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World Forum for Harmonization of Vehicle Regulations**Working Party on Automated/Autonomous and Connected Vehicles****Seventh session**

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Item 8 (c) of the provisional agenda

**UN Regulations Nos. 13, 13-H, 139, 140 and UN GTR No. 8:
Clarifications****Proposal for a Supplement to UN Regulation No. 13 (Heavy
vehicle braking)****Submitted by the expert from Germany ***

The text reproduced below was prepared by the expert from Germany. It is aimed to insert requirements for endurance braking systems for vehicles equipped with an electric regenerative endurance braking system. The text below is an alternative to the text proposed in ECE/TRANS/WP.29/GRVA/2020/37 tabled by the expert from the International Organization of Motor Vehicle Manufacturers (OICA) for discussion at the fifth session of the Working Party on Automated/Autonomous and Connected Vehicles (GRVA). It embraces some major parts of the aforementioned document, in paragraphs 5.2.1.29.7. and 1.8.2.4. (Annex 4). The proposed changes to the current text of the Regulation are marked in bold for new, and strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2020 as outlined in proposed programme budget for 2020 (A/74/6 (part V sect. 20) para 20.37), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.



I. Proposal

Insert new paragraph 2.40., to read:

- 2.40.** *"Brake Estimator"* means a function being able to estimate the remaining brake vehicle deceleration due to brake heat, operating by models considering inputs such as for example type and position of the brakes, number and intensity of brake applications, vehicle speed or ambient temperature.

Insert new paragraphs 5.1.2.4. and subparagraphs, to read:

5.1.2.4. Endurance braking system

The endurance braking system shall make it possible to maintain a constant downhill speed over a long period of time without the use of the friction brakes.

- 5.1.2.4.1.** As an equivalent of a long period of time, a time duration of at least [12] min is deemed to be adequate.

- 5.1.2.4.2.** During the time duration specified in paragraph 5.1.2.4.1. the endurance braking system shall be able to maintain a constant speed of not more than [35] km/h and not less than [30] km/h on a 7 per cent down-gradient for a distance of 6 km.

- 5.1.2.4.3.** In the case of an endurance braking system incorporating electric regenerative braking systems, it shall be deemed to comply with the requirements in paragraphs 5.1.2.4.1. and 5.1.2.4.2., if the endurance braking system is able to store the energy of the maximum negative vertical height difference (requiring energy storage capacity in the traction battery) that can be reached by the vehicle (consuming stored energy in the traction battery on the journey towards the relevant negative vertical height difference), considering the current electric state of charge, using methods such as a global navigation satellite systems combined with a topography model and an intelligent battery management system.

This shall be demonstrated to the satisfaction of the Technical Service.

- 5.1.2.4.4.** As an alternative to paragraph 5.1.2.4.3., endurance braking systems incorporating electric regenerative braking systems may use the service braking system when the vehicle's traction battery is not able to store recuperated energy due to a high state of charge, provided that the service braking system is able to fulfil the requirements of Annex 4, paragraph 1.8.2.4.

In addition, a brake estimator shall warn the driver according to paragraph 5.2.1.29.7.

Insert a new paragraph 5.2.1.29.7., to read:

- 5.2.1.29.7.** Vehicles equipped with an electric regenerative braking system of Category A or B (as defined in paragraphs 2.21.2. and 2.21.3.), using the service braking system in addition to the endurance braking system only when the state of charge of the traction battery does not allow storing of the energy due to a high state of charge, shall warn the driver at the latest when the service braking performance is decreased below the minimum performance value specified in

(a) Annex 4, paragraph 1.6.3. by the yellow warning signal according to paragraph 5.2.1.29.1.2. and

(b) Annex 4, paragraph 2.2.1. by the red warning signal according to paragraph 5.2.1.29.1.1.

The method to assess the service braking performance [(e.g. by temperature/ energy calculation and/or deceleration control)] shall be described by the vehicle manufacturer together with the documentation package required in Annex 18 of this Regulation to the Technical Service.

