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COMMISSION OF THE EUROPEAN COMMUNITIES

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Proposal for a

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**

**on type-approval of hydrogen powered motor vehicles and amending Directive  
2007/46/EC**

(presented by the Commission)

{SEC(2007)1301}

{SEC(2007)1302}

## EXPLANATORY MEMORANDUM

### 1) CONTEXT OF THE PROPOSAL

#### **Grounds for and objectives of the proposal**

The objective of the proposal is to lay down harmonised rules on the construction of motor vehicles with a view to ensuring the functioning of the internal market while at the same time providing for a high level of public safety and a high level of environmental protection.

The proper functioning of the single market in the European Union requires common standards regarding the approval of hydrogen powered vehicles. Action at Community level prevents varying product standards emerging across Member States which results in fragmentation of the internal market and imposition of unnecessary barriers to intra-Community trade.

At the same time, since there are perceived safety issues with using hydrogen for vehicle propulsion, it should be ensured that hydrogen systems are as safe as conventional propulsion technologies.

#### **General context**

Hydrogen is not a source of energy but a promising energy carrier.

The use of hydrogen as fuel for road vehicles offers an environmentally friendly solution for mobility. This is because with the use of hydrogen as fuel, whether in fuel cells or internal combustion engines, there are no carbon emissions and greenhouse gases produced from the vehicle. If the fuel is produced in a sustainable manner, the use of this propulsion technology could significantly contribute to the improvement of the environment.

However, at present hydrogen powered vehicles are not included in the European Community vehicle type-approval framework. This situation results in a fragmented internal market of these vehicles, which discourages the introduction of this environmentally friendly technology.

Furthermore, hydrogen is a substance that has different characteristics from conventional fuels that are used for vehicle propulsion. In order to realise the environmental benefits associated with the use of hydrogen vehicles, the share of these in the total vehicle fleet should be increased. One of the major factors contributing to the increasing number of hydrogen vehicles on the roads is the existence of public confidence in this new technology.

#### **Existing provisions in the area of the proposal**

There are no existing provisions in the area of the proposal.

#### **Consistency with the other policies and objectives of the Union**

The proposal is fully in line with the aims of the European Union's Sustainable Development strategy and contributes significantly to the objectives of the Lisbon strategy.

### 2) CONSULTATION OF INTERESTED PARTIES AND IMPACT ASSESSMENT

#### **Consultation of interested parties**

*Consultation methods, main sectors targeted and general profile of respondents*

In developing the proposal the Commission has consulted stakeholders in a number of ways:

- There was consultation with the Hydrogen Working Group. This is a specialist expert stakeholder working group responsible for supporting the Commission on issues related to the type-approval of hydrogen vehicles. A broad range of interested parties is involved in the work of this group: national authorities, vehicle manufacturers, component suppliers and industry associations.
- A questionnaire was sent to stakeholders in June 2006 on possible policy options regarding the approval framework for hydrogen vehicles. The questionnaire aimed at gathering views of stakeholders as to the preferred option and the associated costs of approval under each of these options.
- A consultant was engaged to provide input for the impact assessment and to give technical advice on the draft proposal for a potential regulation.
- To understand more fully the implications of the policy options, the consultant organised meetings with key automotive companies involved in hydrogen technology to generate additional data on safety, technology and the related costs.
- There were presentations to key stakeholders of the Hydrogen Working Group during the second half of 2006 and early 2007 on the results of the work carried out by the consultant.
- The preliminary draft proposal for a Regulation on the type-approval of hydrogen vehicles was put to public consultation in July 2006. The consultation generated around 20 responses from a range of different stakeholders.

#### *Summary of responses and how they have been taken into account*

During the internet consultation, a number of issues were raised by stakeholders.<sup>1</sup> The impact assessment that accompanies this proposal provides a full account of the substantive issues raised and discusses how they have been taken into consideration.

#### **Collection and use of expertise**

##### *Scientific/expertise domains concerned*

The proposal required analysis of the necessary safety provisions and the assessment of the available policy options as well as the associated economic, societal and environmental impacts.

