



# Economic and Social Council

Distr.: General  
3 July 2015

Original: English

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## Economic Commission for Europe

### Inland Transport Committee

### World Forum for Harmonization of Vehicle Regulations

#### Working Party on Brakes and Running Gear

#### Eightieth session

Geneva, 15–18 September 2015

Item 3 of the provisional agenda

#### Regulations Nos. 13 and 13-H (Braking)

## **Proposal for amendments to Regulation No. 13 (Heavy vehicle braking) and 13-H (Brakes of M<sub>1</sub> and N<sub>1</sub> vehicles)**

### **Submitted by the experts from Germany and The Netherlands\***

The text reproduced below was prepared by the experts from Germany and The Netherlands to introduce into UN Regulation No.13 an amendment that removes a design restriction and allows the vehicle manufacturer the freedom to use new technologies that would have previously been prohibited. The modifications to the existing text of the Regulation are marked in bold for new or strikethrough for deleted characters.

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\* In accordance with the programme of work of the Inland Transport Committee for 2012–2016 (ECE/TRANS/224, para. 94 and ECE/TRANS/2012/12, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

## I. Proposal for a Supplement to the 11 series of amendments to Regulation No. 13

*Paragraph 5.2.1.19.1., amend to read:*

"5.2.1.19.1. The power supply (generator and battery) of the power-driven vehicle shall have a sufficient capacity to provide the current for ~~an electrical~~ **the trailer** braking system. **At the time of type approval, it shall be checked that,** ~~With the engine running at the idling speed recommended by the manufacturer and the all electrical devices required during normal vehicle use supplied by the manufacturer as standard equipment of the vehicle~~ **switched on, the voltage in the electrical energy supply line lines for the electrical braking system of the trailer** shall at maximum current consumption of the electrical braking system (15 A) not fall below the value of ~~11.1~~ **9.6** V measured at the connection. The electrical lines shall not be capable of short circuiting even when overloaded;"

*Delete current paragraphs 5.2.1.19.2. and 5.2.1.19.3.*

*Insert new paragraph 5.2.1.19.2., to read:*

"**5.2.1.19.2. The electrical line transmitting the braking signal to illuminate the stop lamps which is used for enabling the trailer brakes to be activated shall have a terminal with a nominal cross sectional area of at least [1,5mm<sup>2</sup>]."**

*Insert new paragraph 5.2.1.19.3., to read:*

"**5.2.1.19.3. In the case of articulated vehicle combinations, the plug together with the cable shall be a part of the power-driven vehicle. In all other cases, the plug together with the cable shall be a part of the trailer."**

*Annex 10,*

*Paragraph 5.1., amend to read:*

"5.1. For full trailers ~~fitted with compressed air braking systems"~~

*Paragraph 5.1.3., amend to read:*

"5.1.3. **In the case of trailers of categories O<sub>3</sub> and O<sub>4</sub>, the** ~~The~~ permissible relationship between the braking rate TR/PR and the pressure pm shall lie within the designated areas in diagram 2 of this annex for all pressures between 20 and 750 kPa, in both the laden and unladen states of load."

*Annex 14,*

*Title, amend to read:*

"**Special additional requirements and test** ~~test~~ conditions for trailers of categories O<sub>2</sub> with electrical braking systems."

*Paragraph 1.1., amend to read:*

"1.1. **This Annex defines the special requirements for trailers of category O<sub>2</sub> with a service braking system using electric energy supplied by the towing vehicle. On the trailer this electric energy may be converted into another form of energy which may be stored. If this electric energy is converted into pneumatic energy and stored in pneumatic storage devices, Annex 23 shall apply.**

~~For the purposes of the following provisions electrical braking systems are service braking systems consisting of a control device, an electromechanical transmission device, and friction brakes. The electrical control device~~

regulating the ~~voltage~~ **braking force** for the trailer shall be situated on the trailer."

*Paragraph 1.3.*, amend to read:

"1.3. ~~Electrical braking systems shall be actuated by operating the service braking system of~~ **The actuation of the service braking system shall be ensured when the braking signal is generated by** the towing vehicle."

