

## Proposed amendments to ECE Regulation No. 13

Amendments made at the 8<sup>th</sup> meeting (29<sup>th</sup> – 31<sup>st</sup> March 2006) are shown in red.

Paragraphs which are not applicable to passenger cars and would not be part of R.13H, if it would be amended to include vehicle stability control systems, which were identified at the 8<sup>th</sup> meeting are highlighted with a yellow background.

Amendments made at the Subgroup Simulation meeting, 2<sup>nd</sup> March 2006 which were not discussed at the 8<sup>th</sup> meeting are shown in blue.

### A. PROPOSAL (Provisions for vehicle stability control systems)

Add new paragraphs 2.32. to 2.32.2.2., to read:

- 2.32. “Vehicle Stability Function” means an electronic control function for a vehicle which improves the dynamic stability of the vehicle.
- 2.32.1. A vehicle stability function may include one or both of the following:
- directional control
  - roll-over control
- 2.32.2. Control functions within a vehicle stability function:
- 2.32.2.1. “Directional control” means a function within a vehicle stability function that assists the driver within the physical limits of the vehicle in maintaining the direction intended by the driver in the case of a power-driven vehicle, and assists in maintaining the direction of the trailer with that of the towing vehicle in the case of a trailer.
- 2.32.2.2. “Roll-over control” means a function within a vehicle stability function that reacts to ~~the potential of an impending~~ roll-over **in order** to stabilise the power-driven vehicle or towing vehicle and trailer combination or the trailer during dynamic manoeuvres within the physical limits of the vehicle.

Add new paragraph 5.2.1.32., to read:

- 5.2.1.32. The requirements defined within Annex 21 to this Regulation shall apply to those vehicles where there is a requirement for mandatory installation of a vehicle stability function, as specified below:

.....  
In the case of other vehicles, Annex 21 may be applied at the vehicle manufacturer's discretion.

Add new paragraph 5.2.2.23., to read:

5.2.2.23. The requirements defined within Annex 21 to this Regulation shall apply to those trailers where there is a requirement for mandatory installation of a vehicle stability function, as specified below:

.....  
In the case of other vehicles, Annex 21 may be applied at the vehicle manufacturer's discretion.

## **Annex 2**

Add a new paragraph 14.14., to read:

14.14. The vehicle is ~~is not~~<sup>2)</sup> equipped with a vehicle stability function: Yes / No <sup>2)</sup>

If yes:

~~In the case where the vehicle is equipped with a vehicle stability function:  
Vehicle stability function has been approved according to Annex 21: Yes / No <sup>2)</sup>~~

The vehicle stability function fulfils the requirements of Annex 21: Yes / No <sup>2)</sup>

Vehicle stability function is optional equipment: Yes / No <sup>2)</sup>

Vehicle stability function includes directional control: Yes / No <sup>2)</sup>

Vehicle stability function includes roll-over control: Yes / No <sup>2)</sup>

14.14.1. Where an Annex 19 test report has been utilised, the test report number shall be stated:

## **Annex 19**

Add a new paragraph 1.1.5., to read:

1.1.5. Vehicle stability function (refer to paragraph 6.).

Add new a paragraph 6., to read:

## 6. Vehicle Stability Function

### 6.1. General

6.1.1. This section defines a test procedure to determine the dynamic characteristics of a vehicle equipped with a vehicle stability function consisting of at least one of the following functions:

- directional control
- roll-over control.

### 6.2. Information Document

6.2.1. The system/vehicle manufacturer shall supply to the Technical Service an Information Document of the control function(s) for which performance verification is required. This document shall contain at least the information defined in Appendix 7 to this Annex.

### 6.3. Definition of test vehicle(s)

6.3.1. Based on the information supplied in the Information Document, in particular the trailer applications defined in paragraph 2.1. of Appendix 7, the Technical Service shall carry out demonstrative tests as defined in paragraph 2.2.3. of Annex 21 to this Regulation on a representative trailer(s) having up to three axles and equipped with the respective braking system configurations.

6.3.1.1. When selecting a representative trailer(s) for evaluation, consideration shall also be given to the following:

Suspension type: for each suspension group ~~i.e.~~ e.g. balanced pneumatic a representative trailer shall be evaluated.

