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Item 3(a) of the provisional agenda

Regulations Nos. 13 and 13-H (Braking) – Electronic stability control**Proposal for Supplement 10 to the 11 series of amendments
to Regulation No. 13 (Heavy vehicle braking)****Submitted by the informal group on Alternative Method Electronic
Vehicle Stability Control ***

The text reproduced below was prepared by the informal group on Alternative Method Electronic Vehicle Stability Control (AMEVSC) to clarify the requirements in Annex 21 of Regulation No. 13 regarding the use of simulation, specifically in the Appendices 1, 2 and 3 of Annex 21. Modifications to the current provisions of the Regulation including the amendments proposed by ECE/TRANS/WP.29/2011/94 are marked in bold characters for new and strikethrough for deleted text.

* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106, ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Annex 21, Appendix 1, amend to read:

"Annex 21

Appendix 1

Use of the dynamic stability simulation

The effectiveness of the directional and/or roll-over stability control function of power driven vehicles and trailers of categories M, N and O, may be determined by computer simulation.

1. Use of the simulation
 - 1.1. The vehicle stability function shall be demonstrated by the vehicle manufacturer to the Type Approval Authority or Technical Service with the same dynamic manoeuvre(s) as for the practical demonstration in paragraph 2.1.3. or 2.2.3. of Annex 21.
 - 1.2. The simulation shall be a means whereby the vehicle stability performance may be demonstrated with the vehicle stability function enabled or disabled, and in the laden and unladen conditions.
 - 1.3. The simulations shall be carried out with a validated modelling and simulation tool. **The simulation tool shall only be used when the parameters of the vehicle to be type-approved fall within the validated range of parameters of the simulation tool.** The verification shall be carried out using the same manoeuvre(s) as defined in paragraph 1.1. above.

The method by which the simulation tool is validated is given in Annex 21, Appendix 2.

 - 1.3.1. **In the case where a validated simulation tool is used by a vehicle manufacturer for whom the simulation tool was not validated, a single confirmation test shall be conducted by the vehicle manufacturer in conjunction with a Technical Service. The confirmation test shall be a single comparison between an actual vehicle test and a simulation using one of the manoeuvres as defined in paragraph 1.1. above. The confirmation test shall be repeated in the event of a change to the vehicle stability function or simulation tool.**

The results of the confirmation test shall be attached to the type-approval documentation.
- 1.4. **The availability of the simulation tool software, to the software version used, shall be maintained for a period of not less than 10 years."**

Annex 21, Appendix 2, amend to read:

"Annex 21

Appendix 2

Dynamic stability simulation tool and its validation

1. Specification of the simulation tool
 - 1.1. The simulation method shall take into account the main factors which influence the directional and roll motion of the vehicle. ~~A typical~~ **The simulation model may shall** include the following ~~vehicle~~ parameters as applicable ~~in an explicit or implicit form~~¹:
 - ~~(a) Axle/wheel~~
 - ~~(b) Suspension~~
 - ~~(c) Tyre~~
 - ~~(d) Chassis/vehicle body~~
 - ~~(e) Power train/driveline, if applicable~~
 - ~~(f) Brake system~~
 - ~~(g) Pay load~~
 - (a) Vehicle category;**
 - (b) Character of the vehicle;**
 - (c) Vehicle configuration(s) (e.g. 4x2, 6x2, etc., identifying axle functionality (e.g. free running, driven, lifted, steered) and position);**
 - (d) Additional steering axles (e.g. forced steering, self-steering);**
 - (e) Steering ratio;**
 - (f) Drive axles (effect on wheel speed sensing and vehicle speed);**
 - (g) Lift axles (detection/control and wheelbase change effect when lifted);**
 - (h) Engine management (communication, control and response);**
 - (i) Gearbox type (e.g. manual, automated manual, semi-automatic, automatic);**
 - (j) Drive train options (e.g. retarder);**
 - (k) Differential type (e.g. standard or self-locking);**
 - (l) Differential lock(s) (driver selected);**
 - (m) Brake system type (e.g. air over hydraulic, full air);**
 - (n) Brake type (e.g. disc, drum (single wedge, twin wedge, S-cam));**
 - (o) Anti-lock braking configuration;**

- (p) Wheelbase;
- (q) Tyre type (e.g. structure, category of use, size);
- (r) Track width;
- (s) Suspension type (e.g. air, mechanical, rubber);
- (t) Centre of gravity height;
- (u) Lateral acceleration sensor position;
- (v) Yaw rate sensor position;
- (w) Loading.

