

EVSC05-38 (6th meeting document)
(consolidated)

Comments subsequent to the 12th
December 2005 meeting in Paris
given below:

Proposed amendments to ECE Regulation No. 13

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 in maintaining the vehicle in 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 roll-over to stabilise the power-driven vehicle or towing vehicle and trailer combination or the trailer during dynamic manoeuvres.

EVSC06-03 (Japan)
2.32.
“Vehicle Stability Function (EVSC)”
means an stability of the vehicle.

Annex 2

Add a new paragraph 14.14., to read:

14.14. The vehicle is / is not ²⁾ equipped with a vehicle stability function

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 ²⁾

Vehicle stability function is optional equipment:

Yes / No ²⁾

Vehicle stability function includes directional control:

Yes / No ²⁾

Vehicle stability function includes roll-over control:

Yes / No ²⁾

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 performance of a vehicle stability function consisting of at least one of the following functions:

- directional control
- roll-over control.

EVSC05-46 (OICA)
Annex 19, para. 6.1.1

This paragraph mentions a "test procedure to determine the performance of a vehicle stability function."

This is not consistent with the rest of the proposal, which requests a "dynamic demonstration".

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. 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 as appropriate to the

EVSC06-03 (Japan)

6.3.1.

Based on the Appendix 7, the Technical Service ~~shall~~ carries out demonstrative system configurations.

EVSC05-45 & EVSC06-03 (Japan)

6.4.1.

The demonstrative tests to be carried out are specified in paragraph 2.2.3. of Annex 21 to this Regulation. ~~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 as appropriate to the vehicle stability function installed on the trailer with~~ The method of demonstrative tests and results shall be included in the test report.

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 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
- 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
- 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)

Error from Paris meeting (Mr. Gaupp)
Add: **1.3. Control function:**

- 3.2. Test surface information
- 3.3. Demonstrative tests/simulations used for the purpose of evaluating the directional control and the roll-over control as appropriate.
- 3.4. Test results
- 3.5. 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 ^{1/} conducting the test

Signed:
Date:

- 8. Approval Authority ^{1/}

Signed:
Date:

^{1/} To be signed by different persons even when the Technical Service and Approval Authority are the same or alternatively, a separate

Error from Paris meeting (Mr. Gaupp)
Add new paragraph: **3.3. Additional Information** and renumber existing.

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:

Performance Requirements	Annex 20 Reference
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 stability control function complies with the relevant requirements of Annex 19 to this Regulation.
- 8.2. Verification

EVSC05-45 & EVSC06-03 (Japan)
8.1. Testing of a trailer in accordance with Annex 21 to this Regulation may be waived at the time of trailer type approval provided that the **vehicle** stability ~~control~~ function complies with the relevant requirements of Annex 19 to this Regulation.

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 8.1.8. (former), renumber as paragraph 9.1.9.

EVSC05-45 & EVSC06-03 (Japan)
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 control 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.

EVSC05-45 & EVSC06-03 (Japan)
9.1.8.1.
For practical reasons verification of the vehicle stability ~~control~~ function ~~shall~~ may 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 VEHICLES EQUIPPED WITH A VEHICLE STABILITY FUNCTION, WHEN MANDATED

1. General

This annex defines the special requirements for vehicles equipped with a vehicle stability function where the installation of such equipment is mandatory, as specified in paragraphs 5.2.1.31. 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 individual wheel speeds by selective braking based on the evaluation of actual vehicle behaviour in comparison with a determination of vehicle behaviour demanded by the driver.^{1/}

In the case of roll-over control the function shall have the ability to automatically control individual or multiple wheel speeds by selective braking or automatically commanded braking based on the evaluation of actual vehicle behaviour that may lead to vehicle roll-over.^{1/}

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:

EVSC05-46 (OICA)
Annex 21, para. 2.1.1

"...the function shall have the ability to automatically control individual wheel speeds ..."

Proposal: "... the function shall have the ability to control independently left and right wheels of each group of axle."

EVSC05-47 (OICA)
Paragraph 2.1.1. :

Amend second paragraph, to read: "... **the function shall have the ability to automatically control the speed of any individual wheel by selective braking ...**"

Add the following at the end of the second paragraph: "**The function shall assist the driver in maintaining the vehicle/the trailer in the direction intended by the driver.**"

Amend third paragraph, to read: "... **the function shall have the ability to automatically control the speed of any individual wheel or multiple wheel speeds by selective braking ...**"

Add the following at the end of the third paragraph: "**The function shall assist the driver to stabilise the vehicle/the trailer in the case of potential roll-over.**"

- The ability to regulate engine power output.
- In the case of directional control: The determination of vehicle behaviour from values of yaw rate, lateral acceleration and wheel speeds and from the driver's control input to the braking system, to the steering system, and to the engine. 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. Only on-board generated information shall be used.
- In the case of roll-over control: The determination of 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 input to the braking system, and to the engine. 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. Only on-board generated information shall be used.
- 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.