##### *Methodology used*

The following work was carried out by the consultant:

- review of relevant literature to identify safety and environmental issues surrounding the introduction of hydrogen vehicles;
- gathering and evaluation of information on the impacts of the various policy options on public safety, the environment and the economy;
- assessment of stakeholder responses to the questionnaire sent out by the Commission services in June 2006 on the available policy options;

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<sup>1</sup> <http://ec.europa.eu/enterprise/automotive/pagesbackground/hydrogen/consultation/contributions.htm>

- comparison of impacts of policy options regarding public safety, the environment and the economy in qualitative and quantitative terms;
- review of technical requirements of a draft proposal for a potential regulation as to its ability to address the identified safety issues.

#### *Main organisations/experts consulted*

Input for the impact assessment and technical advice on the draft proposal for a potential regulation was provided by TRL Ltd. in the UK.

#### *Summary of advice received and used*

The Commission used the consultant's report as an input to the analysis of the various policy options. The preferred policy option has been selected on the basis of a cost-benefit analysis, as explained in the impact assessment accompanying the proposal.

#### *Means used to make the expert advice publicly available*

The report of TRL is available on the DG Enterprise and Industry web site.<sup>2</sup>

### **Impact assessment**

Four policy options have been considered:

- (1) *No policy change:* This option would involve no further changes to the current situation. Currently, the scope of European Community type-approval legislation does not include hydrogen powered vehicles. Thus, Member States may grant individual approvals without introducing legislation.

With no change in the policy regarding the approval of hydrogen vehicles, there is a high risk that the functioning of the internal market would be impaired. This would result in substantial cost implications for manufacturers and would entail possible repercussions on public safety.

There is a high risk that with no policy change, poor air quality and high levels of noise in cities of the European Union will remain an issue as atmospheric pollution and noise will continue to have a detrimental impact on human health.

This policy option would lead to uneven treatment of vehicle manufacturers with regard to the vehicle approval procedure and would lack any predictability for manufacturers to design their vehicles. Further, it would constitute a substantial barrier for the development of hydrogen technology in the EU.

Therefore, this policy option is not considered to be viable.

- (2) *Legislation at Member State level:* This policy option would involve adoption of legislation at Member State level to accommodate the introduction of hydrogen vehicles.

With diverging standards emerging from Member States, the fragmented situation regarding the approval of vehicles would continue to exist, which would result in manufacturers facing unduly high development and approval costs and limited market accessibility. The policy option would not offer a solution for the present uncertainty regarding the approval of hydrogen vehicles, therefore would discourage further investment in the hydrogen technology.

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<sup>2</sup> [http://ec.europa.eu/enterprise/automotive/pagesbackground/hydrogen/hydrogen\\_final\\_report.pdf](http://ec.europa.eu/enterprise/automotive/pagesbackground/hydrogen/hydrogen_final_report.pdf)

In comparison with the '*Legislation at EU level*' option, this policy option would result in substantially lower environmental benefits and would not ensure that hydrogen vehicles are at least as safe as conventional vehicles.

Thus, the option would result in a fragmented internal market and would not ensure that the policy objectives are attained. Therefore, this is not the approach to be followed.

- (3) *Legislation at European Union level:* This policy option would involve the extension of the EC type-approval legislation to include hydrogen powered vehicles and setting out harmonised provisions for these vehicles.

Legislation at Community level prevents varying product standards emerging across Member States which results in fragmentation of the internal market and imposition of unnecessary barriers to intra-Community trade. Through harmonised standards on hydrogen powered vehicles it is possible to reap the economies of scale as production series can be made for the whole European market. This policy option would open up markets in some Member States where hydrogen vehicles could not currently be sold.

As shown in the impact assessment, this option will have the clear benefits of ensuring the proper functioning of the internal market, providing a high level of public safety throughout all EU Member States and improving noise and air quality levels sooner. This, in turn, will improve public health and, thus, will enable governments to generate savings.

Further, it would be ensured that the European Union keeps pace with other important automotive regions of the World with regard to the introduction of advanced technologies and the international competitiveness of the European industry might be improved.

Thus, this option is pursued in the proposal.

- (4) *Non-regulatory approach:* Self-regulation through a negotiated commitment with the automotive industry to establish requirements for hydrogen powered vehicles.