¹ Parameters not covered shall be a limitation on the use of the simulator

- 1.1.1. The Technical Service conducting the validation shall be provided with an information document covering at least the points in paragraph 1.1. above.
- 1.2. The Vehicle Stability Function shall be added to the simulation model by means of:
 - a) A subsystem (software model) of the simulation tool **as software-in-the-loop**, or
 - b) ~~The~~ **An actual** electronic control ~~box~~ **unit** in a hardware-in-the-loop configuration.
- 1.3. In the case of a trailer, the simulation shall be carried out with the trailer coupled to a representative towing vehicle.
- 1.4. Vehicle loading condition
 - 1.4.1. The simulator shall be able to take into account the laden and unladen conditions.
 - 1.4.2. The load shall be considered to be a fixed load with **given** properties (mass, mass distribution and ~~maximum recommended~~ height of the centre of gravity) ~~specified by the manufacturer~~.
- 2. Validation of the simulation tool
 - 2.1. The validity of the applied modelling and simulation tool shall be verified by means of comparisons with a practical vehicle test(s). The test(s) utilised for the validation shall be those which, without control action, would result in loss of directional control (under-steer and over-steer) **and/or** roll-over control as appropriate to the functionality of the stability control function installed on a ~~representative~~ vehicle.

 During the test(s) the following motion variables, as appropriate, shall be recorded or calculated in accordance with ISO 15037 Part 1:2005 **2006: General conditions for passenger cars** or Part 2:2002: ~~General conditions for heavy vehicles and buses~~ (depending on the vehicle category):
 - (a) Yaw velocity;
 - (b) Lateral acceleration;

- (c) Wheel load or wheel lift;
 - (d) Forward velocity;
 - (e) Driver input.
- 2.2. The objective is to show that the simulated vehicle behaviour and operation of the vehicle stability function is comparable with that seen in practical vehicle tests.
- The ability of the simulator to be used with parameters that have not been validated by a practical vehicle test shall be shown by conducting simulations with varied parameter values. The results of these simulations shall be checked to be logical and similar in comparison to the results of known practical vehicle tests.**
- 2.3. The simulator shall be deemed to be validated when its output is comparable to the practical test results produced by the same vehicle during the manoeuvre(s) selected from those defined with paragraph 2.1.3. or 2.2.3. of Annex 21, as appropriate.
- The simulator shall only be used with regard to features for which a comparison has been made between real vehicle tests and simulator results. The comparisons shall be carried-out in the laden and unladen condition to show the different conditions of load can be adapted to and to confirm the extreme parameters to be simulated, e.g.:
- (a) Vehicle with shortest wheelbase and highest centre of gravity;
 - (b) Vehicle with longest wheelbase and highest centre of gravity.
- In the case of the steady state circular test the under-steer gradient shall be the means of making the comparison.
- In the case of a dynamic manoeuvre, the relationship of activation and sequence of the vehicle stability function in the simulation and in the practical vehicle test shall be the means of making the comparison.
- 2.4. The physical parameters that are different between the reference vehicle and simulated vehicle configurations shall be modified accordingly in the simulation.
- 2.5. A simulator test report shall be produced, a model of which is defined in Appendix 3 of this annex, and a copy attached to the vehicle approval report."

Annex 21, Appendix 3, amend to read:

"Annex 21

Appendix 3

Vehicle stability function simulation tool test report

Test Report Number:

1. Identification
 - 1.1. Name and address of the simulation tool manufacturer
 - 1.2. Simulation tool identification: name/model/number (hardware and software)
2. Simulation tool
 - 2.1. Simulation method (general description, taking into account the requirements of paragraph 1.1. of Appendix 2 to Annex 21)
 - 2.2. Hardware/software in the loop (see paragraph 1.2. of Appendix 2 to Annex 21)
 - 2.3. Vehicle loading conditions (see paragraph 1.4. of Appendix 2. to Annex 21)
 - 2.4. Validation (see paragraph 2. of Appendix 2 to Annex 21)
 - 2.5. Motion variables (see paragraph 2.1. of Appendix 2 to Annex 21)
3. Scope of application
 - 3.1. Vehicle category:**
 - ~~3.1.~~ **3.2.** Character of **the** vehicle (~~e.g. truck, tractor for semi-trailer, bus, semi-trailer, centre-axle trailer, full trailer~~)
 - ~~3.2.~~ **3.3.** Vehicle configuration: (~~e.g. 4x2, 4x4, 6x2, 6x4, 6x6~~)
 - 3.4. Additional steering axles:**
 - 3.5. Steering ratio:**
 - 3.6. Drive axles:**
 - 3.7. Lift axles:**
 - 3.8. Engine management:**
 - 3.9. Gearbox type:**
 - 3.10. Drive train options:**
 - 3.11. Differential type:**
 - 3.12. Differential lock(s):**
 - 3.13. Brake system type:**
 - 3.14. Brake type:**
 - 3.15. Anti-lock braking configuration:**
 - 3.16. Wheelbase:**