EVSC05-45 & EVSC06-03 (Japan)

In the case of directional control: The determination of **actual** vehicle behaviour from values of yaw rate, lateral acceleration and wheel speeds and **of vehicle behaviour demanded by the driver** from **values of the driver's control input to the braking system, to the steering system, and to the engine.** If these values shall be used.

EVSC05-45 & EVSC06-03 (Japan)

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 input to the braking system, and to the engine.~~ If these values shall be used.

EVSC05-45 & EVSC06-03 (Japan)

In the case of a towing vehicle equipped **with [... (name of the device)]** according to paragraph 5.1.3.1. of this Regulation: The ability to apply the independently of the driver.

EVSC06-02 (Russia)

New paragraph 2.1.2.1.

Application of a vehicle stability function shall result increase of capability of safe movement of a vehicle on turns on roads of the certain categories at the certain operational speed for conditions of high and low adhesion coefficient.

[The maximum speed of driving of a vehicle on a circle of constant radius has to be set. The speed limit has to be set for conditions of high and low adhesion coefficient]

2.1.3. The operation of the vehicle stability control shall be demonstrated by a dynamic demonstration on one vehicle configuration and submission of test results and a computer simulation for other vehicle configurations under the condition that these vehicles are equipped with the same vehicle stability function as the one fitted on the vehicle which has been used for the dynamic demonstration together with data which verifies the simulation model against a practical vehicle test. The specification and functionality of the simulator is defined in Appendix 1 to this Annex.

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 under-steer, over-steer and roll-over 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.

EVSC05-45 (Japan)

2.1.3.

The operation of the vehicle stability ~~control~~ function shall be demonstrated by ~~means of one of~~ comparing the condition in which vehicle stability function is disabled and the condition in which the function is fully functioning by using the following tests:

- dynamic demonstrative tests applicable to directional control evaluation,
 1. [J-turn test on low adhesion surface as defined in Appendix 1 to this Annex] and
 2. [sine steer input test on low adhesion surface as defined in Appendix 1 to this Annex];
- dynamic demonstrative tests applicable to roll-over control evaluation,
 1. [steady state circular test on high adhesion surface as defined in Appendix 1 to this Annex)] and
 2. [one period sine steer input test on high adhesion surface as defined in Appendix 1 to this Annex];

If it is impossible to carry out the tests specified above due to limitations of test facility, other recognized tests (e.g. step steer input test, μ -split single lane change, double lane change, reversed steering test (or “fish hook” test), asymmetrical one period sine steer or pulse steer test, etc.) including the critical conditions of under-steer, over-steer and roll-over as appropriate to the vehicle stability function installed on the vehicle can be used.

The test results shall show a visible improvement in dynamic vehicle stability with the vehicle stability function being fully functional as compared to the function being disabled. Details of the tests used and the results ~~being~~ shall be appended to the type approval report/*. ~~This may be carried-out other than at the time of type approval.~~

/* Simulation results specified in Appendix 3 to this Annex may be added to the report to collect information regarding simulation tools defined in Appendix 2 to this Annex for future development of the Regulation to incorporate utilization of simulation tools.

EVSC05-47 (OICA)

Paragraph 2.1.3.

Amend the paragraph which mentions the computer simulation, to read: "a computer simulation, together with data which verifies the simulation model against ~~a practical test~~ **the real vehicle behaviour and the real sensor characteristics.**"

EVSC06-02 (Russia)

The reliability of results of computer simulation shall be confirmed by the results of real tests of one vehicle sample. For the type approval purpose the results of simulation, at least, of the tests confirming compliance with the provisions of the paragraph 2.1.2.1. of this Annex, can be accepted.

New paragraph 2.1.3.1.

It has to be assured that a vehicle stability function does not interfere with the driver in realization of control inputs (steering angle, steering angular velocity). Such conclusion shall concern all possible driving modes and road conditions.

