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Item 6 (a) of the provisional agenda

UN Regulation No. 79:

Automatically Commanded Steering Function

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

Submitted by the experts from France, Japan, Republic of Korea and Germany**

The text reproduced below was prepared by the experts from France, Japan, Republic of Korea and Germany introducing amendments to UN Regulation No. 79, based on informal documents GRRF-86-13 and GRVA-02-33 and working document ECE/TRANS/WP29/GRVA/2019/9. The modifications to UN Regulation No. 79 are marked in bold for new or strikethrough for deleted characters.

* Formerly: **Working Party on Brakes and Running Gear (GRRF)**.

** In accordance with the programme of work of the Inland Transport Committee for 2018–2019 (ECE/TRANS/274, para. 123 and ECE/TRANS/2018/21/Add.1, Cluster 3), 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.



I. Proposal

UN Regulation No. 79, 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 $a_{y_{\text{smax}}}$.

The system may exceed the specified value $a_{y_{\text{smax}}}$ by not more than 0.3 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 $a_{y_{\text{smax}}}$ by not more than 40%, 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/s^2 ."

Annex 8, paragraph 2.4., amend to read:

"2.4. Lateral acceleration

~~The position representing the centre of gravity, at which the lateral acceleration shall be measured, shall be determined in agreement between the vehicle manufacturer and the Technical Service. 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 lateral acceleration shall be measured without taking into account the additional effects due to the movements of the vehicle body (e.g. roll of sprung mass).~~

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 vehicle coordinate system as described in ISO 8855:2011 shall be used."

Annex 8, insert a new paragraph 2.5., to read:

"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 3N. 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.

Annex 8, 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 $a_{y_{\text{max}}}$ 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 (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 $a_{y_{\text{max}}}$. **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 ~~The vehicle does not cross~~ any lane marking.
The moving average over half a second of the lateral jerk does not exceed 5 m/s^3 ."

Annex 8, paragraph 3.2.2.2., amend to read:

- 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.** ~~5.6.2.1.3.~~ of this Regulation.
The moving average over half a second of the lateral jerk does not exceed 5 m/s^3 ."

Annex 8, 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_{min} and 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) 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 $a_{y_{\text{max}}} + 0.1 \text{ m/s}^2$ and $a_{y_{\text{max}}} + 0.4 \text{ m/s}^2$.**
- 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.**

II. Justification

A. Paragraph 5.6.2.1.1. and Annex 8, paragraph 2.4., "Lateral acceleration"

1. It could be interesting to indicate in the report, for traceability, both the position at which the lateral acceleration was measured and the position of the centre of gravity of the vehicle.
2. For dynamical tests, the usual value of sampling rate is at least 100 Hz.
3. The results previously shared demonstrate that an acceptable representation of the dynamical behaviour is obtained when the used filter is 0.5 Hz.
4. When introducing filtering in Annex 8, it has to be ensured that noise, transitional overshooting issues or the filtering itself do not influence the test result. Introducing a filter with a cut-off frequency of 0.5 Hz makes it at the same time necessary to specify other tolerances in the Regulation for the lateral acceleration, so that the thresholds for the lateral acceleration can be exceeded for short time periods. This is done in paragraph 5.6.2.1.1. of the Regulation.

B. Annex 8, paragraph 2., "Overriding Force Test"

5. The intention is to offer the possibility for measuring the torque either with the internal sensor or with an external mean. A driving robot, an additional steering wheel torque system or a force sensor fitted smoothly on the steering wheel, which does not influence the steering of the vehicle, should be usable. The no influence can be checked, for instance, by driving the vehicle on a straight road, and/or in a curve, hand-off, with and without additional system. If in the both cases, the first optical warning signal appears at the same time after driver left the steering wheel, it can be considered there is no effect of the external equipment.

C. Annex 8, paragraphs 3.2.1.1. and 3.2.1.2.

6. The test defined in paragraph 3.2.1. of Annex 8 is only for demonstration of the lane keeping capabilities of the system. Issues with regard to the maximum lateral acceleration are tested according to para. 3.2.2.

In addition, paragraph 3.2.2.2. only needs one pass criterion for the lateral acceleration, namely to stay in the limits given by paragraph 5.6.2.1.1. of the Regulation.

D. Annex 8, new paragraphs 3.2.5. to 3.2.5.2.

7. A condition to be checked before declaring the test requirement fulfilled, such as defined in paragraph 5.6.2.2.3., is added in paragraph 3.2.5.2.
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