

Proposal for amendments to UN Regulation No. 13 (Heavy Vehicle Braking)

This document supersedes and entirely replaces GRVA-22-26 respectively ECE/TRANS/WP.29/GRVA/2025/15 and GRVA-21-12

Submitted by the experts from CLCCR, CLEPA and OICA

The text reproduced below was prepared by the experts from the International Association of the Body and Trailer Building Industry (CLCCR), the European Association of Automotive Suppliers (CLEPA) and International Organization of Motor Vehicle Manufacturers (OICA). It proposes to establish definitions for “e-axle”, “e-axle trailer” and “dynamo function” and establish provisions for the approval of e-axle trailers with regard to their “dynamo function”. It is based on documents GRVA-22-26 prepared by CLEPA respectively ECE/TRANS/WP.29/GRVA/2025/15 and GRVA-21-12.

The modifications to the existing text of UN Regulation No. 13 are marked in **bold** for new characters and in ~~strike through~~ for deleted characters.

I. Proposal

Add a new paragraph 1.2.6., to read:

- 1.2.6. E-axle trailers with e-axes providing electric propulsion and/or incorporating an electric regenerative braking system.**

Add new paragraphs 2.57. to 2.59, to read:

- 2.57. “e-axle” means an axle mounted to a vehicle of category O generating electrical energy and/or providing electrical propulsion.**
- 2.58. “e-axle trailer” means a trailer of category O that is equipped with at least one e-axle.**
- 2.59. “Dynamo function” of an e-axle trailer means the capability of a trailer to provide for the conversion of vehicle kinetic energy into electrical energy without affecting the forces developed by the braking system. A dynamo function is not part of the braking system and not considered as a brake.**

Add new paragraph 5.2.2.26., to read:

- 5.2.2.26. Special additional requirements for dynamo function of e-axle trailers category O ^{footnote[21]}**

~~Footnote [21] shall read:~~

Until uniform technical provisions have been agreed, trailers of Category O₁ and O₂ shall not be equipped with a dynamo function shall not be approved according to this Regulation.

- 5.2.2.26.1. The dynamo function shall not provide a retardation power of more than:**

~~(a)~~ **—22 kW for the complete trailer of Category O₃ and/or O₄;**

~~[(b) —2 kW for the complete trailer of Category O₂.]~~

The maximum power shall be checked at the time of type approval using one of the following methods:

- (a) Calculating the maximum power of the dynamo from the measurement of the vehicle combination retardation with dynamo function active vs dynamo drivetrain disengaged;
- (b) Measuring the power at the transmission shaft or wheel hub;
- (c) Measuring the power at the wheel on a roller test bench, or;
- (d) Measuring the maximum electric power and demonstrating that the value is below 80 per cent of the retardation power limit.

Additionally, it shall be stated in the owner's manual that, in case of a multiple trailer combination of Category O₃ and/or O₄, the 22 kW limit applies to the sum of the retardation power of all dynamo function devices of the combination.

- 5.2.2.26.2. In case the dynamo function has the capability to generate a braking rate (braking rate = brake force / vertical force) exceeding 0.04 per wheel, it shall be controlled such that it does not cause wheel locking **and has no critical impact on the vehicle behaviour.**
- 5.2.2.26.3. The operation of the dynamo function shall be assessed according to Annex 18, **in particular how the system ensures that the brake rate does not exceed 0.04 or how the wheel(s) are prevented from locking, as applicable.**
- 5.2.2.26.4. In case of trailers of Categories O₃ or O₄, it shall be demonstrated that the vehicle still complies with the requirements of Annexes 13 and 21 when the dynamo function is enabled.
- 5.2.2.26.5. In case of a dynamo function according to paragraph 5.2.2.26.2., a comparison shall be conducted with and without the e-axle trailer dynamo function active, to demonstrate the wheels are prevented from locking and there is no critical impact on the vehicle behaviour. During the tests it shall be possible to lock the wheel(s) by the retardation forces induced by the dynamo function. The comparison shall be conducted:
 - (a) With the maximum force of the dynamo function;
 - (b) In unladen condition, and;
 - (c) On a straight road with a low friction surface.
 - (d) Initial speed of 40 km/h or at a speed where the highest retardation force is generated**

If the friction value of the surface is too high and/or braking rate is too low to lock the wheel(s), **the** technical service and vehicle manufacturer shall agree on a way to increase the retardation power or reduce the vertical axle load of the e-axle.

