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### World Forum for Harmonization of Vehicle Regulations

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Item 4.7.4 of the provisional agenda

#### 1958 Agreement:

Consideration of draft amendments to existing

UN Regulations submitted by GRVA

## Proposal for Supplement 2 to the 03 series of amendments to UN Regulation No. 79 (Steering equipment)

### Submitted by the experts from the Working Party on Automated/autonomous and Connected Vehicles\*

The text reproduced below was adopted by the Working Party on Automated/autonomous and Connected Vehicles (GRVA) at its fourth session (ECE/TRANS/WP.29/GRVA/4, paras. 33, 36 and 40). It is based on ECE/TRANS/WP.29/GRVA/2019/19 and Annex III, ECE/TRANS/WP.29/GRVA/2019/24 and Annex IV, ECE/TRANS/WP.29/GRVA/2019/20 and Annex V, as well as ECE/TRANS/WP.29/2019/114 as amended. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee (AC.1) for consideration at their March 2020 sessions.

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\* In accordance with the programme of work of the Inland Transport Committee for 2020 as outlined in proposed programme budget for 2020 (A/74/6 (part V sect. 20) para 20.37), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.



## Supplement 2 to the 03 series of amendments to UN Regulation No. 79 (Steering equipment)

Insert a new paragraph 2.3.4.4., to read:

"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."

Insert a new paragraph 2.3.4.18., to read:

"2.3.4.18. "Specified maximum RCM operating range ( $S_{RCMmax}$ )" 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."

Paragraph 3.5.7.1.1., amend to read:

"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 shall then be initiated by the driver with the appropriate deliberate action(s)."

Paragraph 3.5.7.2.1., amend to read:

"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 shall then be initiated by the driver with the appropriate deliberate action(s)."

Insert a new sentence in paragraph 5.6.2.1.1., to read:

"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  $a_{y_{smax}}$ .

It is recognised that the maximum lateral acceleration specified by the vehicle manufacturer  $a_{y_{smax}}$  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  $a_{y_{smax}}$  by not more than  $0.3 \text{ m/s}^2$ , 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  $a_{y_{smax}}$  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  $0.3 \text{ m/s}^2$ ."

Paragraph 5.6.4.6.4., amend to read:

"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

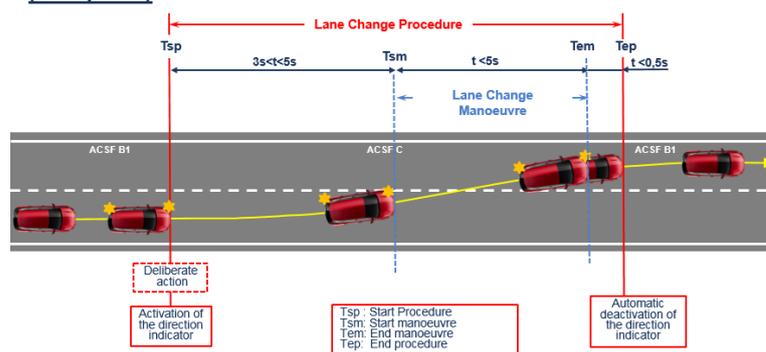
movement necessary to complete the lane change manoeuvre shall be completed as one continuous movement.

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)**

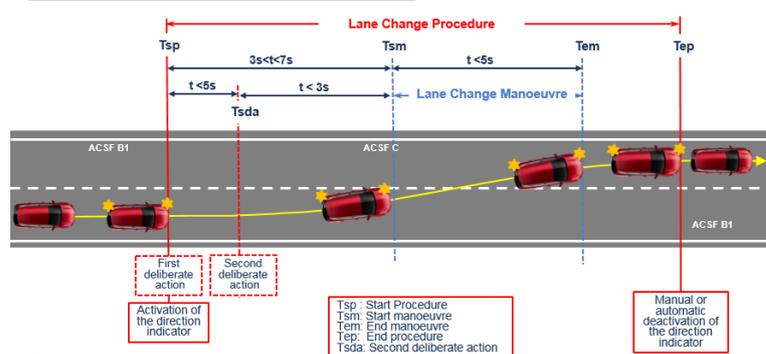


5.6.4.6.4.2. Initiation of the lane change manoeuvre by a second deliberate action

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."