*Insert new paragraph 1.4.1.*, to read:

"**1.4.1. During the tests of paragraph 3., the electrical braking system shall be supplied with a test voltage of maximum 11,1 V, measured at the energy supply connector.**"

*Insert new paragraph 1.5.1.*, to read:

"**1.5.1. During the tests of paragraph 3, the electrical current shall be measured in the energy supply line between the towing vehicle and the trailer.**"

*Paragraph 1.6.*, amend to read:

"1.6. The electrical connection of the electrical braking system to the towing vehicle shall be effected by means of a ~~special~~ plug and socket connection corresponding to ...,<sup>1/</sup> ~~which shall not be compatible with the sockets of the lighting equipment of the vehicle. The plug together with the cable shall be situated on the trailer.~~"

*Footnote 1 in paragraph 1.6.*, amend to read:

~~"<sup>1</sup> Under study.~~ Until the characteristics of this special connection have been determined, the type to be used will be indicated by the National Type Approval Authority granting the approval.

**The connection however shall at least fulfil the following requirements:**

- (a) **The plug and the socket shall have sealings, to prevent liquids or dirt to get into,**
- (b) **The plug and the socket shall have a robust locking mechanism to hold the plug with a connection in the socket,**
- (c) **At least two terminals at the rear of the pins and tubes shall be capable of accepting cables with a cross-sectional area of at least 2,5 mm<sup>2</sup> (energy supply lines)**
- (d) **The socket shall have a cover which closes automatically when the plug is disconnected."**

*Paragraph 2.1.*, amend to read:

"2.1. If there is a battery on the trailer, **for auxiliary use or for the use of the automatic braking according to paragraph 5.2.2.9. of this regulation and** fed by the power supply unit of the towing vehicle, it shall be separated from its supply line during service braking of the trailer."

*Paragraph 2.3.*, amend to read:

"2.3. Electrical braking systems shall be such that even when the voltage in the ~~connection lines~~ **energy supply line between the towing vehicle and the trailer** is reduced to a value of 7 V, **measured at the energy supply connector**, a braking effect of 20 per cent of the (sum of the) maximum stationary axle load(s) is maintained."

*Paragraph 2.4.*, amend to read:

"2.4. Control devices for regulating the braking force, which react to the inclination in the direction of travel (pendulum, spring-mass-system, liquid-

inertia-switch) shall, if the trailer has more than one axle and a vertically adjustable towing device, be attached to the chassis. In the case of single-axle trailers and trailers with close-coupled axles where the axle spread is less than 1 meter, these control devices shall be equipped with a mechanism indicating its horizontal position (e.g., spirit level) and shall be manually adjustable to allow the mechanism to be set in the horizontal plane in line with the direction of travel of the vehicle. **Alternatively, devices which are self leveling to the horizontal plane are allowed on the condition that a warning is given in the case of a failure. Such a warning shall be provided within the driver's indirect field of vision and shall be flashing (not constant). The warning signal may be given by flashing the tell tale specified in paragraph 2.7. The satisfactory condition of the signals shall be easily verifiable.**"

*Paragraph 2.5., amend to read:*

"2.5. The relay for actuating the **service braking system** ~~braking current in accordance with paragraph 5.2.1.19.2. of this Regulation~~, which is connected to the ~~actuating~~ **enabling** line, **referred to in paragraph 5.2.1.19.2.**, shall be situated on the trailer."

*Paragraph 2.7., amend to read:*

"2.7. A tell-tale shall be provided ~~at the control device~~ **within the driver's direct or indirect field of vision**, lighting up at any brake application and indicating the proper functioning of the trailer electrical braking system."

*Insert new paragraphs 2.8. to 2.8.1.2., to read:*

"2.8. **The trailer's braking system may be equipped with one or more energy storage device(s) (energy accumulators), fed direct or indirect by the electric energy supplied by the towing vehicle, provided that all of the following requirements are fulfilled.**

**However these requirements shall not apply when the braking system is such that in the absence of any energy reserve it is possible to achieve a braking performance at least equal to the prescribed performance.**

2.8.1. **Capacity**

2.8.1.1. **The energy storage device (energy accumulator) of the trailer shall be such that after [ten] actuations of the service brake, under the condition prescribed in paragraph 2.8.1.2. below, it shall still be possible to achieve on the [eleventh] application a braking force of at least 25 % of the maximum total axle load and without actuating the automatic brake according to paragraph 2.8.3. of this Annex.**

2.8.1.2. **Testing shall be performed in conformity with the following requirements:**

(a) **the initial energy level in the energy storage device (energy accumulator) may be specified by the manufacturer but is not more than the minimum which assures the prescribed service braking performance of the system,**

(b) **the energy storage device shall not be fed, in addition, any energy storage device (energy accumulator) for auxiliary equipment shall be isolated,**

(c) **each brake actuation shall be carried out with the maximum achievable braking force,**

(d) where the duration of the braking has influence on the energy consumption each brake actuation shall last at least 4,4 seconds."

