

Report on the status of work on the issue of electro-hydraulic systems, (ECE/TRANS/WP29/GRRF/2013/29)

History:

With the document ECE/TRANS/WP.29/GRRF/2012/11 the proposal was made to adapt the Annex 14 to technological progress allowing also electro-hydraulic systems:

"1.1. For the purposes of the following provisions electrical braking systems are service breaking systems consisting of a control device, an electromechanical **or electrohydraulic** transmission device, and friction brakes. The electrical control device regulating the **braking force** voltage for the trailer shall be situated on the trailer."

In the course of further discussion it occurred that further adaption for that purpose should be made and therefore a revised proposal was announced on the 73rd and the 74th session.

During the 75th session of GRRF, the document ECE/TRANS/WP.29/GRRF/2013/29 was presented to replace the preceding document but was subject to some objection as there were:

- Increase of residual voltage from 9.6V to 11.1V (compatibility issue)
- Increase of the nominal voltage from 12V to 13V
- Nature of the connector to be used
- Visibility of the tell tale (R48 issue)
- Need to clarification on the properties of multi-axle trailers to compatibility in the light of similar drawbar forces as the eliminated inertia braked multi-axle trailer showed (<http://www.unece.org/fileadmin/DAM/trans/doc/2004/wp29grrf/TRANS-WP29-GRRF-2004-11e.pdf> resp. UN Regulation No. 13, 10th series of amendments, Supplement 1, para. 5.2.2.2)

As a result the German delegation agreed to submit a revised proposal under consultation of interested parties (Delegations of the Netherlands and Denmark and OICA).

Current state:

The latest state of the proposal is reproduced below, incl. the remaining open discussion points.

Proposal for amendments to Regulation No. 13 (Heavy vehicle braking) and 13-H (Brakes of M₁ and N₁ vehicles)

The text reproduced below was prepared by the experts from Germany to clarify that beside an electromechanical transmission device also an electrical or a hydraulic transmission device is allowed within such a system. The modifications to the existing text of the Regulation are marked in bold for new or strikethrough for deleted characters.

I. Proposal

A. Proposal for Supplement 11 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 braking system. With the engine running at the idling speed recommended by the manufacturer and all electrical devices 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 **9.6 V** measured at the connection. The electrical lines shall not be capable of short circuiting even when overloaded;"

Annex 10, insert new paragraphs 5.3. to 5.3.3., to read:

"5.3. For full trailers with electric braking system
5.3.1. The requirements according to paragraph 5.1.1. apply also for full trailers with electric braking system.
5.3.2. For full trailers with electric braking system and with more than two axles the requirements according to paragraph 5.1.2. apply.
5.3.3. For the calculation to verify the compliance with the provisions of paragraph 5.1.1.3. the influence of the drawbar can be ignored."

Annex 14, Title, amend to read:

"Test conditions for trailers **of categories O₁ and O₂** with electrical braking systems."

Annex 14, paragraph 1.1., amend to read:

"1.1. For the purposes of the following provisions electrical braking systems are service braking systems consisting of a control device, an electromechanical **or electrohydraulic** transmission device, and friction brakes. The electrical control device regulating the ~~voltage~~ **braking force** for the trailer shall be situated on the trailer."

Annex 14, insert new paragraph 1.4.1., to read:

"1.4.1. During the tests of para. 3., the electrical braking system shall be supplied with a test voltage of maximum 9.6 V, measured at the energy supply connector. This voltage shall not be exceeded anywhere in the electrical trailer braking system."

Annex 14, paragraph 1.5., amend to read:

"1.5. The maximum current consumption, **in the supply line between the towing vehicle and the trailer**, shall not exceed 15 A. **During the measurement of the current an inrush peak current with duration of less than 0.2 seconds shall not be taken into account.**"

Annex 14, 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 1/, the plug of which shall not be compatible with the sockets of the lighting equipment of the vehicle. In the case of articulated vehicle combinations, ~~The~~ the plug together with the cable shall be situated

~~on the trailer a part of the power-driven vehicle. In all other cases, the plug together with the cable shall be a part of the trailer.~~

~~1/ Under study. The chosen plug/socket combination shall have the same reliability and functional safety as the well-known plug/socket combination according ISO7638."~~

Annex 14, paragraph 2.1., amend to read:

"2.1. If, for the purpose of **exclusively auxiliary equipment or exclusively automatic braking**, there is a battery on the trailer fed by the power supply unit of the towing vehicle, it shall be separated from its supply line during service braking of the trailer."

