Economic Commission for Europe

Inland Transport Committee

Working Party on the Transport of Dangerous Goods

113th session **5 May 2023**
Geneva, 15-17 May 2023
Item 5 (a) of the provisional agenda
Proposals for amendments to annexes A and B of ADR: construction and approval of vehicles

Endurance braking system incorporating Electric Regenerative Braking Systems

Transmitted by the International Organization of Motor Vehicle Manufacturers (OICA)

Endurance braking system incorporating Electric Regenerative Braking Systems

(Alternative approaches introduced by UN R13-11 supplement 18)

Presentation to WP15 of May 2023

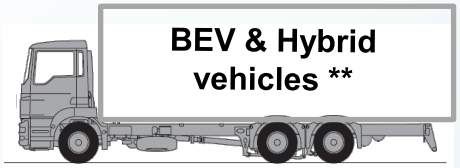
Introduction

- At the 7th session of GRVA of September 2020, GRVA agreed to submit document GRVA/2020/30 from Germany, as amended by GRVA-07-71, to the WP29 session of March 2021, where it was officially adopted as supplement 18 to the 11th series of UN R13 with reference WP29/2021/12.
- The original technical issue is that a vehicle with an endurance braking system incorporating an electric regenerative braking system, e.g. a Battery Electric Vehicle (BEV), is not able to pass the type IIA test with a fully charged traction battery (the worst case for the test), unless the vehicle would be equipped with specific technical solutions like e.g. resistors with high-temp cooling system, extra batteries. Such solutions would negatively impact the vehicle weight and autonomy, packaging (vehicle architecture) and cost, reducing the environmental and economic interest of BEVs.
- Another solution could also be to always keep in the traction battery a free capacity equivalent to the energy of a type-IIA, which would be used by the driver whenever needed. The major issue with that simplistic approach is that this permanently free capacity cannot be used for traction, which reduces the operating range of the vehicle.
- Supplement 18 to UN R13 series 11 is opening the door to new approaches which does not impair the autonomy nor the economic interest of BEVs, while preserving current safety level.
- **The aim of this document is to present the technical content of this amendment, and the rationales which supported GRVA and WP29.**

Rationales supporting the UN R13 amendment

- The interest of the proposed alternatives approach is to permit *smart charging strategies* (e.g. based on route planning) to optimize the use of the installed battery capacity for the purpose of traction, while ensuring the driver is informed of the available endurance braking capacity.
- As an alternative to such *smart charging strategies*, a type-II test with increased performance is also proposed, together with a warning of the driver if the service brake performance falls below a given threshold (due to brake fading).
- Our experience on different type of usages (based on customers experience or simulations) shows the battery state of charge is in the vast majority of cases at a level providing sufficient endurance braking performance for ensuring safety and users satisfaction, at a similar level as with current vehicles (the challenge for electric vehicles is the autonomy for traction, not the ability to provide regenerative braking).
- The *worst case* which is considered in the regulation (passing type-IIA test with a fully charged battery) is something very seldom that the drivers should almost never experience. Reaching the top of a 6km / 7% slope with a fully charged battery is unlikely to happen. However, the new alternatives for endurance brake incorporating electric regenerative braking (as per UN R13 suppl. 18 to series 11) are aiming at ensuring the safety level of e.g. BEVs is preserved even when such worst case would be met in real life.

New options offered by supplement 18 to UN R13-11



** Vehicles equipped with an Electric Regenerative braking system

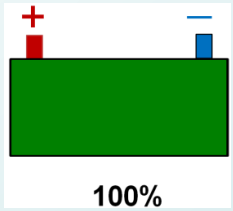
Classic Type-IIA

Option 1

6km at 30kph
Slope 7%

Service brakes prohibited during the test

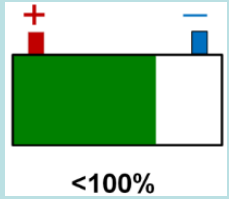
SOC = 100%



or

New options/alternatives to classic Type-IIA for ERB

Classic Type-IIA with endurance brake only

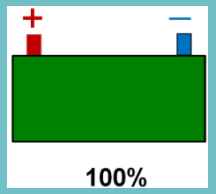


\+ Inform driver prior to when regenerative braking can no longer be provided (i.e. the battery is fully charged battery)

\+

Option 2

Type-II* + Brake estimator



Warn the driver if performance is :

! < 3.3m/s² (N3)
< 3,75m/s² (M3)

! < 2.2m/s² (N3)
< 2.5m/s² (M3)

* Type-II with increased Performance: Slope 7%
Hot-stop 5 m/s²
(use of friction barke and.or endurance brake)

§ 5.1.2.4.3.2.

or

\+

Option 3

Secure free battery capacity to be able to stabilize speed in the forthcoming (predicted) downhill on the route of the vehicle (the system shall be able to secure at least the energy of a type-IIA)

§ 5.1.2.4.3.1.

Backup slides

Comparison of different alternatives (BEVs)

