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### World Forum for Harmonization of Vehicle Regulations

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**Progress on the development of new global technical regulations and of amendments to established global technical regulations – Draft gtr on Hydrogen and fuel cell vehicles (HFCV)**

### **Report summarizing the findings and recommendations in the different areas addressed by the informal group on Hydrogen Fuel Cell Vehicles – Subgroup Environment (HFCV-SGE) in support of the harmonization process**

#### **Submitted by the Working Party on Pollution and Energy\***

The following text is an executive summary of the Technical Report prepared by the informal working group on Hydrogen Fuel Cell Vehicles – Subgroup Environment (HFCV-SGE). It summarizes the outcome of discussions and recommendations available in the different regions in support of the harmonization process. The full Technical Report is available as document ECE/TRANS/WP.29/GRPE/2011/13, adopted at the sixty-second session of the Working Party on Pollution and Energy (GRPE) in June 2011 (ECE/TRANS/WP.29/GRPE/62, para. 39). The Working Party on Noise (GRB) considered the Technical Report at its February 2011 session and noted no reservations with respect to noise issues (ECE/TRANS/WP.29/GRB/51, para. 32).

This document is based on Informal document WP.29-154-14 distributed during the 154<sup>th</sup> session of the World Forum for Harmonization of Vehicle Regulations (WP.29) (ECE/TRANS/WP.29/1091, para. 102). It is submitted to WP.29 and to the Executive Committee (AC.3) of the 1998 Agreement for consideration.

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\* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

## I. Introduction

1. The informal working group on Hydrogen Fuel Cell Vehicles (HFCV) has been operative for several years. In June 2005, the World Forum for Harmonization of Vehicle Regulations (WP.29) and the Executive Committee (AC.3) of the 1998 Agreement agreed on a proposal submitted by Germany, Japan and the United States of America (USA) on how to manage the development process of a global technical regulation (gtr) on hydrogen powered vehicles. However, because of different circumstances, it was not until April 2007 that the group received a clear mandate and a roadmap to achieve its goal of establishing a gtr for this class of vehicles (ECE/TRANS/WP.29/AC.3/17).

2. The final goals of the Subgroup Environment (SGE) are to investigate the possibility of harmonizing environmentally related requirements and to propose actions in those cases where harmonization may not be possible.

3. The areas of competence of the SGE are aspects other than the ones addressed by the Subgroup Safety (SGS), including energy and environmental considerations. The following table summarizes the environmental and other energetic aspects that are pertinent to the vehicles with different propulsion systems that Regulations could address.

### Areas that Regulations could address for vehicles with different propulsion systems

	<i>Fuel Cell (FC)</i>	<i>Hybrid</i>		<i>Internal Combustion Engines (ICE)</i>
	<i>H<sub>2</sub></i>	<i>FC</i>	<i>ICE-H<sub>2</sub></i>	<i>Mono-fuel (H<sub>2</sub>)</i> <i>Bi-fuel</i> <i>Blends</i> <i>Dual fuel</i>
	<i>Environmental &amp; Energetic aspects</i>			
<b>Fuel consumption</b>	X	X	X	X
<b>CO<sub>2</sub> emission</b>				Bi-fuel, blends and dual fuel
<b>External electrical consumption</b>		X	X	
<b>Pollutant emissions</b>			X (NO <sub>x</sub> )	X
<b>H<sub>2</sub> and H<sub>2</sub>O emissions</b>	X	X	X	X
<b>Engine power (measurement procedures)</b>	X	X	X	X
<b>Maximum speed (measurement procedures)</b>	X	X	X	X
<b>Fuel quality (reference)</b>	X	X	X	X
<b>Recycling</b>	X	X	X	X
<b>Disposal (hazardous materials)</b>	X	X	X	X
<b>Noise</b>	X	X	X	X

4. Only Fuel Cell (FC) and Internal Combustion Engines (ICE) engines running both with compressed gaseous hydrogen (CGH<sub>2</sub>) and liquid hydrogen (LH<sub>2</sub>) are addressed. Auxiliary Power Units (APU) are not covered nor included in AC.3's action plan.

5. It is also apparent that electromagnetic compatibility is more a safety related subject discussed in the Working Party on Lighting and Light-Signalling (GRE) for conventional vehicles as well as for electro-hybrid, pure electric and FC vehicles.

6. H<sub>2</sub>/FC vehicles emit hydrogen (exhaust, purge, leakage). Hydrogen is mainly a safety concern and covered by SGS. Therefore, hydrogen emissions are not included in the Technical Report.

7. Water emissions might be a safety problem in the future (water freezing in winter). It is mainly a safety concern and a minor environmental issue. Some scientists consider water emissions from vehicles as a contribution to climate change. The water emissions from H<sub>2</sub>-ICE and FC vehicles are much higher than in the case of conventional vehicles. The foreseeable number of HFCV in the short term is low and, therefore, a Regulation is not needed now. Therefore, the technical report does not contain a chapter on water emissions.

8. The Technical Report (ECE/TRANS/WP.29/GRPE/2011/13) summarizes the SGE findings on the different areas addressed by the group and discusses whether it is adequate or not to support a harmonization process on the environmental and energetic aspects of HFCV.

