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Working Party on the Transport of Dangerous Goods

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**Proposals for amendments to annexes A and B of ADR:
construction and approval of vehicles**

Report of the Informal Working Group on Electrified Vehicles (EV)

Transmitted by the Chair of the Informal Working Group

Introduction

1. The informal group met 3 times between the May 2021 and November 2021 sessions of the WP.15. In this period all meetings were virtual. 71 experts were registered on 13 October 2021 to participate in these virtual meetings representing a relevant mix of stakeholders.

2. The aim of the working group is to collect questions and concerns on the use of EV and to find answers. These questions and answers should identify if and where additional requirements to those already applied to protect the road users are necessary for the protection of dangerous goods (DG) carried.

General

3. EV are Battery Electric Vehicles (BEV), Hydrogen Fuel Cell Vehicles (HFCV) and Hybrid Electric Vehicles (HEV). HEVs are vehicles with more than one drive system such as a combustion engine and an electric motor. For HEV there are many subgroups and acronyms in use. However, to keep it simple, for most HEV the existing requirements for combustion engines need to be applied in addition to any new ones introduced for electric vehicles.

4. Heavy Duty EV are still under development at this moment. Development of a new Heavy Duty vehicle takes several years to complete. Although development started already the designs are not yet finalized fully. This unfinalized designs, and lack of practical experience, make it difficult to estimate the risks for the load presented by these vehicles. On the other hand, the vehicle industry would like to know how to equip these vehicles to include this in the design to have them approved for the carriage of DG.

5. To accommodate the different targets and to ease discussions the informal working group decided to work in smaller subgroups each reporting to the working group. The following subgroups have been envisaged:

- Vehicle manufacture group (Chapter 9.2);
- Vehicle users group (all relevant sections of ADR),
- Load protection group (Chapter 9.3 to 9.8 as appropriate)
- Hydrogen group (interaction with hydrogen and loaded substances);
- EX group (Chapters 9.2 and 9.3 and other relevant sections).

The vehicles manufacturers group, users group and hydrogen group are already active. The other groups will be activated in the near future.

Vehicle categories

6. It is felt to be useful to recall the existing categories of vehicles that carry dangerous goods, and their typical basic safety principles.

7. All vehicles carrying DG with exemption of limited or exempted quantities, or otherwise exempted, have to comply to Chapter 9.1, 9.2.1 and 9.4 to 9.6 as relevant. These are the minimal basis requirements for a safe use on the road to protect occupants and other road users.

8. AT vehicles as defined in Chapter 9.1 are used for carriage in fixed tanks, demountable tanks with a capacity exceeding 1 m³, tank-containers, portable tanks and MEGCs with an individual capacity of more than 3 m³ and battery vehicles with a capacity exceeding 1 m³.

AT vehicles have to comply with the additional requirements of Chapter 9.2 for general safety of the load. These are basic requirements for the electric system, braking system and coupling devices.

9. FL vehicles have to comply with all the requirements of AT vehicles and in addition with requirements to prevent fire and the ignition of a flammable atmosphere by heating, hot spots or sparks.

10. EX vehicles (EX/II, EX/III, MEMU) have to comply with all the requirements of AT vehicles and in addition with requirements to prevent the heating of the explosive substances and article carried. Explosives are very sensitive for heat and may become unstable from a temperature of 1200C. In this respect ADR prescribes in 9.3.5 even a maximum temperature of the inner surface of the load area of 800C to be remain on the safe side. For EX vehicles, with the exception of compatibility group J, no explosive atmosphere is expected to be present. Compatibility Group J contains both an explosive substance and flammable liquid or gel and applies to fuelled missiles and torpedoes . The purpose of the Battery Master Switch for the electrical system should be better justified . (Safety against development of fire by electrical failure while being parked?)

Note 1:

It was expressed that the rigour of the regulation for AT and FL vehicles should take into account a comparison between vehicles carrying large volumes of goods in packages such as IBCs for which only limited requirements apply and tank-vehicles.