Annex 14, paragraph 2.3., amend to read:

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

Annex 14, paragraph 2.5., amend to read:

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

~~Annex 14, 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 exclusively**, lighting up at any brake application and indicating the proper functioning of the trailer electrical braking system."~~

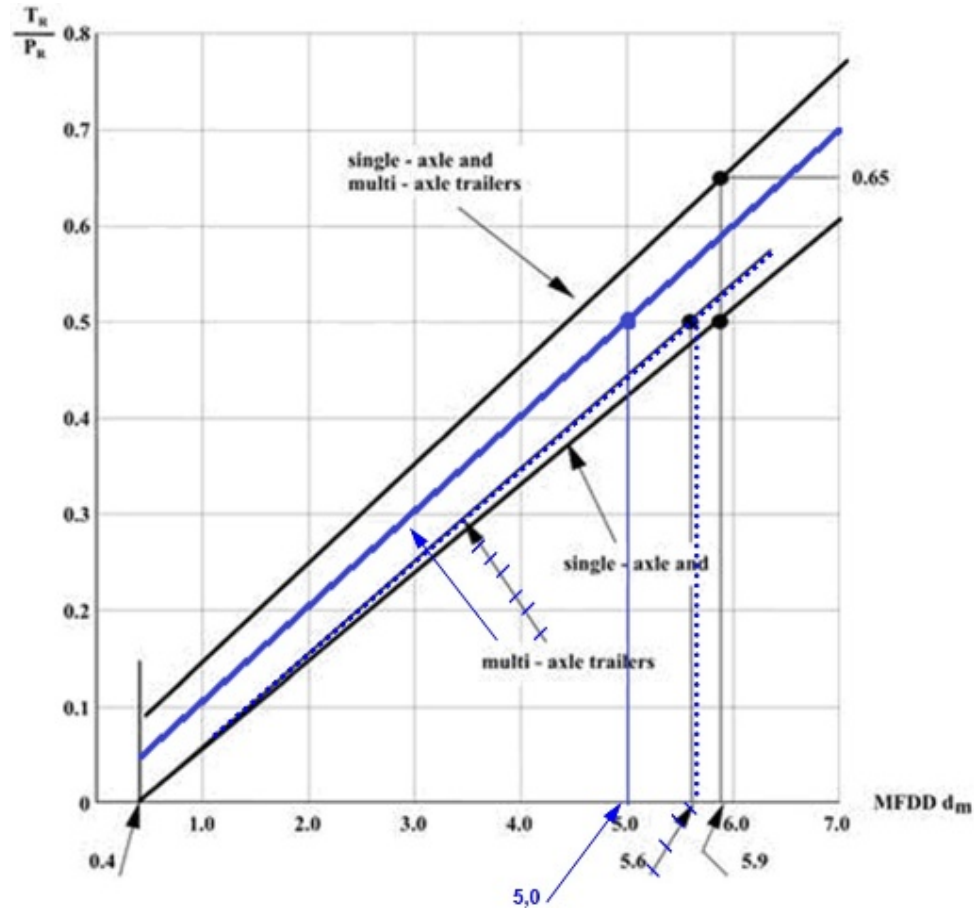
Annex 14, paragraph 3.4., amend to read:

"3.4. The prescribed braking force of the trailer 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/s² with ~~single axle~~ **centre-axle trailers and semi-trailers** and of not more than ~~5-6~~ **[5.0]m/s²** 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. If the braking force is regulated in steps, they shall lie within the range shown in the appendix to this Annex."

"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 instead of "single-axle trailer". The term "full trailer" shall be used instead 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."

B. Proposal for Supplement 16 to the 00 series of amendments to Regulation No. 13-H

Paragraph 5.2.1.17.1., amend to read:

"5.2.17.1. The power supply (generator and battery) of the motor vehicle shall have a sufficient capacity to provide the current for an electric braking system. With the engine running at the idling speed recommended by the manufacturer and all electrical devices 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 **9.6 V** measured at the connection. The electrical lines shall not be capable of short circuiting even when overloaded..."

II. Justification

1. *UN Regulation No. 13, paragraph 5.2.1.19.1., and UN Regulation No 13-H, paragraph 5.2.1.17.1.*

For clarification, the current text: "*the voltage in the electrical lines shall at maximum current consumption of the electrical braking system (15 A) not fall below the value of 9.6 V*" is not clear. What is meant by "*the voltage in the electrical lines*"? It must be the supply line for the electrical braking system of the trailer. The proposed text makes that clear.

2. *UN Regulation No. 13, Annex 10, new paragraphs 5.3., 5.3.1., 5.3.2. and 5.3.3.:*

The current scope of the UN Regulation No. 13 reads that it covers full trailers with an electrical braking system (5.2.2.2, last sentence). Annex 4, para. 1.3.2. requires O₂ 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). These new paragraphs are in essence an import from an old proposal (ECE/TRANS/WP29/GRRF/2003/8) that was made to make some improvements to the inertia braked full trailer shortly before it was eliminated via ECE/TRANS/WP.29/GRRF/2004/11.

3. *UN Regulation No. 13, Annex 14, Title, amend to read:*

"categories O₁ and O₂" are added for clarification.

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

The original text of the Regulation gives constructive requirements for the transmission to be electromechanical. New innovative constructions shall be not excluded.