Wheelbase: wheel base shall not be a limiting factor

Brake type: approval shall be limited to S-cam or disc brakes but should other types become available, then comparative testing may be required.

Braking system: the braking system of the trailer(s) to be evaluated shall comply with all of the relevant requirements of this Regulation.

### 6.4. Test Schedule:

6.4.1. The demonstrative tests to be carried out shall be agreed between the system/vehicle manufacturer and the Technical Service and shall include the critical conditions of ~~roll-over, under-steer and over-steer~~ directional control and roll-over control as appropriate to the vehicle stability function installed on the trailer with the method of demonstration and results being included in the test report.

6.5. Towing vehicle: the towing vehicle used for evaluating the performance of the vehicle (trailer) stability function shall have the necessary pneumatic and electrical connections and if the towing vehicle is equipped with a vehicle stability function as defined in paragraph 2.32. of this Regulation that function shall be disabled.

## 6.6 Test report

6.6.1 A test report shall be produced, the content of which shall be at least that defined in Appendix 8 to this Annex.

Add a new Appendix 7 to Annex 19, to read:

### **Annex 19 – Appendix 7**

#### **Vehicle Stability Function Information Document**

##### 1. General

1.1. Name of manufacturer

1.2. System name

1.3. System variations

1.4. Control function (directional / roll-over / both) including an explanation of the basic function and/or philosophy of the control

1.5. System configurations (where appropriate)

1.6. System identification

##### 2. Applications

2.1. List of trailer types and configurations for which approval is required

2.2. Schematic diagrams of the respective configurations installed on the trailers defined in 2.1. above with consideration given to the following:

- Lift axles
- Steering axles
- Anti-lock braking configurations

2.3. Scope of application with respect to suspension type:

Air suspension: Any type of balanced “trailing arm” air suspension

Other suspensions: to be defined by manufacturer, model and type (balanced/unbalanced).

2.4. Additional information (if applicable) to the application of the directional control and/or the roll-over control function(s)

##### 3. Component Description

- 3.1. Sensors external to the controller
  - Function
  - Limitations on the location of the sensors.
  - Identification e.g. part numbers
  
- 3.2. Controller(s)
  - General description and function
  - Identification e.g. part numbers
  - Limitations on the location of the controller(s).
  - Additional features
  
- 3.3. Modulators
  - General description and function
  - Identification
  - Limitations
  
- 3.4. Electrical Equipment
  - Circuit diagrams
  - Powering methods
  
- 3.5. Pneumatic circuits  
System schematics including anti-lock braking **configurations** associated with the trailer types defined in paragraph 6.2.1 of this Annex
  
- 3.6. Safety aspects of the electronic system in accordance with Annex 18 **to this Regulation**
  
- 3.7. Electro-magnetic compatibility
  - 3.7.1. Documentation demonstrating compliance with Regulation No. 10 including the 02 Series of amendments.

Add a new Appendix 8 to Annex 19, to read:

**Annex 19 – Appendix 8**

**Vehicle Stability Function Test Report**

Test Report No: .....

1. Identification:

1.1. Manufacturer of the vehicle stability function (name and address)

- 1.2. System name / model
- 1.3. Control function
2. System(s) and installations approved:
  - 2.1. Anti-lock braking configurations (where appropriate)
  - 2.2. Range of application (trailer type(s) and number of axles)
  - 2.3. System identification
  - 2.4. Additional features
3. Test data and results:
  - 3.1. Test vehicle data (including the specification and functionality of the towing vehicle)
  - 3.2. Test surface information
  - 3.3. Additional Information
  - 3.4. Demonstrative tests/simulations used for the purpose of evaluating the directional control and the roll-over control as appropriate.
  - 3.5. Test results
  - 3.6. Assessment in accordance with Annex 18 to this Regulation
4. Limits of installation:
  - 4.1. Suspension type
  - 4.2. Brake type
  - 4.3. Location of components on the trailer
  - 4.4. Anti-lock braking configurations
  - 4.5. Other recommendations/limitations (e.g. lifting axles, steering axles, etc.)
5. Attachments
6. Date of test:
7. This test has been carried out and the results reported in accordance with Annex 19 to ECE Regulation No. 13 as last amended by the ..... series of amendments.

Technical Service <sup>1/</sup> conducting the test

Signed: ..... Date: .....