- 3.17. **Tyre type:**
- 3.18. **Track width:**
- 3.19. **Suspension type:**
- 3.20. **Centre of gravity height:**
- 3.21. **Lateral acceleration sensor position:**
- 3.22. **Yaw rate sensor position:**
- 3.23. **Loading:**
- ~~3.3.~~ 3.24. Limiting factors: ~~(e.g. mechanical suspension only)~~
- ~~3.4.~~ 3.25. Manoeuvre(s) for which the simulator has been validated:
4. Verifying vehicle test(s)
- 4.1. Description of vehicle(s) including the towing vehicle in case of trailer testing:
- 4.1.1. Vehicle(s) identification: make/model/VIN
- 4.1.1.1. Non-standard fitments:
- 4.1.2. Vehicle description, including axle configuration/suspension/wheels, engine and drive line, braking system(s) and vehicle stability function content (directional control/rollover control), steering system, with name/model/number identification:
- 4.1.3. Vehicle data used in the simulation (explicit)
- 4.2. Description of test(s) including location(s), road/test area surface conditions, temperature and date(s):
- 4.3. Results laden and unladen with the vehicle stability function switched on and off, including the motion variables referred to in Annex 21, Appendix 2, paragraph 2.1. as appropriate:
5. Simulation results
- 5.1. Vehicle parameters and the values used in the simulation that are not taken from the actual test vehicle (implicit):
- 5.2. Results laden and unladen with the vehicle stability function switched on and off for each test conducted under paragraph ~~3.2.~~ 4.2. of this appendix, including the motion variables referred to in Annex 21, Appendix 2, paragraph 2.1. as appropriate:
6. **Concluding statement**
- The simulated vehicle behaviour and operation of the vehicle stability function is comparable with that of practical vehicle tests.**
- Yes/No**
7. **Limiting factors**
6. This test has been carried out and the results reported in accordance with Appendix 2 of Annex 21 to ECE Regulation No. 13 as last amended by the ... series of Amendments.

Technical Service conducting the test ¹

Signed: Date:

Approval Authority ¹"

¹ To be signed by different persons if the Technical Service and the Approval Authority are the same organisation.

II. Justification

The proposed amendments to Appendices 1, 2 and 3 of Annex 21 provide clarification on the use and validation of the simulation tool. A more uniformed application of the process can be ensured through a more detailed definition of the requirements,.

1. Appendix 1, paragraph 1.3.

The amendment ensures that the tool can only be used when the vehicle parameters of the vehicle for which type-approval is requested fall within the vehicle parameters for which the tool has been validated.

2. Appendix 1, paragraph 1.3.1.

As the tool is basically only software, this new paragraph ensures that a vehicle manufacturer does not blindly use a tool from a third/fourth/fifth/... party.

3. Appendix 1, paragraph 1.4.

This new paragraph ensures that it would be possible to re-evaluate the use of the tool for a period of at least 10 years, should it be necessary.

4. Appendix 2, paragraph 1.1.

The current use of the word "may" means that vehicle parameters that could affect the performance of a vehicle stability function do not have to be included in the tool. The "may" is changed to "shall", the list of vehicle parameters to be considered is expanded to be more comprehensive and a footnote ensures that parameters not covered shall be a limitation on the use of the tool.

5. Appendix 2, paragraph 1.1.1.

The new paragraph provides the Technical Service with information on the claimed performance of the tool.

6. Appendix 2, paragraph 1.2.

These small amendments provide a better understanding, without changing the requirements.

7. Appendix 2, paragraph 1.4.2.

Clarification that the load acts at a fixed point during the simulation, but that it is moveable as required by paragraph 1.4.1. of Appendix 2.

8. Appendix 2, paragraph 2.1.

Motor vehicles are required to have both direction control and roll-over control and, therefore, it is appropriate to add the word "and". The word "representative" is deleted as there is no definition of what it means, and as the verification is by comparison with actual vehicles test results, it is not necessary to define

representative. The titles of the ISO standards bring no benefit and are, therefore, deleted. Part 1 of ISO 15037 was revised in 2006 and the date is, therefore, changed.

9. Appendix 2, paragraph 2.2.

The added paragraph clarifies the conditions under which parameters can be validated without a practical vehicle test result with which to compare the performance of the tool.

10. Appendix 3, paragraph 3, new sub-paragraphs

The list of vehicle parameters to be considered under paragraph 1.1. of Appendix 1 is included in the test report to ensure that each is covered.

11. Appendix 3, paragraph 5.2.

Correction of paragraph cross-referencing.

12. Appendix 3, paragraph 6.

A concluding statement with any limiting factors is added as a new paragraph so that there is an easily understood statement as to the capability/use of the tool.