Note 2:

It is experienced that contractors require FL approval to allow vehicles to enter their premises that are not as such intended for the carriage of DG. An explanation for requiring FL vehicles may be that it is believed that they will provide safety while operating in an explosive atmosphere. However, it should be kept in mind that FL vehicles are safe in explosive atmospheres only under certain conditions. These conditions are in general that the (combustion) engine is not running, the engine, exhaust and other hot items have cooled down sufficiently and that the electrical circuits are broken. A ATEX approved vehicle should also provide protection while operating in an explosive atmosphere. The price for such additional protection is significantly more than for an FL vehicle.

Discussions

11. It was agreed that the group should maintain a broad view on all aspects of electric drive and the use of hydrogen as a fuel. The group in addition committed to be careful to only address those issues that apply specifically to dangerous goods. For example, protection of drivers when charging batteries of filling fuel would be more appropriate for occupational safety in general than the DG regulation.

12. Although heavy duty vehicle of the lighter weight categories are expected soon on the market, it is expected that the more heavy weight category vehicles will appear within a few years. For the heavier weight categories the design is not yet finalized and there is limited practical experience to oversee all the issues. However as introduction is expected before ADR 2025 it is suggested to draft purpose based requirements that may be further detailed as required in a second phase based on experience gained. It is also reminded that existing

regulation for conventional trucks should remain for the near future to accommodate those already in use.

13. In the subgroups a start is made to break down the electric drive system and hydrogen system in components to identify the potential hazards presented by each item. For each of these items it will be checked if requirements are in place and sufficient by other regulations, such as those annexed to the '58 Agreement and managed by WP.29.

Several questions are forwarded by the user group to the vehicle manufacture group to better understand the functioning and effects of the various components. This work is ongoing and it is expected that this will be finished in time for the May 2022 session of WP.15.

14. It will be discussed in the "Hydrogen group" how to rate the effects of hydrogen leakage on the load. This would in particular apply to the carriage of oxygen and oxygen producing substances.

15. For EX vehicles estimation of risks needs to be made anew as even now the fuel allowed for combustion engines is limited to Diesel and the voltage is in principle limited to 25V A.C. and 60V D.C. It may be questioned if these limitations are still justified based on the development of technology. It was also recalled that many FL approved trucks and trailers are also approved as EX vehicle. This is possible because when complying to FL vehicle requirements automatically also the requirements for EX vehicle are fulfilled. This may change for the future as more strict requirements against heat protection may apply for EX vehicles than FL vehicles.

16. In the near future trailers may also be affected by electrification. At short term this may be the fitting of (traction) batteries for the drawing vehicle or equipment for recuperation of braking energy. Based on the definition of "trailer" electric drive of trailers is not possible although work in that sense (amendment of the RE.3) is currently ongoing at WP.29. To address this issue the load protection group should consider the requirements for such situations based on the information of the items by the other groups.

Principle questions for consideration for WP.15

17. Application of Chapter 9.2.4 to AT vehicles

At this moment requirements for engines, tanks and exhausts are not applicable to AT vehicles. It would be logic to place the allowance to EV also in Chapter 9.2.4. However, the question is if the requirements of UN Regulation No. 100 (BEV and HEV) and 134 (HFCV) annexed to the '58 Agreement should also be applicable to AT as a basic safety rule.

18. The application of the Battery Master Switch (BMS) for FL and EX EV.

One of the main questions is if the BMS should also apply to the high voltage drive system. This would mean that the high voltage circuits are no longer energized. This would also mean that equipment that remain operable, such as a Battery Management System and Battery Cooling System should be approved for explosive atmospheres. In the light of the different functions of the BMS for FL and EX vehicles it should be checked if the BMS should still be required for EX vehicles.