8. Approval Authority <sup>1/</sup>

Signed: ..... Date: .....

<sup>1/</sup> To be signed by different persons even when the Technical Service and Approval Authority are the same or alternatively, a separate Approval Authority Authorisation issued with the report.

Appendix 7 (former), renumbered as Appendix 9

## **Annex 20**

Paragraph 2.1.3., amend to read:

2.1.3. A documentation package that contains the relevant verification information including the relevant calculations, where appropriate, for the following:

<b>Performance Requirements</b>	<b>Annex 20 Reference</b>
Cold service braking performance	3.
Parking brake performance	4.
Automatic (emergency) brake performance	5.
Failure of brake distribution system	6.
Anti-lock braking	7.
Vehicle stability function	8.
Functional checks	9.

Add a new Paragraph 8.0., to read:

8.0. Alternative procedure for demonstrating the performance of a trailer equipped with a vehicle stability function.

8.1. Evaluation of a trailer in accordance with paragraph 2 of Annex 21 to this Regulation may be waived at the time of trailer type approval provided that the vehicle stability function complies with the relevant requirements of Annex 19 to this Regulation.

8.2. Verification

8.2.1. Verification of components and installation

The specification of the braking system, in which the stability control function is integrated, installed on the trailer to be Type Approved shall be verified by satisfying each of the following criteria:

	Condition	Criteria
8.2.1.1.	(a) Sensor(s)	No change allowed
	(b) Controller(s)	No change allowed
	(c) Modulator(s)	No change allowed
8.2.1.2.	Trailer types as defined in the test report	No change allowed
8.2.1.2.	Installation configurations as defined in the test report	No change allowed
8.2.1.3.	For other limitations refer to paragraph 4 of the test report as described in Appendix 8 of Annex 19 to this Regulation.	No change allowed

Paragraph 9.1.8. (former), renumber as paragraph 9.1.9.

Add a new paragraph 9.1.8., to read:

#### 9.1.8. Vehicle stability function

9.1.8.1. For practical reasons verification of the vehicle stability function shall be limited to an installation check and observation of the correct warning signal sequence to ensure no faults are present as defined in paragraph 8.2. above.

Add new Annex 21, to read:

### Annex 21

#### SPECIAL REQUIREMENTS FOR CERTAIN VEHICLES EQUIPPED WITH A VEHICLE STABILITY FUNCTION, ~~WHEN MANDATED~~

##### 1. General

This annex defines the special requirements for certain vehicles equipped with a vehicle stability function ~~where the installation of such equipment is mandatory~~, as specified in paragraphs 5.2.1.32. and 5.2.2.23 of this Regulation ~~and paragraph 2.4. of Annex 5 to this Regulation.~~

##### 2. Requirements

##### 2.1. Power-driven vehicles



**2.1.1.** Where a vehicle is equipped with a vehicle stability function as defined in paragraph 2.32. of this Regulation, the following shall apply:

In the case of directional control the function shall have the ability to automatically control individually the ~~wheel speeds on at least two wheels~~ of ~~the left and right wheels on~~ each axle or ~~an axle of each~~ axle group\* by selective braking based on the evaluation of actual vehicle behaviour in comparison with a determination of vehicle behaviour demanded by the driver.<sup>17</sup>

In the case of roll-over control the function shall have the ability to automatically control ~~individually~~ the wheel speeds on at least two wheels of ~~each an~~ axle or axle group\* by selective braking or automatically commanded braking based on the evaluation of actual vehicle behaviour that may lead to vehicle roll-over.<sup>17</sup>

\* In the case of multiple axles, where the spread is greater than 2m, each individual axle shall be considered as an independent axle group.

**2.1.2.** To realise the functionality defined above a vehicle stability function shall include, in addition to selective braking and/or automatically commanded braking, at least the following:

- The ability to control engine power output.
- In the case of directional control: The determination of actual vehicle behaviour from values of yaw rate, lateral acceleration, wheel speeds, ~~and~~ from the driver's control inputs to the braking ~~system, to the~~ and steering systems and to the engine. Only on-board generated information shall be used. If these values are not directly measured, the evidence of the appropriate correlation with directly measured values under all driving conditions (e.g. including driving in a tunnel) shall be shown to the technical service at the time of type approval.
- In the case of roll-over control: The determination of actual vehicle behaviour from values of the vertical force on the tyre(s) (or at least lateral acceleration and wheel speeds) and from the driver's control inputs to the braking system, and to the engine. Only on-board generated information shall be used. If these values are not directly measured, the evidence of the appropriate correlation with directly measured values under all driving conditions (e.g. including driving in a tunnel) shall be shown to the technical service at the time of type approval.
- In the case of a towing vehicle equipped according to paragraph 5.1.3.1. of this Regulation: The ability to apply the service brakes of the trailer via the respective control line(s) independently of the driver.