Options	Design (example)	Safety & Performance
Option 1 **Classic Type IIA**	▪ The vehicle is not using the full capacity of the battery for traction, some capacity (equivalent to the energy of a type-IIA) is "kept free" for endurance braking.	▪ Type IIA can be passed without friction brakes ▪ The vehicle autonomy (traction) is limited.
Option 2 **Alternative 5.1.2.4.3.2.**	▪ The vehicle is not using the full capacity of the battery for traction, some capacity (e.g., a fraction of the energy of a type-IIA) is "kept free" for endurance braking. The friction brakes and the regen braking are together able to pass the type II test with 6km and 7% slope. ▪ The vehicle may use the full capacity of the battery for traction; in that case the friction brakes alone must be sufficient to pass type II with 6km and 7% slope.	▪ The probability to reach the top of a type-IIA slope with a fully charged battery is extremely low. ▪ For the case it would happen, safety is ensured: • The slope can be passed with stable speed of 30km/h • A brake performance of 5m/s² is available at the end. • The driver is informed with a yellow (red) warning in case the brake performance falls below 3.3m/s² (2.2m/s²) • The driver is informed before the battery is full (i.e. before no regen braking is available). • With those information, the driver can take the proper measures (slow down, stop the vehicle). This would then not be a safety issue, but a feature issue. ▪ The vehicle autonomy (traction) is less limited than with the "traditional Type IIA alternative)
Option 3 **Alternative 5.1.2.4.3.1.**	▪ The vehicle is using a *smart charging strategy* (e.g. using GNSS and topography models, securing that sufficient capacity * is "kept free" for endurance braking in the forthcoming (predicted) downhills. ▪ The maximum value of the "free-capacity" is at least the energy equivalent to a type IIA.	▪ Type IIA can be passed without friction brakes. ▪ The driver is informed before the battery is full (i.e. before no regen braking is available). ▪ The vehicle autonomy (traction) is limited in "hilly" areas. With flat roads all around, the vehicle is using the full capacity of the battery for traction.

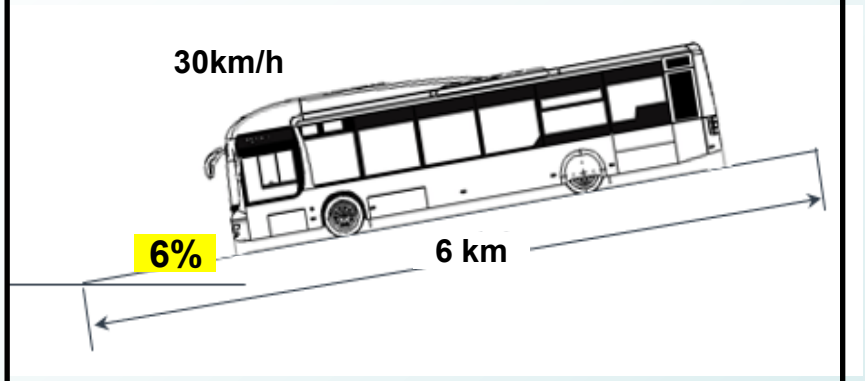
Technical Background

Type II and Type IIA tests

UN R13 before suppl. 18 to series 11

Type-II

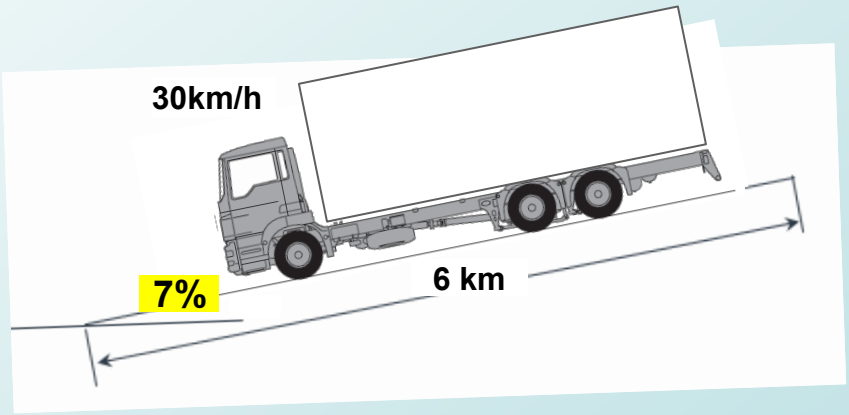
Downhill Behaviour Test



- **Scope**
  - M3 and N3
    (Except vehicles submitted to Type-IIA)
- **Service brake may be used**
- **Pass criteria**: Hot-stop performance after Type-II
  N3: 3.3 m/s²
  M3: 3.75m/s²

Type-IIA

Endurance Braking Performance Test

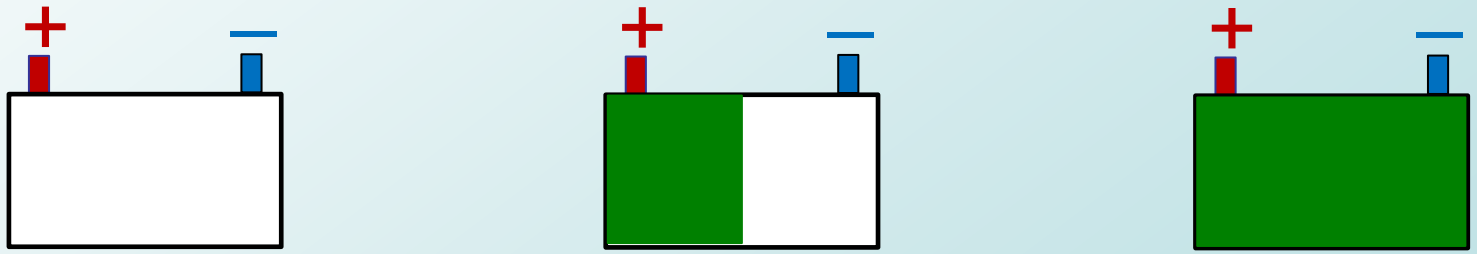


- **Scope**
  - M3 class II, III & B
  - N3 authorized to tow O4 trailers
  - ADR >16t or authorized to tow a O4 trailer
- **Service brake: prohibited (during the test)**
- **Pass criteria**: Average speed of 30km/h (+/- 5 km/h)

Technical Background

Definition of State Of Charge (SoC) in UN R13

2.21.4. “Electrical state of charge” means the instantaneous ratio of electric quantity of energy stored in the traction battery relative to the maximum quantity of electric energy which could be stored in this battery;



SoC **0%** **50%** **100%**