It is not clear that a self commitment provides an adequate guarantee that hydrogen vehicles will be as safe as conventional vehicles or that there will be appropriate sanctions available if the self-commitment were to be breached. In addition, this approach is not likely to ensure that hydrogen vehicles are treated equally in comparison to conventional vehicles in the type-approval procedure. Moreover, it is not apparent that the use of a voluntary approach would offer any additional benefits to the industry, governments or the general public.

The option of non-regulatory approach was therefore not considered further.

The Commission services carried out an impact assessment listed in the Work Programme under the reference number 2006/ENTR/044.

### **3) LEGAL ELEMENTS OF THE PROPOSAL**

#### **Summary of the proposed action**

The impact analysis has identified that the preferred policy option is the adoption of an EU Regulation with the purpose of incorporating hydrogen vehicles of categories M1, M2, M3 and N1, N2, N3 in the EU whole vehicle type approval framework.

The proposal foresees the amendment of the Framework Directive<sup>3</sup> in order to include hydrogen vehicles in the approval procedure. It specifies technical requirements to be applied for the type-approval of hydrogen components (hydrogen containers and hydrogen components other than containers) included in the hydrogen system in order to ensure that hydrogen related components are working in a proper and safe way. In addition, it includes requirements for the type-approval of vehicles with regard to the installation of hydrogen components or systems in vehicles. The proposal foresees the amendment of separate type-approval Directives and Regulations in order to include specific requirements for hydrogen powered vehicles.

### **Legal basis**

The legal basis of the proposal is Article 95 of the Treaty.

### **Subsidiarity principle**

The subsidiarity principle is respected, since the policy objectives cannot be sufficiently achieved by actions of the Member States and can be better achieved at Community level. European Union action is necessary because of the need to avoid the emergence of barriers to the single market.

Community action will better achieve the objectives of the proposal because it will avoid fragmentation of the internal market which would otherwise arise and will ensure the safety of hydrogen vehicles.

### **Proportionality principle**

The proposal complies with the proportionality principle because it does not go beyond what is necessary in order to achieve the objectives of ensuring the proper functioning of the internal market while at the same time providing for a high level of public safety and environmental protection.

### **Choice of instruments**

The proposed instrument is a Regulation. Other means would not be adequate for the following reason:

- The use of a Regulation is considered to be appropriate in providing the required assurance for compliance whilst not requiring the transposition into Member States legislation.

The proposal uses the "split-level approach" that has originally been introduced at the request of the European Parliament and used in other pieces of legislation, e.g. in the case of the Directive for heavy duty vehicle emissions<sup>4</sup> and the Regulation on the Euro 5 and 6 stage of light-duty vehicles emissions<sup>5</sup>. This approach foresees that the proposal and adoption of legislation will be made according to two different, but parallel, routes:

- first, the fundamental provisions will be laid down by the European Parliament and the Council in a Regulation based on Article 95 of the EC Treaty through the co-decision procedure (the 'co-decision proposal');
- secondly, the technical specifications implementing the fundamental provisions will be laid down in a Regulation adopted by the Commission with the assistance of a regulatory committee (the 'comitology proposal').

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<sup>3</sup> Directive 2007/46/EC

<sup>4</sup> Directive 2005/55/EC (OJ L 275, 20.10.2005, p.1), Directive 2005/78/EC (OJ L 313, 29.11.2005, p.1)

<sup>5</sup> Regulation (EC) No 715/2007 (OJ L 171, 29.06.2007, p.1)

#### **4) BUDGETARY IMPLICATION**

The proposal has no implications for the Community budget.

#### **5) ADDITIONAL INFORMATION**

##### **Simulation, pilot phase and transitory period**

There are general transitory periods in the proposal in order to allow sufficient lead times for vehicle manufacturers.

##### **Simplification**

The proposal provides for simplification of administrative procedures for public authorities (EU or national). The proposal is included in the Commission's Work and Legislative Programme under the reference 2006/ENTR/044.

##### **Repeal of existing legislation**

The adoption of the proposal will not lead to the repeal of existing legislation.

##### **Review/revision/sunset clause**

The proposal foresees that technical requirements of the Regulation will be adapted to technical progress in the future.