**2.1.3.** The vehicle stability function shall be demonstrated ~~to the Technical Service~~ by ~~a~~ dynamic ~~demonstration~~ manoeuvre(s) on one vehicle ~~configuration~~. This may be realized by a comparison of results obtained with the vehicle stability function enabled and disabled for a given load condition. ~~For other vehicle configurations~~ As an alternative to carrying-out dynamic manoeuvre(s) for other vehicles and other load conditions, fitted with the same vehicle stability system, ~~it is permissible to~~

~~submit test results~~ the results from actual vehicle tests or a computer simulations may be submitted ~~(together with data which verifies the simulation model, including the real sensor characteristics, against a practical vehicle test).~~

The use of the simulator is defined in Appendix 1 to this Annex.

The specification and ~~functionality~~ validation of the simulator is defined in Appendix ~~1~~ 2 to this Annex.

Until unified test procedures are agreed, ~~the~~ the method by which this demonstration is carried out shall be agreed between the vehicle manufacturer and the Technical Service and shall include the critical conditions of directional control and roll-over control as appropriate to the vehicle stability function installed on the vehicle with the method of demonstration and results being appended to the type approval report. This may be carried-out other than at the time of type approval.

As a means of demonstrating the vehicle stability function any of the following dynamic manoeuvres may be used, but not limited to;

- steady state circular test;
- **reducing radius test;**
- step steer input test;
- sine with dwell;
- J turn;
- $\mu$ -split single lane change;
- double lane change;
- reversed steering test or “fish hook” test;
- asymmetrical one period sine steer or pulse steer input test;

**2.1.4.** Interventions of the vehicle stability function shall be indicated to the driver by a specific optical warning signal. The indication shall be present as long as the vehicle stability function is in an intervention mode. The warning signals specified in paragraph 5.2.1.29. of this Regulation shall not be used for this purpose.

Interventions of the vehicle stability function used in any learning process to determine the vehicle operational characteristics shall not generate the above signal.

The signal shall be visible to the driver, even in daylight, such that the driver can easily verify the satisfactory condition of the signal without leaving the driver’s seat.

**2.1.5.** A vehicle stability function failure or defect shall be detected and indicated to the driver by the specific optical warning signal referred to in paragraph 5.2.1.29. of this Regulation.

The warning signal shall be constant and remain displayed as long as the failure or defect persists and the ignition (start) switch is in the “on” (run) position.

2.1.6. In the case of a power-driven vehicle equipped with an electric control line and electrically connected to a trailer with an electric control line the driver shall be warned by a specific optical warning signal whenever the trailer provides the information “VDC Active” via the data communications part of the electric control line. The optical signal defined in paragraph 2.1.4. above may be used for this purpose.

2.2. Trailers

2.2.1. Where a trailer is equipped with a vehicle stability function as defined in paragraph 2.32. of this Regulation, the following shall apply:

In the case of directional control the function shall have the ability to automatically control individually the ~~wheel~~ speeds ~~on at least two wheels~~ of the left and right ~~wheels on~~ each axle or ~~an axle of each~~ axle group\* by selective braking based on the evaluation of actual trailer behaviour in comparison with a determination of the relative behaviour of the towing vehicle.<sup>1/</sup>

In the case of roll-over control the function shall have the ability to automatically control ~~individually~~ the wheel speeds on at least two wheels of ~~each an~~ axle or axle group\* by selective braking or automatically commanded braking based on the evaluation of actual trailer behaviour that may lead to roll-over.<sup>1/</sup>

\* In the case of multiple axles, where the spread is greater than 2m, each individual axle shall be considered as an independent axle group.