*Insert new paragraphs 2.8.2. to 2.8.2.2., to read:*

**"2.8.2. Warnings**

**2.8.2.1. A warning shall be given when the stored energy falls to a value at which without recharging of the energy storage device (energy accumulator) and irrespective of the load conditions of the trailer, it is possible to brake for a [sixth] time and obtain a braking force of at least twenty five per cent of the maximum total axle load after [five] actuations of the service brake with the maximum achievable braking force. Where the duration of the braking has influence on the energy consumption each brake actuation shall last at least 4.4 seconds.**

**2.8.2.2. The warning signal shall be provided within the driver's indirect field of vision and shall be flashing (not constant). The warning signal may be given by flashing the tell tale specified in paragraph 2.7. The satisfactory condition of the signals shall be easily verifiable."**

*Insert new paragraphs 2.8.3. to 2.8.3.1., to read:*

**"2.8.3. The trailer shall be equipped with a system which applies the a brake and locks the brake mechanically when the energy level in the energy storage device (energy accumulator) is such that a braking with a performance prescribed in paragraph 3.3. of Annex 4 to this regulation can no longer be assured.**

**The system shall provide a total braking force at the periphery of the wheels at least equal to 13.5 per cent of the maximum stationary wheel load.**

**2.8.3.1. It shall be possible to release this braking system manually."**

*Insert new paragraphs 2.9. and 2.9.1., to read:*

**"2.9. The trailer shall be equipped with a system which applies a brake and locks the brake mechanically when the electric energy supply line is disconnected from the towing vehicle. After reconnecting the supply line the brakes shall be released only after operating a release switch.**

**The system shall provide a total braking force at the periphery of the wheels at least equal to 13.5 per cent of the maximum stationary wheel load.**

**2.9.1. It shall be possible to release this braking system manually."**

*Paragraph 3.4., amend to read:*

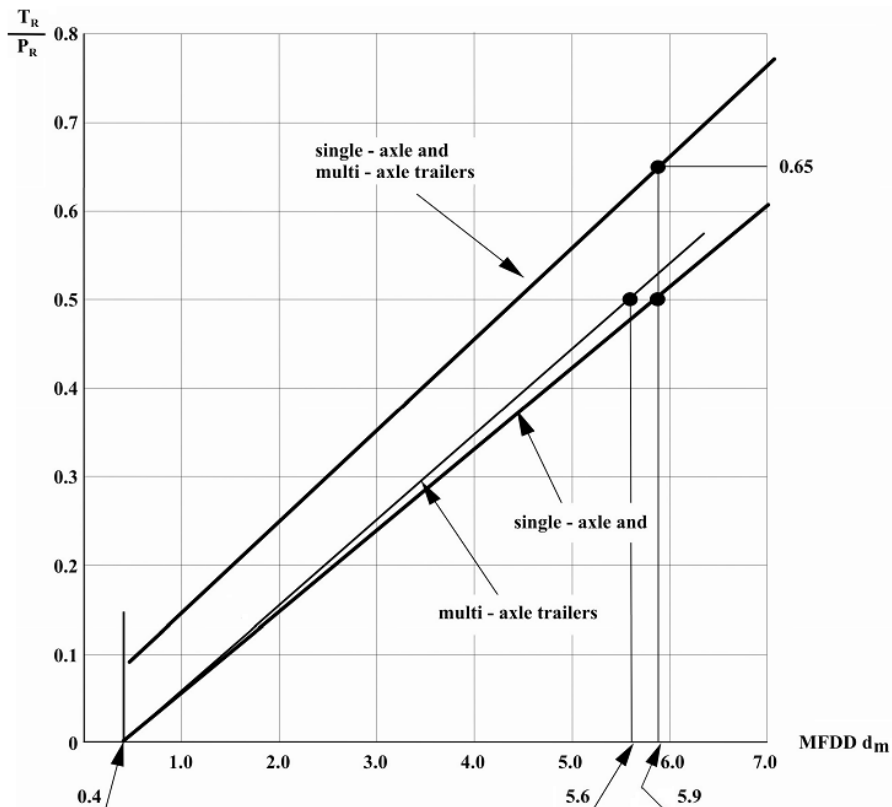
**"3.4. The prescribed braking force of the trailer (including semi-trailers) of at least 50 per cent of the maximum total axle load shall be attained - with maximum mass - in the case of a mean fully developed deceleration of the tractor/trailer combination of not more than 5.9 m/s<sup>2</sup> with single-axle centre-axle trailers and semi-trailers and of not more than 5.6 m/s<sup>2</sup> with multi-axle full trailers. Trailers with close-coupled axles where the axle spread is less than 1 m are also considered as single-axle trailers within the meaning of this provision. Moreover, the limits as defined in the appendix to this annex shall be observed at least until the prescribed braking force of the trailer is attained. If the braking force is regulated in steps, they shall lie within the range shown in the appendix to this annex."**