##### **European Economic Area**

The proposed act concerns an EEA matter and should therefore extend to the European Economic Area.

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**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**

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**(Text with EEA relevance)**

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 95 thereof,

Having regard to the proposal from the Commission<sup>6</sup>,

Having regard to the opinion of the European Economic and Social Committee<sup>7</sup>,

Acting in accordance with the procedure laid down in Article 251 of the Treaty<sup>8</sup>,

Whereas:

- (1) The internal market comprises an area without internal frontiers in which the free movement of goods, persons, services and capital must be ensured. To that end a comprehensive Community type-approval system for motor vehicles is in place. The technical requirements for the type-approval of motor vehicles with regard to hydrogen propulsion should be harmonised to avoid the adoption of requirements that differ from one Member State to another and to ensure the proper functioning of the internal market while, at the same time, providing for a high level of environmental protection and public safety.
- (2) This Regulation is a new separate Regulation in the context of the Community type-approval procedure under Directive [.../.../EC] of the European Parliament and of the Council of [DATE] establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (Framework Directive)<sup>9</sup>. Therefore, Annexes IV, VI and XI to that Directive should be amended accordingly.
- (3) Following the request of the European Parliament, a new regulatory approach has been introduced in EU vehicle legislation. This Regulation should therefore lay down only fundamental provisions on requirements for the type-approval of hydrogen systems and components, whereas the technical specifications should be laid down by implementing measures adopted following comitology procedures.

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<sup>6</sup> OJ C , , p. .

<sup>7</sup> OJ C , , p. .

<sup>8</sup> OJ C , , p. .

<sup>9</sup> [Proposal for the new 'Framework Directive' currently under adoption process. COM(2003)418 and COM(2004)738.]

- (4) In the transport sector, an increased share of more environmentally friendly vehicles should be aimed at and additional efforts should be undertaken in order to place more of those vehicles on the market. The introduction of vehicles with alternative fuels can produce a significant improvement in the urban air quality.
- (5) Hydrogen is considered as a clean way of powering vehicles as vehicles propelled with hydrogen produce neither carbon based pollutants nor emissions of green-house gases from the tailpipe. However, care should be taken that the hydrogen fuel is produced in a sustainable manner, so that the overall environmental balance of introducing hydrogen as fuel for motor vehicles is positive.
- (6) Defining the approval framework for vehicles using hydrogen would contribute to the confidence in the new technology for potential users and the public at large.
- (7) Therefore, it is necessary to create an adequate framework in order to accelerate the placing on the market of vehicles with innovative propulsion technologies and vehicles which use alternative fuels with a low environmental impact.
- (8) The majority of manufacturers are making important investments in the development of hydrogen technology and have already started to place such vehicles on the market. In future years, it is likely that the share of hydrogen powered vehicles will increase in the total fleet. Therefore, the specification of common requirements concerning the safety of those vehicles is necessary.
- (9) It is necessary to implement safety measures for the hydrogen system and its components to obtain type-approval.
- (10) It is necessary to take the installation of the hydrogen system and its components in the vehicle into account for the approval of the vehicle.
- (11) Due to the characteristics of the fuel, hydrogen powered vehicles may require a specific treatment from rescue services. It is, therefore, necessary to lay down vehicle labelling requirements to inform those services of the fuel stored on-board of the vehicle.
- (12) The manufactures should also take appropriate measures to prevent misfuelling of the vehicle.
- (13) The measures necessary for the implementation of this Regulation should be adopted in accordance with Council Decision 1999/468/EC of 28 June 1999 laying down the procedures for the exercise of implementing powers conferred on the Commission<sup>10</sup>.
- (14) In particular, power should be conferred on the Commission to introduce requirements and test procedures relating to new forms of hydrogen storage or usage, additional hydrogen components and the propulsion system. Power should also be conferred on the Commission to establish specific procedures, tests and requirements with regard to the impact protection of hydrogen vehicles and integrated system safety requirements. Since those measures are of general scope and are designed to amend non-essential elements of this Regulation and to supplement this Regulation by the addition of new non-essential elements, they must be adopted in accordance with the regulatory procedure with scrutiny provided for in Article 5a of Decision 1999/468/EC.
- (15) The objectives of this Regulation, namely the realisation of the internal market through the introduction of common technical requirements concerning motor vehicles