For the type approval purpose the afore said conclusion can be based on comparing the condition, in which vehicle stability function is disabled, and the condition, in which the function is fully functioning, by using the the single lane change test maneuver. For the both cases the limiting speed of the test maneuver shall not differ [more than 10%]. The tests shall be performed on the roads with high and low adhesion coefficient.

[The test procedure has to be specified, if the proposal were adopted]

EVSC06-03 (Japan)

2.1.3.

The operation of the vehicle stability ~~control~~ ~~function~~ shall be demonstrated by ~~a~~ dynamic demonstrative tests on at least one vehicle configuration. For other vehicle configurations, ~~and~~ submitted test results and a computer simulation may be used for this purpose ~~for other vehicle configurations~~ under the condition that these vehicles are equipped with the same vehicle stability function as the one fitted on the vehicle which has been used for the dynamic demonstrative tests together with data which verifies the simulation model against a practical vehicle test. The specification and functionality of the simulator is defined in Appendix ~~12~~ to this Annex.

[For directional control, evaluation is carried out by following tests.

1. J-turn test on low adhesion surface as defined in Appendix 1 to this Annex]

For roll-over control, evaluation is carried out ~~agreed between the vehicle manufacturer and the Technical Service~~ and by following test(s).

1. accelerating circular test on high adhesion surface as defined in Appendix 1 to this Annex and
- [2. one period sine steer input test on high adhesion surface as defined in Appendix 1 to this Annex.]

These demonstrations shall include the critical conditions of under-steer, over-steer and roll-over 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.

If it is impossible to carry out the tests for directional control evaluation on low adhesion surface due to limitation of the test facility, submitted of test results and a computer simulation may be used as alternative if agreed by the Technical Service.

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

EVSC05-45 (Japan)
2.1.4.

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.

EVSC05-46 (OICA)
Annex 21, para. 2.1.4

"... 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."

Does this mean a special means has to be available for the driver to verify the satisfactory condition of the signal? Should it be done automatically during power-on phase, the same way it is for e.g. ABS warning signal? This may be acceptable for a failure warning but not for a simple information to the driver.

EVSC05-45 & EVSC06-03 (Japan)
2.1.6.

In the case of a the trailer provides the information "**EVSC ~~VDC~~ Active**" via the data be used for this purpose.

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 individual wheel speeds by selective braking based on the evaluation of actual trailer behaviour in comparison with a determination of the relative behaviour of the towing vehicle.^v

In the case of roll-over control the function shall have the ability to automatically control individual or multiple wheel speeds by selective braking or automatically commanded braking based on the evaluation of actual trailer behaviour that may lead to roll-over.^v

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 trailer behaviour from values of the vertical force on the tyre(s), or at least lateral acceleration and wheel speeds. 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. Only on-board generated information shall be used.

EVSC05-45 & EVSC06-03 (Japan)
2.2.2.

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

- **In the case of directional control:** *[description needed.]*
- **In the case of roll-over control:** The determination of trailer behaviour from values of the information shall be used.

EVSC06-02 (Russia)

New paragraph 2.2.2.1.

Application of a vehicle stability function shall result increase of capability of safe movement of a tractor-trailer combination on turns on roads of the certain categories at the certain operational speed for conditions of high and low adhesion coefficient.

[The maximum speed of driving of a tractor-trailer combination on a circle of constant radius has to be set. The speed limit has to be set for conditions of high and low adhesion coefficient]

2.2.3. The operation of a vehicle stability function shall be demonstrated by a dynamic demonstration on one vehicle configuration and submission of test results and a computer simulation for other vehicle configurations under the condition that these vehicles are equipped with the same vehicle stability function as the one fitted on the vehicle which has been used for the dynamic demonstration together with data which verifies the simulation model against a practical vehicle test. The specification and functionality of the simulator is defined in Appendix 1 to this Annex.

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, under-steer and over-steer 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.

EVSC05-45 (Japan)

2.2.3.

The operation of a vehicle stability function shall be demonstrated by ~~means of one of~~ comparing the condition in which vehicle stability function is disabled and the condition in which the function is fully functioning by using the following tests:

- dynamic demonstrative tests applicable to directional control evaluation,
 1. [J-turn test on low adhesion surface as defined in Appendix 1 to this Annex] and
 2. [sine steer input test on low adhesion surface as defined in Appendix 1 to this Annex];
- dynamic demonstrative tests applicable to ~~for~~ roll-over control evaluation,
 1. [steady state circular test on high adhesion surface as defined in Appendix 1 to this Annex] and
 2. [one period sine steer input test on high adhesion surface as defined in Appendix 1 to this Annex];

If it is impossible to carry out the tests specified above due to limitations of test facility, other recognized tests (e.g. step steer input test, μ -split single lane change, double lane change, reversed steering test (or “fish hook” test), asymmetrical one period sine steer or puls steer test, etc.) including the critical conditions of under-steer, over-steer and roll-over as appropriate to the vehicle stability function installed on the vehicle can be used.