Paragraph 5.6.4.6.7., amend to read:

"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."

*Paragraph 5.6.4.6.8.1., amend to read:*

- "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."

*Insert a new paragraph 5.7., to read:*

- "5.7. Provisions for RCM fitted to vehicles of category M<sub>1</sub> and N<sub>1</sub>.  
Any RCM shall be subject to the requirements of Annex 6."

*Insert a new paragraph 5.7.1., to read:*

- "5.7.1. Vehicles of category M<sub>1</sub> and N<sub>1</sub> meeting the requirements of Category G<sup>1</sup> 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.

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<sup>1</sup> As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, para. 2.

- 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 ( $S_{RCMmax}$ ) 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 ( $S_{RCMmax}$ ) 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.<sup>2</sup> 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.

<sup>2</sup> Two different types of map (e.g. navigation and topographical) supplied by two different suppliers are satisfactory for this requirement.

- 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."

#### *Annex 6*

*Paragraph 1.*, amend to read:

"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."

*Paragraph 2.3.*, amend to read:

- "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."

*Paragraph 2.10.*, amend to read:

- "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."

*Insert new paragraph 2.11., to read:*

- "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.)."

*Paragraph 3.1., amend to read:*

- "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."

*Paragraph 3.2., amend to read:*

- "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."

*Paragraph 3.2.1., amend to read:*

- "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."

*Paragraph 3.3.4., amend to read:*

- "3.3.4. There shall be a clear correspondence between ~~these~~ transmission links and the signals carried between Units. Priorities of signals on multiplexed data paths

shall be stated wherever priority may be an issue affecting performance or safety."

*Paragraph 3.4.4.*, amend to read:

"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:
    - 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 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."

*Paragraph 4.1.1.*, amend to read:

"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."

*Insert new paragraph 4.1.1.1.*, to read:

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

Appendix 1, amend to read:

## 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 8,*

*Paragraph 2.1.* amend to read:

"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. "

*Paragraph 2.4.,* amend to read:

"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."

*Insert a new paragraph 2.5., to read:*

"3.2.5.2. 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. "

*Paragraph 3.2.1.1. and 3.2.1.2., amend to read:*

"3.2.1.1. The vehicle speed shall remain in the range from  $V_{\min}$  up to  $V_{\max}$ .

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  $a_{y_{\max}}$  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  $a_{y_{\max}}$ . 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  $5 \text{ m/s}^3$ ."

*Paragraphs 3.2.2.1. and 3.2.2.2., amend to read:*

"3.2.2.1. The vehicle speed shall remain in the range from  $V_{\min}$  up to  $V_{\max}$

[...] 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  $5 \text{ m/s}^3$ ."

*Paragraph 3.2.3.1.* amend to read:

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

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) 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  $a_{y_{smax}}$ .

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. "

*Insert new paragraphs 3.2.5. to 3.2.5.2., to read:*

"3.2.5. Lane Crossing Warning Test for  $M_1 N_1$  and for  $M_2 M_3 N_2$  and  $N_3$ , 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  $a_{y_{smax}} + 0.1 \text{ m/s}^2$  and  $a_{y_{smax}} + 0.4 \text{ m/s}^2$ .

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."

*Paragraph 3.5.1.2., amend to read:*

"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  $1 \text{ m/s}^2$ ,
- (d) The moving average over half a second of the lateral jerk does not exceed  $5 \text{ m/s}^3$ ,
- (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 M<sub>1</sub>, N<sub>1</sub> vehicle categories and less than 10 s for M<sub>2</sub>, M<sub>3</sub>, N<sub>2</sub>, N<sub>3</sub> 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."

*Paragraph 3.5.4.1.*, amend to read:

"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:  $V_{\text{min}} + 10\text{km/h}$ .

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:  $V_{\text{min}} - 10\text{ km/h}$ ;
- (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."

*Paragraph 3.5.7.1.1.*, amend to read:

"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)."

*Paragraph 3.5.7.2.1.*, amend to read:

"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)."

*Paragraph 3.5.7.3.1.*, amend to read:

"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)."

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