Annex 4, insert a new paragraph 1.8.2.4., to read:

1.8.2.4. For vehicles equipped with an endurance braking system incorporating electric regenerative braking systems and where the service braking system is used when storing of the energy in the traction battery is not possible only due to a high state of charge, two different types of tests shall be carried out:

(a) A test following paragraph 1.8. of Annex 4 where the state of charge of the traction battery is in a condition that allows the conduction of the test without the use of the service braking system (e.g. the state of charge of the traction battery is sufficiently low); and

(b) A test under the conditions of paragraph 1.4.1.2.2. above. After this test and under consideration that the service brakes shall not cool significantly down, an additional test following the provisions of paragraph 1.6.3. of Annex 4 shall be performed. The mean fully developed deceleration shall correspond to a value not below 5m/s².

II. Justification

1. Germany understands from previous discussions at GRVA that the current endurance braking performance test in UN-Regulation No. 13 (Type-IIA), which applies to certain vehicles of category M₃, N₃ and certain vehicles subject to Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) (compare paragraphs 1.8.1.1. to 1.8.1.3. in Annex 4) and which is non-specific with regard to the type of drive (the test is technology-neutral in this regard), poses to be an economical burden to battery electric vehicles incorporating electric regenerative braking systems. Therefore, in order to contribute to the ambition in finding a practical and safe solution for the described challenge, Germany has prepared a proposal as an alternative to ECE/TRANS/WP.29/GRVA/2020/37 (OICA), which also embraces major parts of the aforementioned document (paragraphs 5.2.1.29.7. and 1.8.2.4. (Annex 4)).

2. The approach taken by Germany was to “extract” requirements for endurance braking systems from the existing endurance braking performance test (paragraph 1.8. in Annex 4) and introduce the identified requirements into the “requirement-part” (paragraph 5 “specifications”) of UN Regulation No. 13.

3. It is noted that the performance requirements for endurance braking systems summarized in paragraphs 5.1.2.4., 5.1.2.4.1. and 5.1.2.4.2. are not modified compared to the current specifications from Annex 4. This proposal only suggests to additionally introduce the requirements into paragraph 5 of the Regulation, with the intention to make the endurance brake specification (in general) more transparent.

4. The performance requirements for endurance braking systems (paragraphs 5.1.2.4., 5.1.2.4.1. and 5.1.2.4.2.) are valid for all vehicles equipped with endurance braking systems, no matter which power unit is technically used in the vehicle. Additionally, for battery electric driven vehicles incorporating electric regenerative braking systems further performance requirements regarding the endurance braking system are introduced in paragraphs 5.1.2.4.3. and 5.1.2.4.4. as alternatives:

(a) Alternative 1 (paragraph 5.1.2.4.3.) introduces a new requirement to take the position of the vehicle and topography of its surrounding into account, whereby the necessary battery capacity, which needs to be available, is deviated from.

(b) Alternative 2 (paragraph 5.1.2.4.4.) introduces a new requirement allowing the usage of friction brakes for endurance braking, if recuperation is prevented in case of a too high battery state of charge of the traction battery. (This means that the requirements shall always be fulfilled without the usage of friction brakes if the state of charge at the beginning of the

endurance brake application is sufficiently low.) If friction brakes are used, it is always necessary that the remaining available brake deceleration after fulfilling the endurance brake requirements is still $\geq 5.0 \text{ m/s}^2$. Additionally, vehicles using the friction brakes shall be equipped with a brake estimator alerting the driver in case the efficiency of the brakes falls below the Type-II hot performance test. (This is intended to provide additional safety – it will not activate after the described endurance brake activation, since at that point, the full performance of 5.0 m/s^2 is required.)

5. Paragraph 5.2.1.29.7., introducing a warning for the driver (copied without change) and paragraph 1.8.2.4. amending the according endurance braking performance test in Annex 4 (copied with slight amendment to the wording), are taken over from OICA's proposal (ECE/TRANS/WP.29/GRVA/2020/37) which are supported by Germany and are understood to still be up for discussion since the fifth session of GRVA.
