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**PROPOSAL FOR DRAFT AMENDMENTS TO
THE 05 SERIES OF AMENDMENTS TO REGULATION No. 83**

TO INTRODUCE HYDROGEN (H_2) AS PROPULSION FUEL

INTRODUCTION

Within the framework of the European Integrated Hydrogen Project (EIHP) the proposed amendment to the Vehicle Regulation No 83 to introduce hydrogen as a propulsion fuel, as reproduced below, was prepared by OICA.

BACKGROUND AND JUSTIFICATION

1. Exhaust emissions

Hydrogen fuelled internal combustion engines are only emitting tailpipe N0x emissions in a significant range. Emissions of CO cannot be detected and emissions of hydrocarbons resulting from the oil residue remaining in the combustion chamber are measured in a range comparable to environment concentrations. Therefore only the exhaust gas emissions of N0x should be considered as a pollutant.

2. Definition of a new "Approval E"

Approval E is containing the limitation of NO_X emissions by the engine, crankcase emissions, durability of pollution control devices of vehicles fuelled with H_2 only. Bifuelled vehicles are outlined in Approval B which contains the limitation of exhaust emissions by the vehicle, evaporative emissions, crankcase emissions, durability of pollution control devices, cold start pollutant emissions and on-board diagnostics.

3. Certification Tests

	Test Type I	Test Type II	Test Type III	Test Type IV	Test Type VI	Test Type V	Roadworthiness	OBD Test	OBD system
fuelled by H_2 only	Test with H_2	- -	Test with H_2	- -	- -	Test with H_2	- -	no	yes
bifuelled tank capacity < 15l petrol	Test with H_2	- -	Test with H_2	- -	- -	Test with H_2	- -	yes	yes
bifuelled tank capacity > 15l petrol	Test w.H_2 / petrol	Test with petrol	Test with petrol	Test with petrol	Test with petrol	Test with petrol	Test with petrol	yes	yes

Type I = exhaust emissions after a cold start
Type II = CO emission test at idling speed

Type III = emissions of crankcase gases
Type IV = evaporative emissions
Type VI = exhaust emissions after a cold start at low ambient temperature
Type V = durability of pollution control devices

4. OBD Requirements

OBD test: in analogy to the regulation of vehicles fuelled with LPG / NG an OBD test should not be required for monofuelled H_2 vehicles
OBD system: all H_2 fuelled vehicles (monofuelled/bifuelled) should be equipped with an OBD system

5. Test Fuel

It is suggested to use the H_2 reference fuel as defined in ISO/FDIS 14687.

6. Measurement Technology

Water Condensation :
The measurement of N0x emissions can be done by using a common constant volume sampling facility (CVS) with slight modifications. Due to the high amount of water condensation the following points have to be modified:

- dilution air should be dried and heated to > 30°C
- the gas samples, collected in sampling bags, should be heated > 25°C
- the filter of the dilution air should be preheated if necessary
- the flow capacity of the positive displacement pump or a critical flow venturi, producing a constant volume flow, should be adjusted as to prevent any water condensation

Measurement of N0x:
In the calculation of the corrected concentrations of pollutants in the case of vehicles fuelled by H_2, as only Oxides of Nitrogen are measured, the concentration of N0x in the dilution air should be set to zero in order to avoid the highly complex estimation of the dilution factor. This method seems appropriate due to the fact that the N0x concentration in the dilution air will always be below 0.1 ppm in cause of the reactivity of N0x.

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List of contents, annexes,

Paragraph 1.2., amend to read (scope):

1.2. This regulation does not apply to vehicles equipped with positive ignition engines fuelled with LPG or H_2 used for driving motor vehicles having a maximum mass exceeding 3500 kg, to which regulation Nº 49 is applicable.

Paragraph 2.4., amend to read (definitions):

2.4. "Gaseous pollutants" means the exhaust gas emissions of carbon monoxide, oxides of nitrogen, expressed in nitrogen dioxide (NO_2) equivalent and hydrocarbons assuming ratio of:
- $C_1H_{1,85}$ for petrol
- $C_1H_{1,86}$ for diesel
- $C_1H_{2,525}$ for LPG
- C_1H_4 for NG

In case of vehicles fuelled by H_2, only oxides of nitrogen, expressed in nitrogen dioxide (NO_2) equivalent will be considered as a pollutant.

Paragraph 2.18., amend to read:

2.18. "Fuel requirement by the engine" means the type of fuel normally used by the engine:
- petrol,
- LPG (liquified petroleum gas),
- NG (natutal gas),
- H_2 (hydrogen)
- either petrol or LPG
- either petrol or NG
- either petrol or H_2
- diesel fuel.

