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Item 6 (a) of the provisional agenda

UN Regulation No. 79:

Automatically Commanded Steering Function

Proposal for Amendments to the 03 series of Amendments to UN Regulation No. 79 (Steering equipment)

Submitted by the expert from the European Association for Electromobility**

The text reproduced below was prepared by the expert from the European Association for Electromobility (AVERE) introducing an amendment to UN Regulation No. 79. It is aimed at clarifying the text of the Regulation. The modifications to the existing text of the Regulation are marked in bold for new and 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

Paragraph 5.6.4.4., amend to read:

- "5.6.4.4. Lateral acceleration
- The lateral acceleration induced by the system during the lane change manoeuvre:
- (a) Shall not exceed ~~1~~ **1.5** m/s² 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.
 - (c) The moving average over half a second of the lateral jerk generated by the system shall not exceed 5 m/s³."

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 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 not be initiated before a period of 3.0 seconds and not later than 5.0 seconds after the deliberate action of the driver described in paragraph 5.6.4.6.2. above.

If the vehicle has the ability to align to a sufficient gap in the target lane conforming to the requirements specified in 5.6.4.8.1 and would not result in a critical situation as defined in 5.6.4.7.:

- (a) **the minimum time to initiate the lane change manoeuvre after the deliberate action of the driver is 1.0 second provided that the vehicle is not in a critical situation (as defined in 5.6.4.7.);**
- (b) **the maximum time to initiate the lane change manoeuvre is [20.0] seconds;**

If the ACSF function has not commenced the lane change manoeuvre 10.0 seconds after the deliberate action of the driver, the driver will be notified through an acoustic or visual warning when the manoeuvre is about to commence."

Annex 8, 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~~ **1.5** m/s²,
 - (d) The moving average over half a second of the lateral jerk does not exceed 5 m/s³,
 - (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 seconds and not more than 5.0 seconds, **or up to 20.0 seconds if the system has the ability to align to a sufficient gap and notifies the driver after 10.0 seconds as described in 5.6.4.6.4.**,

- (f) The system provides information to the driver to indicate that the lane change procedure is ongoing,
- (g) The lane change manoeuvre is completed in less than 5 seconds for M₁, N₁ vehicle categories and less than 10 s for M₂, M₃, N₂, N₃ vehicle categories,
- (h) CSF of Category B1 automatically resumes after the lane change manoeuvre is completed, and
- (i) The direction indicator is deactivated not before the end of the lane change manoeuvre and no later than 0.5 seconds after ACSF of Category B1 has resumed. "

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) The lane change manoeuvre has not commenced within 5.0 seconds, **or up to 20.0 seconds if the system has the ability to align to a sufficient gap and notifies the driver after 10.0 seconds as described in 5.6.4.6.4.,** following the deliberate action of the driver described in paragraph 5.6.4.6.2.;
- (g) The lateral movement described in paragraph 5.6.4.6.4. is not continuous.

Paragraph 5.6.4.7., amend to read:

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 ~~3~~ **3.5m/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~~ **0.6** seconds.

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 = ~~3.0~~ **3.5** 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~~ **0.6**s (Remaining gap of the vehicles after the deceleration of the approaching vehicle).

II. Justification

A. Paragraph 5.6.4.4.

1. In situations where the vehicle is required to make quick lane changes (for instance when merging onto a highway or exiting a highway onto an off-ramp), a slightly higher lateral acceleration limit will allow the Automatically Commanded Steering Function (ACSF) to effectively complete the lane change in an assertive way without obstructing or slowing down any traffic behind the ACSF vehicle that is waiting to perform the same manoeuvre.

B. Paragraph 5.6.4.6.4.

2. A driver may initiate a lane change at a time when no critical situation is present with the expectation that the lane change is executed immediately. The three second delay is long enough that a rear approaching vehicle may subsequently create a critical situation even if it did not exist at the time of lane change initiation. This may cause mode confusion for the driver resulting in a potentially dangerous road situation and driver frustration if the lane change is aborted soon after.

3. A rear-approaching vehicle in the target lane will begin to slow down when the turn indicator (suggesting an intended lane change) is perceived. If this happens, the turn indicator is turned off after 5 seconds and no attempt is made to execute a lane change manoeuvre (in spite of there being sufficient space to do so due to the rear vehicle's deceleration). This may result in confusion for the surrounding traffic, potentially resulting in unsafe driving conditions.

4. Modern Assisted or Automatic Lane Change systems (ALC) have the capability to use sensory data from visual, laser, radar and ultrasonic systems to scan for gaps in neighbouring traffic and are subsequently capable of longitudinal acceleration or deceleration in order to safely change lanes in the absence of a critical situation. This behaviour mirrors the behaviour of human drivers in real-world traffic and allows ALC systems to safely navigate road environments with medium traffic.

5. As in the case of manual driving, it is demonstrably safer and better driving practice to continue to convey the intention to perform a lane change (via the turn indicator) until a desired lane change is completed (or the driver changes their mind) rather than turn off the turn indicator and cancel the lane change every 5 seconds. This is particularly true if the driver requests two or more successive ALCs. Within the current requirements, if the first lane change is suppressed, the second lane change manoeuvre would begin only 5 to 11 seconds after the first lane change was initiated. This would leave the turn indicator on for 11 seconds without any significant attempt at lateral movement, confusing other drivers on the road about the intentions of the ego vehicle.

6. Suppression of the lane change after lateral movement has begun would mean bringing the vehicle back to its original lane with a swerving motion (fishtails). This results in a dangerous and uncomfortable experience, and conveys false information to the surrounding traffic. A vehicle in an adjacent lane may anticipate the desired lane change and attempt to move into the ego vehicle's position. If the ego vehicle then cancels the lane change due to the 5 second rule, a collision may occur. This resulting situation is not foreseen within the critical situation provisions but is common in medium traffic situations. Additional flexibility with regard to the vehicle's available time to initiate a lane change manoeuvre mitigates some of this induced risk.

C. Annex 8, Paragraph 3.5.1.2.

7. Adjustments to reflect changes proposed for the other provisions described in this document.

D. Paragraph 5.6.4.7.

8. A rear-approaching vehicle typically starts to respond as soon as it sees the turn indicator of the vehicle in the adjacent lane become active. As the regulation mandates that the lane change manoeuvre begin at most 3 seconds (and at least 1 second) after lane change

initiation, it is reasonable to expect both higher deceleration and lower time to reaction on the part of the approaching vehicle.

9. We believe that the critical distance should give more weight to the relative speed of the two negotiating vehicles rather than the velocity of the ego vehicle. For instance, if the speed of the ego vehicle is much higher than that of the rear approaching vehicle, it would not be unsafe to have a lower critical distance. To that effect, considering the distance travelled by the lane change vehicle alone is less relevant to the lane change than the distance maintained between the two negotiating vehicles. This is particularly true if the ACSF vehicle has the ability to speed up or slowdown in order to safely complete the lane change.

10. Overly conservative or hesitant behaviour may confuse surrounding traffic and impede normal traffic flows. An oncoming vehicle, post deceleration may be confused as to why the ACSF vehicle has not begun the lane change in spite of the available space gap with the indicator active.