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<sup>10</sup> OJ L184, 17.7.1999, p. 23. Decision as amended by Decision 2006/512/EC (OJ L200, 22.7.2006, p.11).

using hydrogen, cannot be sufficiently achieved by the Member States. Due to the scale of the action required the objectives can be better achieved at Community level. Therefore, the Community may adopt measures, in accordance with the principle of subsidiarity, as set out in Article 5 of the Treaty. In accordance with the principle of proportionality, as set out in that Article, this Regulation does not go beyond what is necessary for that purpose,

HAVE ADOPTED THIS REGULATION:

*Article 1*

***Subject matter***

This Regulation establishes the requirements for the type approval of vehicles with regard to hydrogen propulsion, and for the type-approval of hydrogen components and hydrogen systems. This Regulation also establishes requirements for the installation of such components and systems.

*Article 2*

***Scope***

This Regulation applies to:

- (1) hydrogen powered vehicles of categories M and N, including impact protection and electric safety of such vehicles;
- (2) hydrogen components designed for motor vehicles of categories M and N, listed in Annex I;
- (3) hydrogen systems designed for motor vehicles of categories M and N, including new forms of hydrogen storage or usage.

*Article 3*

***Definitions***

For the purposes of this Regulation, the following definitions shall apply:

- (1) "hydrogen powered vehicle" means any motor vehicle that uses pure hydrogen or a mixture of hydrogen and natural gas as fuel to propel the vehicle;
- (2) "propulsion system" means the internal combustion engine or fuel cell system used to propel the vehicle;
- (3) "hydrogen component" means the hydrogen container and all other parts of the vehicle that are in direct contact with hydrogen or which form part of a system installed because of the use of hydrogen;
- (4) "hydrogen system" means an assembly of hydrogen components and connecting parts fitted on hydrogen powered vehicles, excluding the propulsion systems or auxiliary power units;
- (5) "Maximum Allowable Working Pressure" (MAWP) means the maximum pressure to which a component is designed to be subjected to and which is the basis for determining the strength of the component under consideration;
- (6) "Nominal Working Pressure" (NWP) means, in case of containers, the settled pressure at a uniform temperature of 288K (15°C) for a full container, or in case of other components, the pressure level at which a component typically operates;
- (7) "inner tank" means the part of the container designed to use liquid hydrogen that contains the cryogenic hydrogen.

For the purposes of point 4, the following shall be considered as hydrogen systems:

- (a) usage monitoring and control system;
- (b) vehicle interface system;
- (c) excess flow system;
- (d) overpressure protection system;
- (e) heat exchanger failure detection system.

#### *Article 4*

##### ***Obligations of the Manufacturers***

1. Manufacturers shall demonstrate that all new hydrogen powered vehicles sold, registered or put into service within the Community and all hydrogen components or hydrogen systems sold or put into service within the Community are type approved in accordance with this Regulation.
2. For the purposes of the vehicle type approval, the manufacturers shall equip the hydrogen powered vehicles with hydrogen components and systems that are tested and installed in accordance with this Regulation.
3. For the purposes of the type approval of components and systems, the manufacturers shall ensure that hydrogen components and systems are tested in accordance with this Regulation.
4. Manufacturers shall provide to the approval authorities appropriate information about the vehicle specifications and test conditions.
5. Manufacturers shall provide information for periodic inspection of the hydrogen systems and components during the service life of the vehicle.

#### *Article 5*

##### ***General requirements for hydrogen components and systems***

The manufacturers shall ensure that:

- (a) the hydrogen components and systems function in a correct and safe way and they reliably withstand the electrical, mechanical, thermal and chemical operating conditions without leaking or visibly deforming;
- (b) the hydrogen system is protected against over-pressurisation;
- (c) materials of those parts of the hydrogen components and systems, which are to be in direct contact with hydrogen are compatible with hydrogen;
- (d) hydrogen components and systems withstand expected temperatures and pressures during their lifetime;
- (e) hydrogen components and systems reliably withstand a range of operating temperatures laid down in the implementing measures;
- (f) hydrogen components are marked in accordance with the implementing measures;
- (g) all hydrogen components with directional flow have the flow direction clearly indicated.