2.2.2. To realise the functionality defined above a vehicle stability function shall include, in addition to automatically commanded braking and where appropriate selective braking, at least the following:

- The determination of actual trailer behaviour from values of the vertical force on the tyre(s), or at least lateral acceleration and wheel speeds. Only on-board generated information shall be used. If these values are not directly measured, the evidence of the appropriate correlation with directly measured values under all driving conditions (e.g. including driving in a tunnel) shall be shown to the technical service at the time of type approval.

2.2.3. The vehicle stability function shall be demonstrated ~~to the Technical Service~~ by ~~a~~ dynamic ~~demonstration~~ manoeuvre(s) on one vehicle ~~configuration~~. This may be done by a comparison of results obtained with the vehicle stability function enabled and disabled for a given load condition. ~~For other vehicle configurations~~ As an alternative to carrying-out dynamic manoeuvre(s) for other vehicles and other load conditions, fitted with the same vehicle stability system, ~~it is permissible to submit test results~~ the results from actual vehicle tests or ~~a~~ computer simulations may be submitted ~~(together with data which verifies the simulation model, including the real sensor characteristics, against a practical vehicle test).~~

The use of the simulator is defined in Appendix 1 to this Annex.

The specification and ~~functionality~~ validation of the simulator is defined in Appendix ~~2~~ to this Annex.

~~Until unified test procedures are agreed,~~ the method by which this demonstration is carried out shall be agreed between the trailer manufacturer and the Technical Service and shall include the critical conditions of roll-over control and directional control as appropriate to the vehicle stability function installed on the trailer with the method of demonstration and results being appended to the type approval report. This may be carried-out other than at the time of type approval.

As a means of demonstrating the vehicle stability function any of the following dynamic manoeuvres may be used, but not limited to;

- steady state circular test;
- ~~reducing radius test;~~
- step steer input test;
- sine with dwell;
- J turn;
- $\mu$ -split single lane change;
- double lane change;
- reversed steering test or “fish hook” test;
- asymmetrical one period sine steer or pulse steer input test;

**2.2.4.** Trailers equipped with an electric control line, when electrically connected to a towing vehicle with an electric control line, shall provide the information “VDC active” via the data communications part of the electric control line when the vehicle stability function is in an intervention mode. Interventions of the vehicle stability function used in any learning process to determine the trailer operational characteristics shall not generate the above information.

<sup>1/</sup> Additional interaction with other vehicle systems or components is allowed. Where these systems or components are subject to special Regulations, such interaction shall comply with the requirements of those Regulations, e.g. interaction with the steering system shall comply with the requirements set out in Regulation 79 for corrective steering.

Add new Appendix 1, to read:

## **Annex 21 - Appendix 1**

### **USE OF THE DYNAMIC STABILITY SIMULATION**

The ~~efficiency~~ effectiveness of the directional and/or roll-over stability control function of power-driven vehicles and trailers of categories M, N and O ~~equipped with a Vehicle Stability Function~~, may be determined by computer simulation. ~~In the case of any trailer, a representative~~

~~towing vehicle shall be defined for the purpose of computer simulation in agreement with the Technical Service.~~

## 1. ~~GENERAL CONDITIONS~~ USE OF THE SIMULATION

### 1.1 ~~Modelling and simulation tool~~

~~The simulations shall be carried out with a validated modelling and simulation tool which is either used by or has been agreed with a type approval authority or Technical Service (see paragraph 4 below) on the basis of data which verifies the simulation model against a practical vehicle test.~~

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

## Annex 21 - Appendix 2

### DYNAMIC STABILITY SIMULATION TOOL AND ITS VALIDATION

#### 1. SPECIFICATION OF THE SIMULATION TOOL

1.1. ~~1~~ The simulation method shall take into account the main factors which influence the directional and roll motion of the vehicle. A typical model may include the following vehicle parameters in an explicit or implicit form:

- Axle/wheel parameters
- ~~o axle/wheel geometry;~~
- ~~o axle kinematics and compliance~~
- ~~o wheel loads;~~
- ~~o track width;~~
- ~~o centre of gravity positions of unsprung masses;~~

- inertia (mass,  $J_x$ ,  $J_y$  &  $J_z$ ) of unsprung masses;
- in the case of steered wheels:
  - principal of steering;
  - steering ratio or self-steering characteristics.