The test results shall show a visible improvement in dynamic vehicle stability with the vehicle stability function being fully functional as compared to the function being disabled. Details of the tests used and the results ~~being~~ shall be appended to the type approval report/* . ~~This may be carried-out other than at the time of type approval.~~

/* Simulation results specified in Appendix 3 to this Annex may be added to the report to collect information regarding simulation tools defined in Appendix 2 to this Annex for future development of the Regulation to incorporate utilization of simulation tools.

EVSC06-02 (Russia)

The reliability of results of computer simulation shall be confirmed by the results of real tests of one tractor-trailer combination sample. For the type approval purpose the results of simulation, at least, of the tests confirming compliance with the provisions of the paragraph 2.2.2.1. of this Annex, can be accepted.

New paragraph 2.2.3.1.

It has to be assured that a vehicle stability function does not interfere with the driver in realization of control inputs (steering angle, steering angular velocity). Such conclusion shall concern all possible driving modes and road conditions.

For the type approval purpose the afore said conclusion can be based on comparing the condition, in which vehicle stability function is disabled, and the condition, in which the function is fully functioning, by using the the single lane change test maneuver. For the both cases the limiting speed of the test maneuver shall not differ [more than 10%]. The tests shall be performed on the roads with high and low adhesion coefficient.

[The test procedure has to be specified, if the proposal were adopted]

EVSC06-03 (Japan)

2.2.3.

The operation of a vehicle stability function shall be demonstrated by ~~a~~ dynamic demonstrative tests on at least one vehicle configuration. For other vehicle configurations, ~~and~~ submitted test results and a computer simulation may be used for this purpose ~~for other vehicle configurations~~ under the condition that these vehicles are equipped with the same vehicle stability function as the one fitted on the vehicle which has been used for the dynamic demonstrative tests together with data which verifies the simulation model against a practical vehicle test. The specification and functionality of the simulator is defined in Appendix ~~12~~ to this Annex.

[For directional control, evaluation is carried out by following tests.

1. J-turn test on low adhesion surface as defined in Appendix 1 to this Annex]

For roll-over control, evaluation is carried out ~~agreed between the vehicle manufacturer and the Technical Service~~ and by following test(s).

1. accelerating circular test on high adhesion surface as defined in Appendix 1 to this Annex and
- [2. one period sine steer input test on high adhesion surface as defined in Appendix 1 to this Annex.]

These demonstrations shall include the critical conditions of under-steer, over-steer and roll-over 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.

If it is impossible to carry out the tests for directional control evaluation on low adhesion surface due to limitation of the test facility, submitted of test results and a computer simulation may be used as alternative if agreed by the Technical Service.

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.

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2.2.4.

Trailers equipped with an , shall provide the information “~~VDC~~ EVSC active” via the data not generate the above information.

1/ 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.

EVSC05-45 (Japan)

Add new Appendix 1, to read:

Annex21 – Appendix 1

DYNAMIC DEMONSTRATIVE TESTS

1. Dynamic demonstrative tests applicable to directional control evaluation
 - 1.1. [J-turn test on low adhesion surface]
[test condition and procedure to be specified]
 - 1.2. [Sine steer input test on low adhesion surface];
[test condition and procedure to be specified]
2. Dynamic demonstrative tests applicable to roll-over control evaluation
 - 2.1. [Steady state circular test on high adhesion surface]
[test condition and procedure to be specified]
 - 2.2. [One period sine steer input test on high adhesion surface];
[test condition and procedure to be specified]

EVSC06-03 (Japan)

Add new Appendix 1, to read:

Annex21 – Appendix 1

DYNAMIC DEMONSTRATIVE TESTS

The efficiency of the roll-over stability function of power-driven vehicles and trailers of categories M,N and O equipped with a Vehicle Stability Function shall be demonstrated by following method.

1. Dynamic demonstrative tests applicable to roll-over control evaluation.

1.1 Accelerating circular test on high adhesion surface

1.1.1. Variables and reference system

The variables to be determined may be selected for test purposes from those given in ISO 15037-2 and shall be monitored using appropriate transducers. The variables relate to the intermediate axis system(X,Y,Z) as specified in ISO 8855.