Annex 14-Appendix, amend to read:

## Annex 14 - Appendix

### Compatibility of the braking rate of the trailer and the mean fully developed deceleration of the tractor/trailer combination (trailer laden and unladen)

In the diagram the terms "centre-axle trailer" and "semi-trailer" shall be used in stead of "single-axle trailer". The term "full trailer" shall be used in stead of "multi-axle trailer".



Notes:

1. Limits indicated in the diagram refer to laden and unladen trailers. When the trailer unladen mass exceeds 75 per cent of its maximum mass, limits shall be applied only to "laden" conditions.

2. Limits indicated in the diagram do not affect the provisions of this annex regarding the minimum braking performances required. However, if braking performances obtained during test – in accordance with provisions indicated in paragraph 3.4. of this annex - are greater than those required, said performances shall not exceed the limits indicated in the above diagram.

TR = sum of braking forces at periphery of all wheels of trailer.

PR = total normal static reaction of road surface on wheels of trailer.

$d_m$  = mean fully developed deceleration of tractor/trailer combination.

## II. Proposal for a Supplement to the 00 series of amendments to Regulation No. 13-H

*Paragraph 5.2.17.1., amend to read:*

"5.2.17.1. The power supply (generator and battery) of the power-driven vehicle shall have a sufficient capacity to provide the current for ~~an electrical~~ **the trailer** braking system. **At the time of type approval, it shall be checked that,** ~~With the engine running at the idling speed recommended by the manufacturer and the all electrical devices~~ **required during normal vehicle use supplied by the manufacturer as standard equipment of the vehicle** switched on, the voltage in the electrical **energy supply line lines for the electrical braking system of the trailer** shall at maximum current consumption of the electrical braking system (15 A) not fall below the value of **11.1** ~~9.6~~ V measured at the connection. The electrical lines shall not be capable of short circuiting even when overloaded;"

*Delete paragraph 5.2.17.2. and 5.2.17.3.*

*Insert a new paragraph 5.2.17.2., to read:*

"5.2.17.2. **The electrical line transmitting the braking signal to illuminate the stop lamps which is used for enabling the trailer brakes to be activated shall have a terminal with a nominal cross sectional area of at least [1,5mm<sup>2</sup>]."**

*Insert new paragraph 5.2.17.3., to read:*

"5.2.17.3. **In the case of articulated vehicle combinations, the plug together with the cable shall be a part of the power-driven vehicle. In all other cases, the plug together with the cable shall be a part of the trailer."**

## III. Justification

*UN Regulation No. 13, Paragraph 5.2.1.19.1., and UN Regulation No 13-H, Paragraph 5.2.1.17.1.:*

1. Text amended for clarification, proposed text makes clear that the electrical energy supply line is meant. The currently mentioned 9.6 V measured at the connection is unrealistic low and not necessary. The minimum voltage at the battery of the towing vehicle with running engine is 12 V although in practice voltages of 13.5 to 14.5 V are more common. The loss of voltage between the battery and the connector depends on the electrical resistance (section width) of the cable. With the modern vehicles in use today it is very unlikely that all standard electrical equipment of the vehicle is switched on at the same time. Therefor the text is changed. Only all the electrical devices required during normal vehicle use have to be switched on.

*UN Regulation No. 13, Paragraph 5.2.1.19.2., and UN Regulation No 13-H, Paragraph 5.2.17.2.:*

2. The control of the braking systems according to Annex 14 and Annex 23 depends on the actual deceleration of the motor vehicle independent whether such a deceleration is caused by a failed or non-failed towing vehicle's service braking system. The wording of paragraph 5.2.1.19.2. is identical with that of paragraph 5.2.1.18.2. for compressed air braking systems and therefore comparable.