- Suspension parameters

- principal of suspension;
- height of roll centre;
- suspension stiffness (vertical and roll; lateral and fore/aft if significant);
- suspension damping characteristics;
- suspension kinematics (if significant);
- roll stabiliser characteristic.

- Tyre parameters

- pure cornering characteristics;
- pure braking characteristics;
- combined cornering and braking characteristics;
- relaxation lengths (dynamic behaviour) for cornering and braking;
- radial/vertical stiffness;
- lateral stiffness;
- dynamic tyre/road friction coefficient ranging from low (ice) to high (dry asphalt) on an individual wheel basis.

- Chassis/vehicle body parameters

- centre of gravity position of sprung masses;
- inertia (mass,  $J_x$ ,  $J_y$  &  $J_z$ ) of sprung masses;
- chassis/vehicle body (torsional) stiffness if significant.

- Power train/driveline parameters if applicable

- power source characteristics (engine traction/braking torque/torque converter);
- transmission characteristics (gear ratios);
- differential gearing (gear reduction, locking characteristics).

- Brake system parameters

- dynamic characteristics of the braking system.

- Payload parameters

- centre of gravity positions;
- Inertia (mass,  $J_x$ ,  $J_y$  &  $J_z$ ).

Other parameters/properties

- driver model with path following properties for the subjective type of simulation tests;
- steering stiffness;
- load sharing distribution between the axles of a bogie;
- in the case of a height levelling system the properties/characteristics of the height levelling system.

~~The vehicle parameter values represent the loaded condition and are expressed in SI units.~~

~~The values of relevant parameters (e.g. suspension, tyres, etc.) have to be non-linear to predict correctly the directional and roll-over stability of the vehicle.~~

- 1.1.2. The Vehicle Stability Function shall be added to the simulation model by means of
- a) a subsystem (software model) of the simulation tool;
  - or
  - b) the electronic control box in a hardware-in-the-loop configuration.

### ~~2.~~ 1.3. **TRAILERS**

In the case of a trailer, it shall be simulated using the characteristics of a representative power-driven vehicle ~~to be agreed by the type approval authority or Technical Service in consultation with the manufacturer of the trailer.~~

### ~~3.~~ 1.4 **VEHICLE LOADING CONDITION** Vehicle loading condition

- ~~3.1.4.1. The standard test condition shall be the maximum technical permissible mass of the vehicle distributed among the axles as declared by the manufacturer such that the load on each axle is proportional to the maximum permissible load for each axle.~~

~~The simulator shall be able to take into account the laden and unladen conditions.~~

- ~~3.1.4.2. The load shall be considered to be a fixed load with properties (mass, mass distribution and maximum recommended height of the centre of gravity) specified by the manufacturer.~~

~~In the case of a tank type vehicle the normally intended load shall be considered as an equivalent fixed load.~~

- ~~3.2. Every test shall be carried out with the stability function engaged and disengaged.~~

~~All tests shall be repeated in the unladen condition.~~

## 4.2. VALIDATION OF THE SIMULATION TOOL

- ~~4.1.1.~~ 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 result in loss of directional control (under-steer and over-steer) or roll-over control as appropriate to the functionality of the stability control function installed on a representative vehicle. Such a test(s) may include one or more of the following:
- o steady state circular test (examples of such a test may be found in ISO 4138, ISO 14792);
  - o reducing radius test;
  - o step steer input test (examples of such a test may be found in ISO 7401, ISO 14793);

- sine with dwell;
- J-turn;
- $\mu$ -split single lane change;
- double lane change (a lane description example may be found in ISO 3888 Part 1);
- reversed steering test or “fish hook” test;
- asymmetrical one period sine steer or pulse steer input test;
- other recognised tests(s).

During the test(s) the following motion variables, as appropriate, shall be recorded or calculated in accordance with ISO 15037 ~~Road vehicles – Vehicle dynamics test methods –~~ Part 1:2005: General conditions for passenger cars or Part 2:2002: General conditions for heavy vehicles and buses (depending on the vehicle category):

- yaw velocity;
- lateral acceleration;
- wheel load or wheel lift;
- forward velocity;
- driver input;

~~4.2. 2.2 The modelling and simulation tool can be regarded as valid when the simulation data is within [5%] for a steady state test and within [10%] for a dynamic test of the practical test data.~~

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.

2.3. The simulator shall be regarded as validated when its results are shown to be comparable with those obtained from practical vehicle tests.