The comparison shall **also** include tests

- (a) With right and left wheel(s) of the vehicle are situated on surfaces with differing coefficients of adhesion**
- (b) When the e-axle passes from a high to a low value of coefficients of adhesion.**

The coefficients of friction shall be chosen in order to demonstrate compliance with paragraph 5.2.2.26.2.

Annex 2, add new paragraph to read:

14.18. The trailer is equipped with an e-axle having a dynamo function: yes/no

Annex 4, paragraph 1.4.1.2.2., amend to read:

- 1.4.1.2.2. Every test shall be repeated on the unladen vehicle. In the case of a power-driven vehicle there may be, in addition to the driver, a second person on the front seat who is responsible for noting the results of the test;

In the case of a tractor for a semi-trailer, the unladen tests will be conducted with the vehicle in its solo condition, including a mass representing the fifth wheel. It will also include a mass representing a spare wheel, if this is included in the standard specification of the vehicle;

In the case of a vehicle presented as a bare chassis-cab, a supplementary load may be added to simulate the mass of the body, not exceeding the minimum mass declared by the manufacturer in Annex 2 to this Regulation;

In the case of an e-axle trailer the e-axle functions shall not be used during the brake applications.

In the case of a vehicle equipped with an electric regenerative braking system, the requirements depend on the category of this system:

Category A: Any separate electric regenerative braking control which is provided, shall not be used during the Type-0 tests.

Category B: The contribution of the electric regenerative braking system to the braking force generated shall not exceed that minimum level guaranteed by the system design.

This requirement is deemed to be satisfied if the batteries are at one of the following state of charge conditions where state of charge³ is determined by the method set out in Appendix to this annex:

- (a) At the maximum charge level as recommended by the manufacturer in the vehicle specification; or
- (b) At a level not less than 95 per cent of the full charge level, where the manufacturer has made no specific recommendation; or
- (c) At the maximum level which results from automatic charge control on the vehicle, or
- (d) When the tests are conducted without a regenerative braking component regardless of the state of charge of the batteries.

Annex 4, add new paragraph 1.7.1.3. to read:

1.7.1.3. The dynamo function, if any, shall not be used during the brake applications.

Annex 5, paragraph 2.2.1.2., amend to read:

2.2.1.2. In the case of an electrical failure of the anti-lock system, integrated or combined endurance braking systems and/or an e-axle function shall be switched off automatically. An e-axle with a dynamo function is excluded from that requirement, if the prevention from locking the wheel(s) is not based on the anti-lock braking system.

Annex 5, paragraph 2.2.1.3., amend to read:

2.2.1.3. The effectiveness of the endurance braking system and/or an e-axle shall be controlled by the anti-lock braking system such that the axle(s) braked by the endurance braking system and/or an e-axle cannot be locked by that system at speeds above 15 km/h. An e-axle with a dynamo function is excluded from that requirement, if the prevention from locking the wheel(s) is not based on the anti-lock braking system. However, this requirement shall not apply to that part of the braking system constituted by the natural engine braking.

Annex 10, paragraph 1.1.1., amend to read:

1.1.1. Where the vehicle is installed with an endurance braking system and/or a dynamo function the retarding force shall not be taken into consideration when determining the vehicle performance with respect to the provisions of this annex.

Annex 19, paragraph 4.5.1.5., amend to read:

- 4.5.1.5. The rolling resistance of the vehicle combination is to be determined by measuring the time taken for the vehicle speed to reduce from 55 to 45 km/h and the distance covered, when tested in the same direction in which the verification test will be carried out and with the engine disconnected and any endurance braking system **and dynamo function** disengaged.

Annex 19, paragraph 4.5.1.6., amend to read:

- 4.5.1.6. Only the brakes of the axle under test shall be actuated and reach an input pressure at the brake input device of 90 ± 3 per cent (after maximum build up time of 0.7 s) of its asymptotic value. The test shall be carried out with the engine disconnected and any endurance braking system **and dynamo function** disengaged.

Annex 19, Appendix 5, paragraph 2.2., amend to read:

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

Sensor locations

Modulator locations

Lift axles

Steering axles

e-axles

Tube: type - bore size(s) and lengths

Annex 19, Appendix 7, paragraph 2.2., amend to read:

- 2.2. Schematic diagrams of the respective configurations installed on the trailers defined in item 2.1. above with consideration given to the following:
- (a) Lift axles;
 - (b) Steering axles;
 - (c) Anti-lock braking configurations;
 - (d) e-axles.**

Annex 20, paragraph 2.2., amend to read:

- 3.2.1.3. The number and arrangement of axles i.e. lifting, steering, **e-axles** etc. of the "subject trailer" shall not differ from that of the reference trailer.