3. In the case of pneumatic braking systems, on application of the service braking system a full or partial control pressure is transmitted via the trailer brake control valve (ports 41/42) to the trailer according to the control of the non-failed pneumatic service brake circuit.

Such analogous electrical control signal - transmitted by the "parts not affected by the failure" to the trailer - is not existing.

4. Thus, this requirement seems to be inappropriate for motor vehicle authorized to tow trailers having no comparable connecting lines as trailers of categories O<sub>3</sub> or O<sub>4</sub> (see paragraph 5.2.1.18.2.) and should be replaced by the new proposed paragraph 5.2.1.19.2. addressing the electrical line transmitting the braking signal to illuminate the stop lamps which is used for enabling the trailer brakes to be activated.

5. In consequence of this, paragraph 2.5. of Annex 14 has been amended accordingly.

*UN Regulation No. 13, Annex 10, paragraph 5.1.:*

6. The current scope of the UN Regulation No. 13 reads that it covers full trailers with an electrical braking system (para. 5.2.2.2., last sentence). Annex 4 para. 1.3.2. requires O<sub>2</sub> trailers, as to their behaviour on a low adhesion ground, to comply with the relevant provisions of Annex 10 but there are none (para. 5, resp. 5.1 covers only full trailers fitted with compressed-air braking systems). Therefore, the restriction to compressed air braking systems has been deleted.

*UN Regulation No. 13, Annex 10, paragraph 5.1.3.:*

7. The compatibility band makes only sense for heavy commercial vehicles with compressed air braking.

*UN Regulation No. 13, Annex 14, Title:*

8. "Special additional requirements" and "categories O<sub>2</sub>" are added for clarification. Only the additional requirements for the electrical braking system are in Annex 14. The general requirements found elsewhere in the regulation are also to be applied to the electrical braking systems.

*UN Regulation No. 13, Annex 14, paragraph 1.1.:*

9. Text amended in order to clarify that the Annex 14 is about trailers using electric energy supplied by the towing vehicle to energize the trailer braking system. The electric energy can for that reason be stored on the trailer and used directly or indirectly by the trailer braking system. However for trailer braking systems with pneumatic storage devices Annex 23 shall apply.

10. The original text of the Regulation requires the transmission to be electromechanical and the control device to be electric. New innovative electrohydraulic and electro-pneumatic systems should not be excluded. Therefore the wording "electrical" has to be removed and "voltage" has to be replaced by "braking force" to remove the design restrictions.

*Remark: For Annex 23, there is only a draft available to date. It deals with the same situation like Annex 14 i.e. O<sub>2</sub>-trailers, electrical supply by the towing vehicle, electrical energy storage but the brake actuation being made by compressed air via additional energy storage i.e. air tanks. The idea to separate the latter system from those in Annex 14 comes from that Regulation No. 13 holds already a lot of requirements for braking systems with compressed air which are then analogously carried over. Furthermore the system makes use of standard parts for braking systems with compressed air and there is a pdi-infrastructure for braking systems with compressed air. In all these are reasons discussed to keep this system separately*

*UN Regulation No. 13, Annex 14, paragraph 1.3.:*

11. Text amended for clarity. The braking signal to illuminate the stop lamps, generated by the towing vehicle, is used for enabling the trailer brakes to be activated. In the current requirements the enabling signal is generated by a device connected to each brake circuit or by the stop lamp switch. However by using the braking signal to illuminate the stop lamps



the trailer brakes will also be applied when e.g. the towing vehicle's brakes are activated by "automatically commanded braking".

*UN Regulation No. 13, Annex 14, insert new paragraph 1.4.1.:*

12. The voltage during the test and the place where it should be measured is an important parameter for the braking performance of the trailer.

The current text is not clear, what means "nominal 12 V" (current paragraph 1.4.) with regard to the voltage to be used during the test described in paragraph 3 nor is it clear where during the tests the voltage has to be measured. The proposed text brings the necessary clarity.

*UN Regulation No. 13, Annex 14, insert new paragraph 1.5.1.:*

13. The proposed text clarifies where the current has to be measured.

*UN Regulation No. 13, Annex 14, paragraph 1.6.:*

14. The requirement for a special plug, not compatible with the sockets of the lightning equipment of the vehicle, is deleted. A good connection is guaranteed by the new requirement in paragraph 2.8.3; in the case the energy supply line is not connected to the towing vehicle the trailer brake is automatically applied.