In the case of the steady state circular test the understeer 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.

#### 4.2.2. Variations made to the vehicle model

The physical parameters that are different between the reference vehicle and simulated vehicle configurations shall be modified accordingly in the simulation.

4.2.3. A simulator test report shall be produced, a model of which is defined in Appendix ~~2~~ 3 of this annex, and a copy attached to the vehicle approval report.

~~Calculation of the difference between the simulation and test data: maximum deviation divided by the range of the motion variable during the test.~~



Add new Appendix 2, to read:

## **Annex 21 - Appendix 2 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. Scope of application
  - 2.1. Vehicle type: (e.g. truck, tractor, bus, semi-trailer, centre-axle trailer, full trailer)
  - 2.2. Vehicle configuration: (e.g. 4x2, 4x4, 6x2, 6x4, 6x6)
  - 2.3. Limiting factors: (e.g. mechanical suspension only)
  - 2.4. **Manoeuvre(s) for which the simulator has been validated:**

#### 3. Verifying vehicle test(s)

- 3.1. Description of vehicle(s) including the towing vehicle in case of trailer testing:
  - 3.1.1. Vehicle(s) identification: make/model/VIN
    - 3.1.1.1 Non-standard fitments:
  - 3.1.2. Vehicle description, including axle configuration/suspension/wheels, engine and drive line, braking system(s) and vehicle stability function content (directional control/roll-over control), steering system, with name/model/number identification:
  - 3.1.3. Vehicle data used in the simulation (explicit):
- 3.2. Description of test(s) including location(s), road/test area surface conditions, temperature and date(s):
- 3.3. Results laden and unladen with the vehicle stability function switched on and off:

#### 4. Simulation results

- 4.1. Vehicle parameters and the values used in the simulation that are not taken from the actual test vehicle (implicit):
- 4.2. Results laden and unladen with the vehicle stability function switched on and off for each test conducted under paragraph 3.2. of this appendix:

5. ~~Comparison between the simulation and test results for the following motion variables, as appropriate, recorded during the tests:~~
  - ~~yaw velocity;~~
  - ~~lateral acceleration;~~

- ⊖ roll angle;
- ⊖ forward velocity;

~~5.1. Maximum deviation of the steady state tests: ..... %~~

~~5.2. Maximum deviation of the dynamic tests: ..... %~~

65. This test has been carried out and the results reported in accordance with Appendix 1 of Annex 21 to ECE Regulation No. 13 as last amended by the ..... series of amendments.

65.1. Technical Service conducting the test <sup>(1)</sup>: .....

Signed: ..... Date: .....

65.2. Approval Authority <sup>(1)</sup>: .....

Signed: ..... Date: .....

<sup>(1)</sup> To be signed by different persons if the Technical Service and the Approval Authority is the same organisation.

## B. JUSTIFICATION

To support the mandatory introduction of a vehicle stability function it is necessary to have a definition of what a vehicle stability function is and how it is to be approved by a Technical Service.

A system definition method of specifying the vehicle stability function, together with a performance demonstration – either an actual vehicle or a computer simulation (where the computer simulation tool has been approved against actual vehicle tests) – has been chosen in preference to a purely functional test so that:

- a) a vehicle stability function is not designed to meet a single critical situation (a single test), to the detriment of other critical situations,
- b) the homologation of each vehicle requires such a large number of different tests, to cover all critical situations, that the cost is prohibitive,
- c) system supplier/vehicle manufacturer winter test facilities can be utilised rather than low temperature test facilities having to be developed by the Technical Services,
- d) development - in a new field - is not restricted through a minimum level test requirement that provides no incentive for future development of higher performance functions.

The term “Vehicle Stability Function” has been chosen as it is believed to be unconnected with a specific organization. Organization specific terminology includes – Vehicle Dynamics Control (VDC), Vehicle Stability Control (VSC), Electronic Stability Control (ESC), Electronic Stability Program (ESP), Electronic Stabilisation Programme (ESP), Porsche Stability Management

(PSM), Dynamic Stability Control (DSC), Dynamic Stability Program (DSP), Roll Stability Program (RSP), Trailer Roll Stability Program (TRSP), Roll Over Protection (ROP), Roll Stability Control (RSC), and Roll Stability Support (RSS).