, for each fault condition of the type defined in subsection 10.4.4, the warning signal to be given to the driver and/or to service/technical inspection personnel.

10.4.4.2. This documentation must describe the measures in place to ensure *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.

11. VERIFICATION AND TEST

11.1. The functional operation of *the system*, as laid out in the documents required in section 10, must be tested as follows:

11.1.1. Verification of the function of *the system*.

The Testing Facility must verify *the system* under non-fault conditions by testing a number of selected functions from those described by the manufacturer in subsection 10.2.

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

11.1.1.1. The verification results must correspond with the description, including the control strategies, provided by the manufacturer in subsection 10.2.

11.1.2. Verification of the *safety concept* of subsection 10.4

The reaction of *the system* must 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 Testing Facility must conduct this check for at least one individual unit, but must not check the reaction of *the system* to multiple simultaneous failures of individual *units*.

The Testing Facility must verify that these tests include aspects that may have an impact on vehicle controllability and user information (HMI aspects).