15. The requirement with regard the place of the cable is moved to the main part of the regulation, the new paragraph 5.2.1.19.3. The content is adapted in order to bring the requirements for the electrical braking system in line with the requirements for the air braking systems, paragraph 5.1.3.8. Electric braking systems are relatively often used on semi-trailers.

*UN Regulation No. 13, Annex 14, footnote 1 to paragraph 1.6.:*

16. At this moment it is not yet possible to specify a standard for the connection. However for safety reasons the most important basic requirements are proposed to be added to the footnote. For the energy supply of the electrical braking system at least two pins and tubes are specified to be capable of accepting cables with a cross section of 2,5 mm<sup>2</sup>.

*UN Regulation No. 13, Annex 14, paragraph 2.1.:*

17. In this proposal provisions are introduced for an energy storage device on the trailer providing the energy for the electric service brake. It does not make sense to separate this energy storage device from the supply line. However batteries used for auxiliary equipment and/or the automatic braking, according to paragraph 5.2.2.9. of this regulation, should be separated from the supply line to supply the service braking system with the maximum available energy. The text is amended in order to restrict the requirement to the batteries not used for the electrical service brake.

*UN Regulation No. 13, Annex 14, paragraph 2.3.:*

18. For clarification, the current text does not make clear where the voltage has to be measured.

*UN Regulation No. 13, Annex 14, paragraph 2.4.:*

19. At the time the current version of Annex 14 was written there were not yet highly reliable micro-electronic devices to detect the deceleration of the combination. These devices often appear as a sensor-cluster which is able to detect the acceleration on all three axes at the same time. With these sensors it is relatively easy to generate a self-leveling system which does not need to be adjusted by the user. The text of paragraph 2.4. is amended to allow these new devices.

20. Because the driver leaves the automatic adjustment to the device he assumes the adjustment is correct. For that reason the driver shall be warned in the case there is a failure in the device.

*UN Regulation No. 13, Annex 14, paragraph 2.5.:*

21. Text is amended in order to delete the design restriction and to adapt to the new paragraph 5.2.1.19.2.

*UN Regulation No. 13, Annex 14, paragraph 2.7.:*

22. The text assures that the tell tale is visible for the driver from his driving seat.

*UN Regulation No. 13, Annex 14, paragraph 2.8. to 2.8.3.1.:*

(a) Paragraph 2.8.:

23. New paragraph allowing energy storage devices on the trailer for the service brake. This allowance is necessary to open new possibilities for innovative improvements of the functioning of the electric braking systems.

24. However if storage devices are not necessary to achieve the prescribed performance the requirements shall not apply.

(b) Paragraph 2.8.1.:

25. To guarantee sufficient energy in the energy accumulator, requirements for the capacity are necessary. This is analogous to the air brake system.

(c) Paragraph 2.8.1.1.:

- Text based on paragraph 1.2.1. of Annex 7 part C. Text is adapted to be general.

- Because the capacity of a battery depends on the temperature and on the time it has been used, the capacity of the battery (when new) shall be larger compared to conventional energy storage devices.

- The 25%-braking requirement is based on the common practice in Regulation No. 13 to specify the secondary braking performance in combination with energy storage devices. In the case of pneumatic braking systems Regulation No. 13, Annex 7 specifies after eight full stroke actuations half the pressure after a first full stroke actuation. This value implies also about half of the braking forces after a certain amount of full stroke applications. Generally the prescribed secondary braking performance is half the service braking performance. In the case of electric braking systems Annex 14 prescribes braking forces of 50 per-cent of the maximum axle load.

- A provision is added with regard to the actuation of the automatic braking device, according to paragraph 2.8.3. (text based on paragraph 1.3 of Annex 7).

(d) Paragraph 2.8.1.2.:

- The initial energy level has to be at the cut-in pressure. That is the worst case during normal operation of the system.

- Text analogous to e.g. text para. 1.2.1.2.2. of Annex 7 Part C.

- Specification of "a braking from 60 km/h to 0 km/h with the maximum achievable braking force" instead of the in Regulation No. 13 commonly used "full stroke actuations of towing vehicle's service braking system" is necessary to take into account that the control of the electric braking system is on the trailer.

