

**Amendments to AMEVSC-08-05e as a result of 10th / 11th May meeting
shown in blue text with gray highlight – final document**

**Proposed amendments to the Proposal for Supplement 10 to
the 11 series of amendments to Regulation No. 13**

(Document GRRF/2012/2)

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 value of each relevant parameters of the vehicle to be type-approved fall within the validated range of parameters of the simulation tool falls within the range of each respective parameter of the simulation tool, as listed in paragraph 1.1 of Appendix 2 to this Annex, is included in the simulation tool and when the value of each parameter falls within its respective validated**

range. The verification shall be carried out using the same manoeuvre(s) as defined in paragraph 1.1. **above of this Appendix.**

The method by which the simulation tool is validated is given in **Appendix 2 to this** 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 conformation test shall be conducted by the vehicle manufacturer in conjunction with a Technical Service.~~

A vehicle manufacturer using a validated simulation tool that was not directly validated by themselves for a vehicle type-approval shall carry-out at least one confirmation test.

~~The~~ **This** confirmation test shall be **conducted in conjunction with a Technical Service and 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 of this Appendix.**

The confirmation test shall be repeated in the event of a change to the ~~vehicle stability function of~~ **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."

*** The necessity of a confirmation test shall be subject to a discussion between the vehicle manufacturer, the Technical Service and the Approval Authority.**

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~~ **tool** shall take into account the main factors which influence the directional and roll motion of the vehicle.

1.1.1. A typical The simulation ~~model~~ **tool** ~~may~~ shall ~~include~~ **take into account** the following ~~vehicle~~ **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;
- ~~(i)~~ (c) Gearbox type (e.g. manual, automated manual, semi-automatic, automatic);
- ~~(k)~~ (d) Differential type (e.g. standard or self-locking);
- ~~(l)~~ (e) Differential lock(s) (driver selected);
- ~~(m)~~ (f) Brake system type (e.g. air over hydraulic, full air);
- ~~(n)~~ (g) Brake type (e.g. disc, drum (single wedge, twin wedge, S-cam));
- ~~(q)~~ (h) Tyre type (e.g. structure, category of use, size);
- ~~(r)~~ (i) Suspension type (e.g. air, mechanical, rubber);

1.1.2.

The simulation model shall include at least the following parameters as applicable ¹:

- ~~(e)~~ (a) Vehicle configuration(s) (e.g. 4x2, 6x2, etc., identifying axle functionality (e.g. free running, driven, lifted, steered) and position);
- ~~(d)~~ (b) ~~Additional Steering axes (e.g. forced steering, self steering)~~ (working principle);
- ~~(e)~~ (c) Steering ratio;
- ~~(f)~~ (d) Drive axle(s) (effect on wheel speed sensing and vehicle speed);
- ~~(g)~~ (e) Lift axle(s) (detection/control and wheelbase change effect when lifted);
- ~~(h)~~ (f) Engine management (communication, control and response);
- ~~(i)~~ (g) Gearbox type (e.g. manual, automated manual, semi-automatic, automatic) characteristic(s);
- ~~(j)~~ (h) Drive train option(s) (e.g. retarder, regenerative braking, auxiliary propulsion system);
- ~~(n)~~ (i) Brake type (e.g. disc, drum (single wedge, twin wedge, S-cam)) characteristic(s);
- ~~(o)~~ (j) Anti-lock braking configuration;
- ~~(p)~~ (k) Wheelbase;
- ~~(r)~~ (l) Track width;
- ~~(t)~~ (m) Centre of gravity height;

~~(u)~~ (n) Lateral acceleration sensor position;

~~(v)~~ (o) Yaw rate sensor position;

~~(w)~~ (p) Loading

¹ Parameters not covered taken into account shall be a limitation on limit the use of the simulator simulation tool.

1.1.1.3. The Technical Service conducting the validation shall be provided with an information document covering at least the points in paragraphs 1.1.1. and 1.1.2. 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 simulation tool 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.~~

The simulated load shall, as a minimum, meet the following criteria:

- a fixed load,
- a given mass,
- a given mass distribution, and
- a given height of the centre of gravity.

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 Part 1:2006 General conditions for passenger cars or Part 2:2002: General conditions for heavy vehicles and buses (depending on the vehicle category): as relevant:

- (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~~ **simulation tool** 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."

2.5.1. A simulation tool validation carried-out in accordance with Annex 21 appendix 2 and appendix 3, prior to the entry into force of Supplement [10] to the 11 series of amendments to this Regulation, may continue to be used for a new vehicle stability function approval or the extension of an existing vehicle stability function approval without the need to produce a new validation test report as defined in Appendix 3 provided that the scope of application is complied with."

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. **Brake characteristic(s):**
 - ~~3.15.~~ 3.16. **Anti-lock braking configuration:**

- ~~3.16.~~ ~~3.17.~~ **Wheelbase:**
- ~~3.17.~~ ~~3.18.~~ **Tyre type:**
- ~~3.18.~~ ~~3.19.~~ **Track width:**
- ~~3.19.~~ ~~3.20.~~ **Suspension type:**
- ~~3.20.~~ ~~3.21.~~ **Centre of gravity height:**
- ~~3.21.~~ ~~3.22.~~ **Lateral acceleration sensor position:**
- ~~3.22.~~ ~~3.23.~~ **Yaw rate sensor position:**
- ~~3.23.~~ ~~3.24.~~ **Loading:**
- 3.3. ~~3.24.~~ ~~3.25.~~ Limiting factors: ~~(e.g. mechanical suspension only)~~
- 3.4. ~~3.25.~~ ~~3.26.~~ 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**
- 8.** 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.