Paragraph 2.19.1., amend to read:

2.19.1. Limitation of exhaust emissions by the vehicle, evaporative emissions, crankcase emissions, durability of pollution control devices, cold start pollutant emissions and on-board diagnostics of vehicles fuelled with unleaded petrol, or which can be fuelled with either unleaded petrol and LPG or NG or H_2. (**Approval B**)

Insert a new paragraph 2.19.4., to read:

2.19.4. Limitation of NO_X emissions by the engine, crankcase emissions, durability of pollution control devices of vehicles fuelled with H_2 (**Approval E**).

Insert a new paragraph 5.2.4., to read (specifications and tests):

5.2.4. Positive ignition engine powered vehicles fuelled with H_2 only shall be subjected to the following tests:
- Type I (verifying the average exhaust emissions after a cold start),
- Type III (emission of crankcase gases),
- Type V (durability of antipollution control devices),

Paragraph 5.3.1.2.1.1., amend to read (Type I test):

5.3.1.2.1.1. Vehicles that are fuelled with LPG or NG shall be tested in the Type I test for variation in the composition of LPG or NG, as set out in annex 12. Vehicles that can be fuelled either with petrol or LPG or NG or H_2 shall be tested on both the fuels, tests on LPG or NG being performed for variation in the composition of LPG or NG, as set out in annex 12.

Paragraph 5.3.1.2.1.2., amend to read:

5.3.1.2.1.2. Notwithstanding the requirement of paragraph 5.3.1.2.1.1 vehicles that can be fuelled with either petrol or with LPG or NG or H_2, but where the petrol system is fitted for emergency purposes or starting only and which the petrol tank cannot contain more than 15 litres of petrol will be regarded for the test Type I as vehicles that can only run on LPG or NG or H_2.

Paragraph 5.3.1.2.4., amend to read:

5.3.1.2.4. During the test, the exhaust gases are diluted and a proportional sample collected in one ore more bags. The exhaust gases of the vehicle tested are diluted, sampled and analysed, following the procedure below, and the total volume of the diluted exhaust is measured. Not only the carbon monoxide, hydrocarbon and nitrogen oxide emissions, but also the particulate pollutant emissions from vehicles equipped with compression-ignition engines are recorded. In case of vehicles fuelled by H_2 only the nitrogen oxide emissions are sampled and analysed.

Paragraph 5.3.2.1., amend to read (Type II test):

5.3.2.1. This test is carried out on all vehicles powered by positive ignition engines except those vehicles having a maximum mass exceeding 3.5 tonnes. Vehicles that are fuelled with H_2 only are exempted from this test.

Paragraph 5.3.2.1.1., amend to read:

5.3.2.1.1. Vehicles that can be fuelled either with petrol or with LPG or NG or H_2 shall be tested in the test Type II in the case of LPG or NG with both fuels and in the case of H_2 with petrol only.

Paragraph 5.3.2.1.2., amend to read:

5.3.2.1.2. Notwithstanding the requirement of paragraph 5.3.2.1.1. vehicles that can be fuelled with either petrol or with LPG or NG or H_2, but where the petrol system is fitted for emergency purposes or starting only and which the petrol tank cannot contain more than 15 litres of petrol will be regarded for the test Type II as vehicles that can only run on LPG or NG or H_2.

Paragraph 5.3.3.1.1., amend to read (Type III test):

5.3.3.1.1. Vehicles that can be fuelled either with petrol or with LPG or NG or H_2 should be tested in the Type III test on petrol only.

Paragraph 5.3.3.1.2., amend to read:

5.3.3.1.2. Notwithstanding the requirement of paragraph 5.3.3.1.1. vehicles that can be fuelled with either petrol or with LPG or NG or H_2, but where the petrol system is fitted for emergency purposes or starting only and which the petrol tank cannot contain more than 15 litres of petrol will be regarded for the test Type III as vehicles that can only run on LPG or NG or H_2.

Paragraph 5.3.4.1., amend to read (Type IV test):

5.3.4.1. This test shall be carried out on all vehicles referred to in paragraph 1. except those vehicles having a compression-ignition engine, and the vehicles fuelled with LPG or NG or H_2 and those vehicles with a maximum mass greater than 3,500 kg.

Paragraph 5.3.4.1.1., amend to read:

5.3.4.1.1. Vehicles that can be fuelled either with petrol or with LPG or NG should be tested in the test Type IV on petrol only.

Insert a new paragraph 5.3.4.1.2., to read:

5.3.4.1.2. Notwithstanding the requirement of paragraph 5.3.4.1.1. vehicles that can be fuelled with either petrol or with H_2, but where the petrol system is fitted for emergency purposes or starting only and which the petrol tank cannot contain more than 15 litres of petrol will be regarded for the test Type IV as vehicles that can only run on H_2.

Insert a new paragraph 5.3.5.1.5., to read (Type VI test):

5.3.5.1.5. Vehicles that can be fuelled either with petrol or H_2 should be tested in the Type VI test on petrol only. Vehicles that are fuelled by H_2 only or that can be fuelled either with petrol or with H_2 but where the petrol system is fitted for emergency purposes or starting only and which the petrol tank cannot contain more than 15 litres of petrol are exempted from this test.