Annex 21, add new paragraph 1.2.7., to read:

- 1.2.7. In the case of trailers the number and arrangement of e-axles;**

II. Justification

1. The modifications proposed in this document intend to define the provisions for the approval of e-axle trailers with regard to their "dynamo function".
2. The detailed justifications for the modified paragraphs above are:
 - a. Paragraph 1.2.6.: Until further amendment of Reg 13 is developed and agreed, trailers with electric propulsion and electric regenerative braking systems shall not be in the scope of Reg 13 approvals.
 - b. Paragraph 5.2.2.26.: new paragraph to define the technical requirements and limitations for dynamo function of an e-axle trailer. A footnote is inserted to limit the approval of dynamo function to O2, O3 and O4 trailers until a further amendment of Reg 13 will be agreed to include O1 category.
 - c. Paragraph 5.2.2.26.1.: power of the dynamo function shall be limited to protect motor vehicle functions of heavy vehicles like mass estimation from relevant impact by the trailer dynamo function. An electric power of 20 kW is a target value which covers most use cases of a dynamo function e.g. supply of

cooling systems for O3 and O4 trailers. Taking into account losses of energy during the conversion from mechanical to electric energy a retardation power of maximum 22 kW will impact the motor vehicle functions, which is tolerable.

For O2 trailers a electric power of 2 kW is a target value and its impact on light towing motor vehicles is tolerable.

To check the mentioned limit values different methods are described: measuring retardation power using a vehicle test or a test bench, measuring retardation power directly in the drive train system or measuring the electric power and respecting some losses.

An additional requirement is introduced to state in the owner's manual that in the case of multiple trailer combinations and more than one dynamo function the sum of power of all dynamo function systems shall be below the limit of 22 kW.

- d. Paragraph 5.2.2.26.2.: purpose of this requirement is to avoid locking of wheel(s) that are impacted by the dynamo function. If the wheels braking rate is below 0.04 (like the friction value of wet ice), wheels will not lock. If the braking rate is higher, a control function shall avoid locking of wheels.
- e. Paragraph 5.2.2.26.3.: the operation of the dynamo function together with the braking functions shall be part of the functional safety assessment according to Annex 18 of Reg 13.
- f. Paragraph 5.2.2.26.4.: to ensure that the requirements of Annexes 13 and 21 are fulfilled by O3 and O4 trailers with the dynamo function enabled. For O2 trailers neither anti-lock nor stability control systems are established.
- g. Paragraph 5.2.2.26.5.: to transfer 5.2.2.26.4. into a concrete instruction. Test conditions are defined to ensure that wheel(s) impacted by the dynamo function are prevented from locking. Depending on the max torque of the dynamo function and the friction value available on the test track it may be practically difficult to realize a locking of the wheel(s). In that case technical service and manufacturer shall agree on a way to increase the torque or to reduce the friction value.
- h. Annex 4, paragraph 1.4.1.2.2.: During testing the performance of the braking functions shall not be supported by braking forces of the e-axle trailer.
- i. Annex 4, paragraph 1.7.1.3.: During testing the performance of the braking functions shall not be supported by retardation forces of the dynamo function.
- j. Annex 5, paragraph 2.2.1.2.: trailers for transport of dangerous goods shall switch off an e-axle function in case of a failure in the anti-lock system. If the lock preventing function of the e-axle function is not realized by an anti-lock system, the e-axle function is excluded from that requirement.
- k. Annex 5, paragraph 2.2.1.3.: it is the requirement to control e-axle functions by an anti-lock function. E-axes with a dynamo function are excluded from that requirement, if the wheel(s) are prevented from locking by the impact of an other control system.
- l. Annex 10, paragraph 1.1.1.: The performance of the braking functions shall not be supported by retardation forces of a dynamo function.
- m. Annex 10, paragraph 4.5.1.5.: to insure a dynamo function is disengaged (like an endurance braking system) during the determination of the rolling resistance.
- n. Annex 19, paragraph 4.5.1.6.: to avoid influence of the dynamo function on the brakes during this test.
- o. Annex 19 - Appendix 5 paragraph 2.2.: to include e-axes as an additional parameter
- p. Annex 19 - Appendix 7 paragraph 2.2.: to include e-axes as an additional configuration parameter
- q. Annex 20 paragraph 2.2.: to include e-axes as an additional configuration parameter
- r. Annex 21, new paragraph 1.2.7.: to include e-axes as an additional configuration parameter