#### Article 6

##### ***Requirements for hydrogen containers designed to use liquid hydrogen***

The hydrogen containers designed to use liquid hydrogen shall be tested in accordance with the test procedures set out in Annex II.

#### Article 7

##### ***Requirements for hydrogen components other than containers designed to use liquid hydrogen***

1. The hydrogen components other than containers designed to use liquid hydrogen shall be tested in accordance with the test procedures set out in Annex III with regard to their type.
2. The pressure relief devices shall be designed in a way that ensures that the pressure in the inner tank or in other hydrogen components does not exceed a permissible value. The values shall be set in proportion to the Maximum Allowable Working Pressure (MAWP) of the hydrogen system. A safety system for heat exchangers shall be provided to detect their failure.

#### Article 8

##### ***Requirements for hydrogen containers designed to use compressed (gaseous) hydrogen***

1. The hydrogen containers designed for the use of compressed (gaseous) hydrogen shall be classified pursuant to point 1 of Annex IV.
2. The containers referred to in paragraph 1 shall be tested in accordance with the test procedures set out in Annex IV with regard to their type.
3. A detailed description of all principal material properties and tolerances used in the container design shall be provided, including the results of the tests to which the material has been submitted.
4. The use of the mixture of gaseous hydrogen and natural gas as fuel is allowed.

#### Article 9

##### ***Requirements for hydrogen components other than containers designed to use compressed (gaseous) hydrogen***

1. The hydrogen components other than containers designed to use compressed (gaseous) hydrogen shall be tested in accordance with the test procedures set out in Annex V with regard to their type.
2. The use of the mixture of gaseous hydrogen and natural gas as fuel is allowed.

#### Article 10

##### ***General requirements for the installation of hydrogen components and systems***

The hydrogen components and systems shall be installed in accordance with the requirements laid down in Annex VI.

## Article 11

### ***Timetable for application***

1. With effect from the date set out in the second paragraph of Article 15, the national authorities shall refuse, to grant EC type-approval or national type-approval in respect of new types of vehicles on grounds relating to hydrogen propulsion or, to grant EC component type-approval or national type-approval in respect of new types of hydrogen components or systems, which do not comply with the requirements set out in this Regulation.
2. With effect from [date, 36 months from the date of entry into force] national authorities shall, on grounds relating to hydrogen propulsion in the case of new vehicles which do not comply with the requirements set out in this Regulation, consider the certificates of conformity to be no longer valid for the purposes of Article 26 of Directive [.../.../EC] and shall prohibit the registration, sale and entry into service of such vehicles, and, in the case of new hydrogen components or systems which do not comply with the requirements set out in this Regulation, shall prohibit their sale and entry into service.
3. Without prejudice to paragraphs 1 and 2 of this Article, and subject to the entry into force of the implementing measures adopted pursuant to Article 12(1), if a manufacturer so requests, national authorities may not, on grounds relating to hydrogen propulsion refuse to grant EC type-approval, or national type approval for a new type of vehicle or a new type of hydrogen component or system, or prohibit the registration, sale or entry into service of a new vehicle or prohibit the sale or entry into service of a new hydrogen component or system, where the vehicle, component or system concerned complies with the requirements set out in this Regulation.

## Article 12

### ***Implementing measures***

1. The Commission shall, in accordance with the procedure referred to in Article 39(9) of Directive [2007/.../EC], adopt the following implementing measures:
  - (a) the administrative provisions for the EC type-approval of vehicles with regard to the hydrogen propulsion, and of hydrogen components and systems;
  - (b) the information to be provided by manufacturers for the purposes of type-approval and periodic inspection referred to in Article 4(4) and (5);
  - (c) the detailed rules for the test procedures set out in Annexes II to V;
  - (d) the detailed rules for hydrogen components and systems set out in Annex VI;
  - (e) the requirements for the safe and reliable functioning of hydrogen components and systems as set out in Article 5.
2. The Commission may, in accordance with the procedure referred to in Article 39(9) of Directive [2007/.../EC], adopt the following implementing measures:
  - (a) specific technical requirements for the application of Article 8(4) and Article 9(2);
  - (b) specification for the requirements relating to any of the following:

- new forms of hydrogen storage or usage;
  - impact protection of the vehicle;
  - integrated system safety requirements, covering at least detection of leakage and the requirements relating to purge gas;
  - electrical isolation and electric safety;
- (c) other measures necessary for the application of this Regulation.