During the test, following variables are measured.

- vehicle speed (km/h)
- lateral acceleration (m/s^2)
- roll angle (degree)

1.1.2. Measuring equipment

The measuring and recording equipment shall be in accordance with ISO 15037-2.

1.1.3. Test conditions

The limits and specifications for ambient and vehicle test conditions shall be in accordance with ISO 15537-2

A coefficient of adhesion on road surface shall be greater than 0.5.

The use of anti-rollover outriggers shall be considered for any testing approaching the rollover limit.

1.1.4. Test vehicle

General specifications of the vehicle shall be in accordance with ISO 15037-2

1.1.5. Test procedures

1.1.5.1 Warm-up and Initial driving condition

Warm-up and Initial driving condition shall be in accordance with ISO 15037-2

1.1.5.2 Constant radius test

A standard radius of [50m] is used .
If it is impossible to have specified radius due to limitations of test facility, path with other radius may be selected. Whatever the radius chosen, the vehicle shall be steered such that the reference point of the first unit remains within 0.5m of the intended circular path except critical condition.

- (a) stop the vehicle along the line of test radius.
- (b) accelerate the vehicle gradually to the speed that is just before roll-over condition.
- (c) measure the three variables from the initial condition to the critical condition.
- (d) compare the conditions in which vehicle stability function is disabled and fully functioning.
- (e) repeat (a) to (d) in reverse direction.

1.1.6. Presentation of results

Maximum value of following parameters at each demonstrative test shall be presented in the test report in accordance with Appendix2 to this Annex.

- vehicle speed (km/h)
- lateral acceleration (m/s^2)
- roll angle (degree)
- other variables

Following data shall be plotted on Figure A.3 in accordance with Annex A to ISO 14792.

- vehicle roll angle versus lateral acceleration.

The test results shall show a visible improvement in dynamic vehicle stability with the vehicle stability function being fully functional as compared to the function being disabled.

Annex21 – Appendix2

Test report – Presentation of results

1. Record of test results

Test number	1	
Test type		
Increasing speed on a constant radius		
The condition of vehicle stability function		
On, off		
Maximum vehicle speed, km/h		
Maximum centripetal acceleration, m/s ²		
Maximum roll angle, degrees		
Other selected variables [variable 1],[units] [variable 1],[units] [variable 1],[units]		

Add new Appendix 1, to read:

Annex 21 - Appendix 1

DYNAMIC STABILITY SIMULATION

The efficiency of the directional and/or rollover stability 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

1.1. Modelling and simulation tool

EVSC05-45 (Japan)

Annex 21 - Appendix ~~±~~2

EVSC06-03 (Japan)

Annex 21 - Appendix ~~±~~3

EVSC05-45 (Japan)

~~The efficiency of the directional and/or rollover stability 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.~~

EVSC06-03 (Japan)

(Above deletion reinstated.)

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 basis of data which verifies the simulation model against a practical vehicle test.

EVSC05-45 & EVSC06-03 (Japan)
The simulations tool which is either used by ~~or has been agreed with~~ a type approval authority or Technical Service (see paragraph 4 below) on a practical vehicle

1.1.1. The simulation method shall take into account the main factors which influence the directional and roll motion of the vehicle. The model shall include at least the following vehicle parameters in an explicit or implicit form:

EVSC05-46 (OICA)
Annex 21, Appendix 1 – Dynamic stability simulation

Paragraph 1.1.1 states that *"the model shall include at least the following vehicle parameters ..."*

Axle/wheel parameters

- axle/wheel geometry;
- wheel loads;
- track width;
- centre of gravity positions of unsprung masses;
- inertia (mass, Jx, Jy & Jz) of unsprung masses;
- in the case of steered wheels:
 - principal of steering;
 - steering ratio or self steering characteristics.

This is too stringent. If one wants to mandate a list of parameters to be used in the simulation, then a parameter sensitivity analysis is needed to select primary parameters and leave secondary ones, the same way it was done for R111. However, this is a huge work, where vehicle manufacturers are probably not ready to share information too deeply with their competitors/other parties (as this is core knowledge of manufacturers).

Suspension parameters

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

EVSC05-47 (OICA)
In the paragraph "Suspension parameters", delete "principal of suspension", "height of roll centre" and "suspension kinematics" and add "axle's kinematics and compliance" to the preceding paragraph "Axle/wheel parameters".