All technical provisions can be achieved with electromechanical transmission devices and with electrohydraulic transmission devices.

Electrohydraulic and electronic solutions also exist on the market and shall be covered by the legislation.

The electrical control device ultimately controls the braking force of the trailer as a function of the deceleration of the combination. It seems of no added value to prescribe how it gets there. Consequently also the wording "voltage" has to be replaced by "braking force".

5. *UN Regulation No. 13, Annex 14, paragraph 1.4.1.,*

The voltage during the test and the place where it should be measured is an important parameter for the braking performance of the trailer. This requirement is analogous to UN Regulation No. 13,

Annex 4, paras. 3.1.2.2 and 3.1.3.2. The only known values available at any time are those in para. 5.2.1.19.1 of UN Regulation No. 13 and para. 5.2.17.1 of UN Regulation No. 13-H.

6. *UN Regulation No. 13, Annex 14, paragraph 1.5.,*

The proposed text clarifies where the maximum current of 15 A has to be measured. When the brakes are applied there is often a peak current. It should be clear that such a peak current can be permitted when the duration is less than 0.2 seconds. The base of this value is in UN Regulation No. 79 (steering equipment) para. 6.2.3. (measurement of the steering effort).

7. *UN Regulation No. 13, Annex 14, paragraph 1.6 and the change to footnote 1,*

Nowadays many semitrailers are equipped with electrical braking systems. When separated from the towing vehicle the cable and connector are easily damaged. And to bring the requirements for the electric braking system in line with the requirements for air braking systems, UN Regulation No. 13 para. 5.1.3.8.

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

This is to clarify what that battery may be intended for.

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

For clarification, the current text does not make clear where the voltage has to be measured. The text mentions the battery on the trailer (for the energy supply of the trailer brakes) to make this possibility clear. For safety reasons this requirement shall also apply to a battery on the trailer.

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

For clarification and to allow systems, which use a battery on the trailer for the energy supply to the trailer brakes.

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

A tell-tale at the control device is sometimes not visible for the driver.

Similar to UN Regulation No. 55, Annex 5, para. 12.2.9.

11. *UN Regulation No. 13, Annex 14, paragraph 3.4 and Appendix (diagram),*

It is not clear which requirements should be applied to semi-trailers. The current requirements apply to single axle trailers and multi axle trailers. That could be interpreted as centre axle trailers and full trailers.

The prescriptions regarding the axle spread are not relevant if the terms "centre-axle trailer", "semitrailer" and "full trailer" are used.

Therefore the diagram in the appendix to Annex 14 also has to be amended accordingly.

A major reason for the demise of the inertia braked full trailer was its tendency of being dynamically unstable which is due to the drawbar forces in the event of braking, thus creating a situation prone to buckle the combination at least on low adhesion ground where even a balanced brake force distribution may not avoid the implications pictured in ECE/TRANS/WP.29/GRRF/2004/10.

The current scheme to the braking performance of a "multi axle trailer" in Annex 14 (braking force of the trailer of at least 50 per cent of the maximum total axle load at deceleration rate of $5,6\text{m/s}^2$ of the combination) results in drawbar forces similar to those of an inertia braked "multi-axle trailer" with a pivoted drawbar (Annex 12, para. 10.3.1.). Setting the above trailer performance at a deceleration rate of $5,0\text{m/s}^2$ of the combination drawbar forces are reduced to 14%, at $4,905\text{m/s}^2$ they will have gone.

III. Main controversies

1. The increase of residual voltage from 9.6V to 11.1V is to provide for more power to electric-hydraulic systems while the arguments against are the difficulties on the electrical

infrastructure of towing vehicles and a gap the compatibility between vehicles before and after an amendment.

2. The proposal of increase of the nominal voltage from 12V to 13V raised the discussion on the nature of this voltage. Is it just a nominal value or is it the testing voltage for the trailer instead of the residual voltage (9.6V/11.1V)?

3. As to the nature of the connector to be used there is some reluctance to make a standard while on the other hand in case of failure in the connection there is no braking effect and high drawbar forces.

4. The current prescriptions on the tell tale are old ones and it is disputable if it is state of the art or if it collides with other regulations (e.g. UN Regulation No. 48). The compromise made here provides under 2.7. the wording "...within the driver's direct or indirect field of vision **exclusively**,...". The illuminating of the tell tale in the event of failure only instead now in case of brake activation may put a burden on current simple designs.

5. The proposed change to Annex 10 for the multi-axle trailer is intended to consider them there at all, because currently 5.1.1 is a subtitle of 5.1 which addresses full trailers fitted with compressed-air braking systems. The change correlates to the change in the appendix for multi-axle trailers eliminating the drawbar forces and thus making it possible excluding the drawbar forces from the considerations to Annex 10. There is some reluctance to such adaption and one must say that it puts more strain on the trailer brakes. It has also been questioned that the multi-axle trailer to Annex 14 would be as instable as the inertia braked one.