- In some cases the used energy depends also on the time the brakes are applied, e.g. in the case electromagnets are used to generate the braking force. To avoid different interpretations the time is fixed at 4.4 s. This time is derived from the 50 per cent braking force and 60 km/h (Annex 14 paras. 3.4 and 3.5) and the type 0 test of M<sub>2</sub>, M<sub>3</sub>, N<sub>2</sub> and N<sub>3</sub> vehicles:  $v = 60 \text{ km/h}$ ,  $a = 5.0 \text{ m/s}^2$  and  $s = 0.15 v + v^2/130$  (Annex 4 paragraph 2.1.1.). These givens lead to a braking time of 4,4 seconds.

*UN Regulation No. 13, Annex 14, paragraph 2.8.2.1. and 2.8.2.2.:*

## (a) Paragraph 2.8.2.1.:

- Based upon paragraph 5.2.1.13.1. text is adapted to the electric trailer braking system. Secondary brake braking performance is generally half of the service braking performance. A similar requirement can be found in paragraph 5.2.2.16.1.

- To compensate the loss of capacity of a battery over time the warning shall be given when the energy level has fallen to a [20%] higher value compared to conventional energy storage devices.

- Specification of "a braking from 60 km/h to 0 km/h with the maximum achievable braking force" instead of the in Regulation No. 13 commonly used "full stroke actuations of towing vehicle's service braking system" is necessary to take into account that the control of the electric braking system is on the trailer.

- In some cases the used energy depends also on the time the brakes are applied, e.g. in the case electromagnets are used to generate the braking power. To avoid different interpretations the time is fixed at 4.4 s. This time is derived from the calculation when a vehicle is braked from an initial speed of 60km/h to standstill according to the stopping distance formula  $s = 0.15 v + v^2/130$ ."

## (b) Paragraph 2.8.2.2.:

26. Text based upon paragraph 5.2.1.29. The flashing is not specified in detail since that may be too restrictive. From which position the signal has to be verifiable is not specified either because the tell tale (warning) is on the trailer. It is not necessary to specify such in detail.

*UN Regulation No. 13, Annex 14, paragraph 2.8.3. and 2.8.3.1.:*

## (c) Paragraph 2.8.3.:

- This requirement is uniquely for an electric trailer braking system and not for all the other trailer braking systems. However air brake systems of trailers O<sub>3</sub> and O<sub>4</sub> have in practice a system which keeps the trailer brakes applied as long as there is insufficient pressure in the reservoirs although there has to be some pressure otherwise the trailer is not braked in the case the trailer is not equipped with spring brakes.

- The same applies for trailers with electric energy storage devices without sufficient energy in those storage devices. This requirement is necessary because there are no requirements with regard to the time necessary to bring the energy level of the storage device to a sufficient high level. E.g. the recharging of an empty battery can take a rather long time. Mechanical locking is necessary to assure the trailer is also braked when no energy is left e.g. after a certain time being parked.

## (d) Paragraph 2.8.3.1.:

27. It is necessary to have a possibility to release the brakes for the purpose of maneuvering the trailer by hand; and because a trailer with energy storage devices could come to a standstill at a place where it endangers the other traffic.

*UN Regulation No. 13, Annex 14, paragraph 2. and 2.9.1.:*

## (e) Paragraph 2.9.:

28. This provision is inserted to safeguard that a trailer with electrical brakes can only be towed away when the electric energy supply line is properly connected to the towing vehicle. That assures that the connection to the towing vehicle is safe.

29. The requirement with regard the switch to release the brake after reconnection is necessary for safety reasons. In the case the supply line is reconnected to a trailer, parked e.g. on a slope, the trailer could move unexpected and could injure the operator. The

necessity to operate the release switch before the brakes are released prevents such unexpected movements of the trailer.

(f) Paragraph. 2.9.1.:

30. It is necessary to have a possibility to release the brakes for the purpose of maneuvering the trailer by hand.

*UN Regulation No. 13, Annex 14, paragraph 3.4.:*

31. Text "including semi-trailers" and "at least until the prescribed braking force of the trailer is attained" added for clarity.

*UN Regulation No. 13, Annex 14, Appendix:*

32. Terms "single axle trailer" and "multi-axle trailer" changed for clarity, in the past terms such terms were used. In the meantime these terms are no longer current and replaced by "full trailer", "centre-axle trailer" and "semi-trailer".

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