Tyre parameters

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

EVSC05-47 (OICA)
In the paragraph "Tyre parameters", amend the parameter "relaxation length" to read "relaxation lengths for cornering and braking" and delete the parameter "lateral stiffness".

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 brakes.

Pay load 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 subsystem (software model) of the simulation tool;
 - or
 - the electronic control box in a hardware-in-the-loop configuration.

EVSC05-47 (OICA)

Amend the paragraph “Brake system parameters”, to read: **“dynamic characteristics of brake system (command, transmission, brake proper)”**

EVSC05-47 (OICA)

Paragraph 1.1.2.:

Delete point a) **(“software model of the vehicle stability function”)**.

2. 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. VEHICLE LOADING CONDITION

- 3.1. 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 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. VALIDATION OF THE SIMULATION TOOL

- 4.1.1. 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:

- steady state circular test;
- step steer input test;

EVSC05-45 (Japan)

2.

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.

EVSC05-46 (OICA)

1. Annex 21, Appendix 1, para. 3 – Vehicle load condition

"... in the case of a tank vehicle the normally intended load shall be considered as an equivalent fixed load."

This should be consistent with R111 (e.g. water-filled tank ...)

EVSC05-47 (OICA)

Paragraph 4.1.1.:

Amend the last paragraph, to read: **"During the test(s) the following motion variables as appropriate shall be recorded or calculated in coherence with ISO 15037 Road vehicles -- Vehicle dynamics test methods -- Part 1: General conditions for passenger cars or Part 2: General conditions for heavy vehicles and buses (depending on the vehicle category):"**

- μ -split single lane change;
- double lane change;
- 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:

- yaw velocity;
- lateral acceleration;
- roll angle;
- forward velocity;
- driver input;

- 4.2. 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. A simulator approval report shall be produced, a model of which is defined in Appendix 2 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.

EVSC05-47 (OICA)

Replace "roll angle" by "wheel load or wheel lift".

EVSC05-45 & EVSC06-03 (Japan)

4.2.

The modelling and test of the practical test data. A simulator ~~approval~~ report shall be produced, a model ... vehicle approval report.

EVSC05-46 (OICA)

Annex 21, Appendix 1, para. 4 – Validation of the simulation tool

In paragraph 4.2 it is mentioned that "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."

Inputs and outputs from the simulation should be defined, if one wants to define acceptance criteria. The question is: are we able to define this today? In any case, 5% or 10% seems difficult to achieve, as test result spread from one test to another is often more than this rate.

EVSC05-47 (OICA)

Paragraph 4.2.:

- Tolerances should depend on the purpose of the simulated test. For roll-over stability, precision has to be high on wheel load but yaw rate is not very important. For directional stability, a precise yaw rate is very important but wheel load is less important.
- Are the given tolerances of 5 and 10% valid for all motion variables listed in the preceding paragraph? The tolerances defined in ISO 15037 could give an orientation.
- Concerning the tolerances of the stability system's sensors (see Δa in justification of para. 2.1.3. of Annexe 21), two alternatives are possible:
 - Either the simulator includes the simulation of the stability system's sensors and a threshold for Δa has to be validated.
 - Or the simulator does not include the simulation of the stability system's sensors and absolute tolerances (to be defined) have to be certified by the manufacturer or supplier.

Remark: manufacturers consider that the first option is the best one but they do not ignore that current software tools may not offer this possibility.

Add new Appendix 2, to read:

Annex 21 - Appendix 2

**VEHICLE STABILITY FUNCTION
SIMULATION TOOL TEST REPORT**

Test Report Number:

1. Identification

EVSC05-45 (Japan)

Annex 21 - Appendix ~~2~~3

EVSC06-03 (Japan)

Annex 21 - Appendix ~~2~~4

- 1.1. Name and address of the simulation tool manufacturer
- 1.2. Simulation tool identification: name/model/number (hardware and software)
2. Approved use
 - 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)
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;

EVSC06-03 (Japan)

2. ~~Approved use~~ Applicable to

- lateral acceleration;
- roll angle;
- forward velocity;
- 5.1. Maximum deviation of the steady state tests:
.... %
- 5.2. Maximum deviation of the dynamic tests:
.... %

6. Approval

6.1. Technical Service conducting the test ⁽¹⁾:

.....

Signed:

Date:

6.2. Approval Authority ⁽¹⁾:

.....

Signed:

Date:

⁽¹⁾ 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,

EVSC05-45 (Japan)
5. ~~Approval~~ [Acceptance of the simulation results]

EVSC06-03 (Japan)
6. ~~Approval~~ Verification

- 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).
