

Economic Commission for Europe

Inland Transport Committee

Working Party on the Transport of Dangerous Goods

114th session

23 October 2023

Geneva, 6-10 November 2023

Item 5 (a) of the provisional agenda

Proposals for amendments to annexes A and B of ADR:

Construction and approval of vehicles

Report of the Informal Working Group on Electrified Vehicles

Transmitted by the Netherlands on behalf of the informal working group on electrified vehicles

I. Introduction

1. The Informal Working Group on Electrified Vehicles (IWG-EV) met 3 times between the May 2023 (113th) and November 2023 (114th) sessions. The meeting sequence was irregular rather than the planned meeting every 2 months. Partly this was due to the holiday season and development of the proposal in document ECE/TRANS/WP.15/2023/14 and informal document INF.3. The vacancy of the secretarial function is also felt in the overall running of the group.

2. Taking into account the timeline for amendments for ADR 2025 it was felt appropriate to present the amendments to include Battery Electric Vehicles (BEV) for the FL category, and Hydrogen Fuel Cell Vehicles (HFCV) and Hydrogen Fuelled Vehicles with Internal Combustion Engines (H2 ICE) for AT and FL categories at the November 2023 session of WP.15. This timing would allow for corrections deemed necessary to be discussed, implemented for the April 2024 session of WP.15 (115th) and inclusion of the requirements in ADR 2025. For electrified trailers the developments in WP.29 are awaited and for EX categories the developments to prove battery safety.

3. The informal working group is organized in 5 sub-groups. In the last period the truck manufacturers group was active while the users, hydrogen groups and trailer and body builder groups were dormant awaiting new developments. The EX group has yet to be started up.

II. Scope and design neutrality

4. The principle is that ADR shall only include additional items to the requirements already applicable for the general safety of vehicles. However, from the start of the IWG-EV it was felt that UN Regulation No. 100 (further R100) and UN Regulation No. 134 (further R134) were not very well matured for commercial vehicles. In the meantime, more improvements are introduced in the said regulations. Some important issues remain, that may find a place in the ADR. Once these issues are dealt with in R100 and R134 they can be removed from ADR.

5. In addition, it was felt that to maintain a certain level of general safety, it may be necessary to maintain in ADR reference to the various UN vehicle regulations such as R100 or R134.

6. Technology is developing fast and the requirements in ADR should not hinder the development. For this reason, it was felt to draft requirements in such a way that the purpose is given rather than the means. This presents challenges for manufacturers, approval authorities and competent authorities to determine if the requirement is dealt with in a

sufficient way. It was suggested that a guidance should be provided explaining in more detail what the expected outcome needs to be, to guarantee a harmonized approval. This guidance is still under consideration and may be developed before the publication of ADR 2025.

III. Battery Electric Vehicles (BEV)

7. The safety level in R100 is in general very high for the electric power train. The efficiency (development of heat) and temperatures in normal running conditions are favourable compared to trucks with Internal Combustion Engines (ICE).

8. However, it was felt that from a safety perspective each vehicle should be fitted with an insulation monitoring system. Because of this system, the requirements in 9.2.2 for the electrical system should not apply. In principle this system will be fitted but it is not a requirement in R100 for each individual vehicle.

9. Another topic is the safety of a battery in malfunction and accidental conditions. Lithium-ion batteries contain a flammable electrolyte and easily combustible materials. Although constantly monitored by an electronic system with the possibility to regulate the temperature a thermal event may occur in a cell of the battery. The question here is if the one malfunctioning cell will ignite other cells leading to a thermal runaway.

10. Depending on the composition of the battery such as cell chemistry, cell shape, distance between cells and other measures it is possible in the case of a thermal runaway of one cell to prevent a thermal propagation into a full-scale battery fire. It was discussed that an amendment to a standard was available for design and construction of batteries and to evaluate the risk of a thermal runaway. For example, this evaluation needs to be based on tests performed by cell manufacturers and small-scale tests of ways of construction. If this offers proof to prevent a thermal runaway, no further measures need to be taken.

11. If prevention of thermal propagation cannot be proven, mitigating measures shall be taken. For example, in the form of shielding and or guiding away hot combustion gases. Because battery fires are very difficult to extinguish additional measures were mentioned, such as options to flood the battery. However, no consensus could be reached on the wording for the last-mentioned measure and for this reason it is kept in square brackets. It was also noted that amendments to Chapter 9.7 should be considered in respect of protection against thermal propagation. The position of WP.15 would be welcome on expectations on this topic.