Paragraph 5.3.6.1.1., amend to read (Type V test):

5.3.6.1.1. Vehicles that can be fuelled either with petrol or with LPG or NG or H_2 should be tested in the type V test on petrol only. In that case the deterioration factor found with unleaded petrol will also be taken for LPG or NG or H_2. Vehicles that are fuelled by H_2 only or that can be fuelled either with petrol or with H_2 but where the petrol system is fitted for emergency purposes or starting only and which the petrol tank cannot contain more than 15 litres of petrol should be tested in the type V test on H_2 only.

Paragraph 5.3.7.1., amend to read (roadworthiness testing):

5.3.7.1. This requirement applies to all vehicles powered by a positive-ignition engine for which type approval is sought in accordance with this amendment. Vehicles that are fuelled by H_2 only or that can be fuelled either with petrol or with H_2 but where the petrol system is fitted for emergency purposes or starting only and which the petrol tank cannot contain more than 15 litres of petrol are exempted from this test.

Annex 1

Item 4.2.2., amend to read:

4.2.2. Fuel: Diesel / Petrol / LPG / NG / H_2

Insert a new item 4.2.14., to read :

4.2.14. H_2 fuelling system: yes/no [1/]

Insert a new item 4.2.14.1., to read :

4.2.14.1. Approval number:

Insert a new item 4.2.14.2., to read:

4.2.14.2. Electronic engine management control unit for H_2 fuelling

Insert a new item 4.2.14.2.1., to read :

4.2.14.2.1. Make (s):

Insert a new item 4.2.14.2.2., to read:

4.2.14.2.2. Type (s):

Insert a new item 4.2.14.3., to read:

4.2.14.3. Further documentation:

Insert a new item 4.2.14.3.1., to read:

4.2.14.3.1. Description of the safeguarding of the catalyst at switch over from petrol to H_2 or back:

Insert a new item 4.2.14.3.2., to read:

4.2.14.3.2. System layout (electrical connections, vacuum connections, compensation hoses, etc.):

Annex 2

Item 16.1.1., amend to read:

16.1.1. In the case of vehicles fuelled with LPG or NG or H_2:

Item 16.1.1.1., amend to read:

16.1.1.1. Repeat the table for all reference gases of LPG or NG, showing if results are measured or calculated. In the case of vehicles designed to run either on petrol or on LPG or NG or H_2 repeat if required by 5.3.1 (Scope) for petrol and for all reference gases of LPG or NG and the reference gas of H_2.

Annex 4

Insert a new item 3.2.2. to read:

3.2.2. In the case of H_2 the reference fuel according to ISO/FDIS 14687 has to be used.

Item 6.2.3., amend to read:

6.2.3. In the case of vehicles that can be fuelled either with petrol or with LPG or NG or H_2 it is permissible to start with one fuel and switch to another after a predetermined period of time which cannot be changed by the driver.

Annex 4, Appendix 5

Insert a new item 2.3.4.2.4., to read:

2.3.4.2.4. In the case of vehicles fuelled by H_2 the dilution air can be heated > 30° C and can be dried in order to prevent water condensation

Item 2.3.4.4., amend to read:

2.3.4.4. The gas samples shall be collected in sampling bags of adequate capacity so as not to reduce the sampling rate. The bags shall be made of material such as will not change the concentration of synthetic pollutant gases by more than $\pm$ 2 per cent after 20 minutes. In the case of vehicles fuelled by H2 the gas samples can be heated > 25° C in order to prevent water condensation.

Item 3.1.3.1., amend to read:

3.1.3.1. A filter (D) for the dilution air, which can be preheated and dried if necessary. This filter shall consist of activated charcoal sandwiched between two layers of paper, and shall be used to reduce and stabilise the hydrocarbon concentrations of ambient emissions in the dilution air;

Insert a new item 3.1.3.5.3., to read:

3.1.3.5.3 sufficient to prevent any water condensation in case of a vehicle fuelled by H_2.

Item 3.2.3.1., amend to read:

3.2.3.1. A filter (D) for the dilution air, which can be preheated and dried if necessary : the filter shall consist of activated charcoal sandwiched between two layers of paper, and shall be used to reduce and stabilise the hydrocarbon background emission of the dilution air;

Insert a new item 3.2.3.18.3., to read:

3.2.3.18.3. sufficient to prevent any water condensation in case of a vehicle fuelled by H_2.

Annex 4, Appendix 8

Insert a new item 1.3.1., to read:

1.3.1. In the case of vehicles fuelled by H_2, as only Oxides of Nitrogen are measured, Cd should be set to zero, so that Ci = Ce.

Annex 10

Add a new Annex 10b, to read:

Specifications of H_2 Reference Fuel: According to ISO / FDIS 14687

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