19. Combustion heaters (9.2.4.7).

Combustion heaters may be fuelled by hydrogen for HFCV. For this UN Regulation No. 122 needs to be amended. For BEVs it is expected that the heater will become high voltage electric. It is expected that UN Regulation No. 122 will be amended for high voltage. As the electric system is not like a combustion heater, i.e. does not draw air from the outside of the cabin nor expels exhaust gases to the outside the question is whether for this new situation a modification is needed either to modify the title of 9.2.4.7 or not regulate at all high voltage electric heaters.

Conclusion

20. The working group is in full swing in investigating the risks involved in the use of EV. It was felt that recent developments in the Blevé WG should be taken in account for consideration. In the Annex to this report you may find preliminary draft amendments for the

ADR Chapter 9.2. WP.15 is kindly requested to agree with the work done by the Informal Working Group and the continuation of its work.

Annex 1

Draft amendment of Chapter 9.2 for inclusion of EV (Based on ADR 2021)

9.2.2.1 General provisions

The installation shall be so designed, constructed and protected that it cannot provoke any unintended ignition or short circuit under normal conditions of use.

The electrical installation as a whole, with the exception of the high voltage drive system complying with the technical provisions of UN Regulation No. 100 and UN Regulation No. 134, shall meet the provisions of 9.2.2.2 to 9.2.2.9 in accordance with the table of 9.2.1.

9.2.2.2.1 Cables

Amend the third paragraph to read (deleted wording stricken through and new wording underlined):

The cables shall be in conformity with standard ISO 6722-1:2011+Cor 01/2012 ~~or~~, ISO 6722-2:2013 [or ISO 19642:2019 part 1 to 13 as appropriate].

9.2.2.2.2 Additional protection

Amend the third paragraph to read (new wording underlined):

The additional protection is complied with if multicore cable in conformity with ISO 14572:2011 [or ISO 19642:2019 part x] is used or one of the examples in figures ... (rest unchanged).

9.2.2.7 (EX only)

[amendment needed for the application of high voltage heaters and other equipment on trucks.]

9.2.4.3

Introduce a new section (d) and amend the heading and first sentence to read:

9.2.4.3 Fuel tanks ~~and~~, cylinders and batteries.

The fuel tanks and cylinders supplying the engine [or fuel cell] or batteries intended to drive the [traction] motor of the vehicle shall meet the following requirements:

(d) Batteries for the electric drive system shall meet the requirements of UN Regulation No. 100⁸ or UN Regulation No. 134⁹. Measures shall be taken to prevent any danger to the load by heating or ignition and provide protection against any outflow or leakage, even accidental, of the load.

9.2.4.4

Amend the heading of 9.2.4.4 to read:

9.2.4.4 [Internal combustion] Engine and electric motor(s)

Introduce a new penultimate sentence to read:

Electric motor(s) propelling the engine and the high voltage system shall meet the requirements of UN Regulation No. 100⁸ or UN Regulation No. 134⁹. Measures shall be taken to prevent any danger to the load by heating or ignition and provide protection against any outflow or leakage, even accidental, of the load.

Add a new paragraph at the end of 9.2.4.4 to read:

[The high voltage drive system shall comply with 9.2.2.8]

Amend the last sentence to read:

~~In case of EX/II and EX/III vehicles the engine~~ shall be propelled by an engine of the compression-ignition construction using only liquid fuel with a flashpoint above 55 °C_i - gases shall not be used.

[pending outcome discussions of the core group on EX vehicles]

Consequential amendment:

Renumber the existing foot notes as 8 and 9 as 10 and 11 respectively.

9.2.4.7 Combustion heaters

[pending outcome discussion of WP.15 as 9.2.4.7 is limited to combustion heaters, even at this moment these requirements, correct or not, do not apply to electric heaters.]

Amend 9.2.7 to read:

Fuel systems using refrigerated liquefied gases ~~engines fuelled by LNG~~ shall be so equipped and situated to avoid any danger to the load due to the gas being refrigerated.

(Justification : The above amendment makes this requirement applicable to LNG as well as refrigerated liquefied hydrogen.)
