

## Economic Commission for Europe

### Inland Transport Committee

#### Working Party on the Transport of Dangerous Goods

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Any Other Business

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### The carriage of machinery containing hydrogen

#### Note by the Government of the Netherlands

#### Introduction

1. Recently many questions are received on the carriage of hydrogen in machinery. As the use of hydrogen is developing there are many initiatives and developments that may be temporarily until a definitive supply system is in place.
2. This document aims to give information on the application of ADR to these machineries but also to discuss if the safety requirements are just and sufficient.
3. Certainly, in the European Union (EU), and probably outside the EU as well, we can find different regulation that may apply to these equipments such as the machine directive and the pressure equipment directive for use on site, the General Safety Regulation for road vehicles and ADR.

#### Examples

4. Below two examples are given that at first sight are identical in approach but are differently treated in ADR.

##### Case A:

This concerns a trailer of the category O2 (750kg - 3500kg). In this trailer 3 hydrogen storage vessels are permanently fitted, each of 300 Litres and at 350 bar working pressure. Connected to these storage vessels is a fuel cell to produce electricity on site. In this case a building site to recharge electric building equipment overnight. Each vessel is equipped with a closing device that is closed during transport. To function, a fuel cell requires additional equipment such as pressure reduction valve(s) and heating and cooling system and a battery.

5. For this equipment UN 3529 would apply: "... OR MACHINERY, FUEL CELL, FLAMMABLE GAS POWERED". For UN 3529, SP363, SP667 and SP669 apply.

SP363 exempts equipment if the conditions under this special provision are met. This equipment meets the requirements of "d" I SP363, although also "f" applies to the battery (2.2.9.1.7).

SP667 applies to small production series lithium cells or pre-production cells or batteries and damaged cells or batteries. This seems not by definition to apply to this equipment.

SP669 applies to trailers with electric production and storage systems but for use during transport (in that case they shall be assigned to UN 3166 or UN 3171). This does not apply as the use is only on site.

6. Provision 2.2.9.1.7 concerning the batteries refer to the Manual of Tests and Criteria in Part III of subsection 38.3. As the batteries have been carried before being placed in the equipment it is assumed that they comply.

7. In addition, for the member states of the European Union the hydrogen vessels and equipment as valves and safety devices are not exempt from TPED based on article 2 (b) of TPED, i.e. construction and approval following chapter 6.2.

Besides the requirements from TPED in the member states of the European Union this equipment is completely exempt from ADR. Even labelling (label 2.1 in this case) may be disputes as 5.2.1.1 states that labelling shall be affixed “*unless otherwise provided for by a special provision in column (6)*” where SP 363 in column (6) stating “no other requirements of ADR apply”.

### **Case B:**

8. This concerns a trailer of the category O2 (750kg - 3500kg). In this trailer 2 hydrogen storage vessels are placed each of 350 Litres, one at 350 bar working pressure and one at 700 bar working pressure. Connected to these storage vessels is an electrolyser that can produce hydrogen locally by plugging in the mains electricity system.

9. The purpose of this machinery is to produce hydrogen on site and storing and compressing this for the particular purpose of the equipment or vehicles services at 350 bar or 700 bar. Besides the electrolyser and extension cord it will contain a compressor and probably a cooling system, both running on the mains system. When the machinery will be carried to another location it is assumed that the containers only contain limited amounts of hydrogen. Each containment will be fitted with a valve that is closed during carriage.

10. For this equipment UN 3537 would apply: “ARTICLES CONTAINING FLAMMABLE GAS”. UN 3529 do not apply because it is not machinery powered by an internal combustion engine on flammable gas, not a fuel cell, but a machine to produce a flammable gas (hydrogen). For UN 3537, SP274 applies, packaging instruction P006 and transport category 4 in column (15).

SP274 refers to 3.1.2.8 concerning the technical name of the substance or item on the transport document.

P006 refers to UN 3537 to 3548 and requires in particular in (3) (d) that receptacles comply with section 4.1.6 and Chapter 6.2. Part (4) states containments shall be fixed properly and “*prevent movement*”.

Transport category 4 refers to the table of 1.1.3.6.3 where the maximum total quantity per transport unit is “unlimited”. This gives exemption of the requirements mentioned in 1.1.3.6.2.

11. In Case B, basic training for the participants is required, a transport document, a fire extinguisher of 2 kg, labels, flash light etc.

### **Remarks**

12. It may be suggested that during carriage that the rest of the system of the machinery is disconnected from the hydrogen storage vessels and shall be in compliance with ADR. From a general safety point of view this should NOT be promoted in particular for hydrogen.

13. It is strange that for machinery working on hydrogen no requirements are applicable. At least a basic training of the personal involved (driver) in handling and safety procedures should be required and the ability to recognize the hazard of such machinery by emergency services.

14. It may be questioned what the maximum total capacity of the hydrogen storage vessels should be limited. In the examples the total capacity is limited approximately 1.000 litres at 350 bar. What if this would become 10.000 litres at 700 bar? Or, what if it will become refrigerated liquefied hydrogen with a capacity of 1.000 litres?

15. It is essential for safety that the valves of the hydrogen storage vessels are closed during carriage.