IV. Hydrogen Fuel Cell Vehicles (HFCV)

12. The general safety level of HFCV is quite high. However, two items are worth to be mentioned here.

13. Although hydrogen containers are very strong and withstand many punishments, they may weaken in a fire. To prevent explosion due to weakening, the containers are provided with thermal pressure relief devices (TPRDs) at each end of the container. These TPRDs vent through vent pipes in a determined direction. Flow restricting of these pipes by mechanical damage is most critical and the piping should be as short as possible. For this reason, the discharge direction is not prescribed. In principle low mounted containers should discharge down and high mounted containers behind the cab should discharge up. It was argued that when the TPRDs are activated there would already be a considerable fire around the vehicle to which the discharged hydrogen would only contribute. However, in these cases the risk of an explosion is the worst case and should be prevented at all costs. It was felt that the existing requirement for CNG were also sufficient for hydrogen, only impingement of the battery was added.

14. The automatic closing function of the shut-off valves on the hydrogen containers is a very important safety issue. On vehicles with ICE the stopping of the engine closes these valves. HFCV also have an electric power train and the engine will not stop like an ICE. To assure that the valves close in dangerous situations, such as overturning or impact, additional requirements are given. The values of 23° for tilting and 1.5 G deceleration come respectively from UN Regulation No. 111 and the latest fashion of the regulation for Event Data Recorder

(EDR / DSSAD). For the last value it needs to be noted that other deceleration triggers are finally adopted (3.25 m/s² for 0.7 seconds) that require amendment of the value in document ECE/TRANS/WP.15/2023/14.

V. Liquid hydrogen

15. Although the latest up-date of the Global Technical Regulation No. 13 (GTR 13) includes liquid hydrogen, this is not transposed in the new, coming version of R134. From industry it is welcomed to have this option open. In principle the behavior of liquid hydrogen will not be that different than LNG, although the temperature and properties of the gases are different. Tanks will be double walled and will offer a high level of safety. Boil-off, due to heat leak through the tank insulation will result in limited releases in the gaseous phase dispersing in the air rapidly, and so limiting an explosive atmosphere. Based on these assumptions it was felt justified to include this option while referring to the technical provisions in GTR 13. It has been confirmed that Regulation (EU) 2021/535 is equivalent to the GTR 13 concerning liquid hydrogen.

VI. Hydrogen Fuelled Vehicles with ICE

16. The possibility to fuel an ICE vehicle with hydrogen, in mono or dual fuel configurations, is seen as very important to decrease the CO₂ emission but also to build the hydrogen infrastructure by increasing demand. The containers for storage of hydrogen and their safety systems will be the same as those for fuel cell vehicles which are the safety requirements to check leakage of the system. The shut-off valves will close automatically when the engine stops so the additional requirements for fuel cell vehicles need not to apply.

VII. Open issues

17. A point of concern is the high voltage installation on trailers. As R100 is not applicable to trailers (Category O) the systems coupled to the drawing vehicle by the Electric Power Take-Off (E-PTO) are not covered by the safety provisions. Also, batteries that are on the trailer, connected for charging by the vehicle or isolated from the rest of the electrical system are not regulated. In the past mainly lead-acid batteries were used to power equipment such as electronic steering systems for trailers. Now more and more Li-ion batteries are installed on the trailer. These batteries can be anything and the robustness is uncertain. In particular for FL trailers this leads to difficulties when the battery master switch will be activated and interchangeability of trailers.

18. It is expected that when electrification of trailers is realized, and communication protocol is established between drawing vehicle and trailer that part of this topic will be dealt with. It is possible that some provisions are necessary for non-galvanically connected Li-ion batteries on trailers.

19. EX vehicles are extra sensitive for heating up the load compartment. In the case of a battery fire, evacuation of the explosives from the load compartment is difficult, and the effects of a detonation are extensive. For this reason, there is reluctance to include the EX category at this moment. It is expected that batteries will become safer over time and experience will be gained to take a practice-based decision.

VIII. Consequential amendments

20. It is recommended that Special Provision 392 is updated in the table to allow carriage of automotive containers based on Regulation (EU) 2021/535 – on the type-approval of vehicles, and of systems, components and separate technical units intended for such vehicles, as regards their general construction characteristics and safety.

IX. Future of the IWG-EV

21. When the proposals for BEV, HFCV and H2-ICE vehicles for AT and FL are adopted for ADR 2025 the main work of the IWG-EV is accomplished. For the work on EX vehicles a collaboration may be sought between the Working Group on Explosives under the banner of the Sub-Committee of Experts on the Transport of Dangerous Goods. The work on electrified trailers depends on progress made in WP.29.

22. It is proposed that the IWG-EV will remain active until the adoption of the proposals for AT and FL vehicles is realized and then kept dormant for a year to deal with unforeseen problems as seen necessary. However, it is foreseen that vehicles will develop significantly over the next decade possibly requiring further updates to the regulations. Industry organized in OICA and CLCCR are therefore invited to keep WP.15 informed about new developments and the need for up-dates to be considered.