## **II. Harmonization assessment in the area of environmental and energetic aspects**

### **A. Fuel consumption**

9. Regulations should be established consistently with common agreement on the issues involved. The basis for Regulations could be standards (national or regional) existing or under development. The related content should be, therefore, harmonized on an international basis.

### **B. Fuel quality**

10. Once the technology to produce and assure the quality of hydrogen fuel containing minute amounts of impurities as specified in the fuel standards is established and such reference fuel is made available, it will be possible to evaluate the effect of impurities on individual vehicles and thus help developing FC vehicles.

### **C. Pollutant emissions of hydrogen (H<sub>2</sub>) fuelled vehicles**

11. Worldwide harmonization is possible in case of Heavy Duty Vehicles (HDV) and 2-wheeled motorcycles, because gtrs for the measurement of pollutant emissions already exist. This is not the case for Light Duty Vehicles (LDV), and the development of a worldwide harmonized test cycle and measurement procedure especial for LDV using H<sub>2</sub> in ICE is not efficient and feasible.

12. When motorcycles or HDV with ICE using H<sub>2</sub> would be ready for marketing, an amendment to gtr No. 2 on the Worldwide harmonized Motorcycle emission Test Cycle (WMTC) or gtr No. 4 on the Worldwide harmonized Heavy Duty Certification procedure (WHDC) could easily be developed. Such amendments of the existing gtrs only need the definition of the reference fuel, the calculation method for NO<sub>x</sub> (H<sub>2</sub> fuel) and the definition

of the H<sub>2</sub>-bi-fuel approach. This can be considered as a midterm activity for both vehicle categories.

13. For LDV, the following should be considered: introducing a reference fuel (gas), a calculation method for the NO<sub>x</sub> emissions and the definition of the H<sub>2</sub>-bi-fuel approach with the gtr on Worldwide harmonized Light vehicle Test Procedures (WLTP). In the meantime, the existing national legislation or Regulation No. 83 can be amended.

14. As a conclusion, it is not proposed to develop a dedicated gtr for the measurement and limitation of pollutant emissions of H<sub>2</sub> vehicles.

#### **D. Carbon dioxide (CO<sub>2</sub>) emissions of hydrogen (H<sub>2</sub>) fuelled vehicles**

15. Worldwide harmonization is possible in the case of 2-wheeled motorcycles, because gtrs for measuring CO<sub>2</sub> emissions already exist. This is not the case for LDV, and the development of a worldwide harmonized test cycle and measurement procedure especially for LDV using H<sub>2</sub> in ICE as H<sub>2</sub>-bi-fuel is not efficient and feasible.

16. When motorcycles with ICE using H<sub>2</sub> (H<sub>2</sub>-bi-fuel) would be ready for marketing, an amendment of gtr No. 2 (WMTC) can easily be developed. Such an amendment would only need an extension of the scope to H<sub>2</sub>-bi-fuel vehicles and the decision on measuring the vehicle CO<sub>2</sub> emission in the petrol mode only. In this case there is no need to adapt the existing measurement and calculation methods. The amendment of gtr No. 2 can be considered as a midterm activity.

17. For LDV it should be considered to introduce this H<sub>2</sub>-bi-fuel approach (see above) with the WLTP gtr. In the meantime, existing national legislation or Regulation No. 101 can be amended.

18. As a conclusion, it is not proposed to develop a dedicated gtr for the measurement of CO<sub>2</sub> emissions of H<sub>2</sub> vehicles.

#### **E. Noise emissions**

19. Regulation Nos. 41 (motorcycles) and 51 (passenger cars, trucks, buses) cover test procedures and performance requirements limiting the noise emissions of these vehicles. Rolling sound emissions of tyres are regulated by Regulation No. 117.

20. These existing Regulations are already applicable for H<sub>2</sub> powered vehicles.

21. Activities for the development of gtrs in the field of noise emissions are possible in future, but currently not mandated by AC.3.

22. As a conclusion, it is not proposed to develop a special gtr for the measurement and limitation of noise emissions of H<sub>2</sub> vehicles.

#### **F. Reusability, recyclability and recoverability**

23. Regulations addressing the issue of reusability, recyclability and recoverability of hydrogen vehicle components (especially FC components) need to be considered. However, it is not proposed to develop a dedicated gtr addressing H<sub>2</sub> vehicle's reusability, recyclability and recoverability.

### III. Summary and conclusions

24. There are three areas in the field of Regulations for HFCV where international harmonization is recommended:

- (a) Test methods for measuring fuel consumption;
- (b) Test and calculation method for measuring pollutant and CO<sub>2</sub> emissions;
- (c) Definition of a reference fuel for test purposes.

25. In the first case — fuel consumption — the recommendation is to use standards that exist or are under development and harmonize them on an international basis. The open question here is the development of a harmonized test cycle (currently underway at the United Nations). In the meantime, harmonization will be part of the method for measuring the fuel consumption, thereby allowing each region to apply its own test cycle until the world harmonized test cycle has been approved.

26. On the other hand, it is perceived as helpful to define a reference fuel (fuel standard) as this will allow evaluating the effect of impurities on individual vehicles and supporting the development of HFCV.

27. It is, however, recommended to waive the development of a stand-alone gtr for environmental related provisions for HFCV. It is preferable to amend case by case existing Regulations or gtrs to accommodate this class of vehicles or to consider HFCV directly during the developing process of new Regulations.

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