### *Article 13*

#### ***Amendments to Directive 2007/46/EC***

Annexes IV, VI and XI to Directive 2007/46/EC are amended in accordance with Annex VII to this Regulation.

### *Article 14*

#### ***Sanctions for non-compliance***

1. Member States shall lay down the provisions on penalties applicable for infringement by manufacturers of the provisions of the present Regulation and shall take all measures necessary to ensure that they are implemented. The penalties provided for must be effective, proportionate and dissuasive. Member States shall notify those provisions to the Commission no later than [*date, eighteen months after entry into force of this Regulation*] and shall notify it without delay of any subsequent amendment affecting them.
2. The types of infringements which are subject to a penalty shall include:
  - (a) making false declarations during the approval procedures or procedures leading to a recall;
  - (b) falsifying test results for type approval or in-use compliance;
  - (c) withholding data or technical specifications which could lead to recall or withdrawal of type approval;
  - (d) refusal to provide access to information;
  - (e) use of defeat devices.

### *Article 15*

#### ***Entry into force***

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

It shall apply from [*DATE - 24 months after entry into force*], with the exception of Article 11(3) which shall apply from the date of entry into force.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, [...]

*For the European Parliament*  
*The President*  
[...]

*For the Council*  
*The President*  
[...]

## ANNEX I

### List of components subject to type approval

The following hydrogen components are subject to type-approval:

- (a) components designed to use liquid hydrogen:
  - (1) container;
  - (2) automatic valve (if first automatic valve downstream of the container or if a safety device);
  - (3) check valve or non-return valve (if safety device);
  - (4) flexible fuel line (if upstream of first automatic shut off valve or other safety devices);
  - (5) heat exchanger (if upstream of first automatic shut off valve);
  - (6) manual valve (if first manual valve downstream of the container or if a safety device);
  - (7) pressure regulator (if upstream of first automatic shut off valve);
  - (8) pressure relief valve;
  - (9) pressure, temperature and flow sensor (if safety device);
  - (10) refuelling connection or receptacle.
- (b) components designed to use compressed (gaseous) hydrogen:
  - (1) container;
  - (2) automatic valve;
  - (3) container assembly;
  - (4) fittings;
  - (5) flexible fuel line;
  - (6) heat exchanger;
  - (7) hydrogen filter;
  - (8) manual valve;
  - (9) non-return valve;
  - (10) pressure regulator;
  - (11) pressure relief device;
  - (12) pressure relief valve;
  - (13) receptacle;
  - (14) removable storage system connector;
  - (15) sensors (pressure or temperature or hydrogen or flow sensors) if used as a safety device.

## ANNEX II

### Applicable test procedures for hydrogen containers designed for the use of liquid hydrogen

Type of test
Burst test
Bonfire test
Maximum filling level test
Pressure test
Leak test

The test procedures to be applied for the type-approval of hydrogen containers shall include:

- (a) **Burst test:** The purpose of the test is to provide evidence that the hydrogen container does not fail before a specified level of high pressure, the burst pressure (safety factor multiplied by the MAWP) is exceeded. In order to obtain type-approval, the value of the real burst pressure in the test must exceed the required minimum burst pressure.
- (b) **Bonfire test:** The purpose of the test is to provide evidence that the container with its fire protection system does not burst when tested under the specified fire conditions.
- (c) **Maximum filling level test:** The purpose of the test is to provide evidence that the level of hydrogen during the filling procedure never causes the opening of the pressure relief devices.
- (d) **Pressure test:** The purpose of the test is to provide evidence that the hydrogen container can withstand a specified level of high pressure. In order to prove this, the container shall be pressurized to a given value for a specified time. After the test the container shall not show any signs of visible permanent deformation or visible leaks.
- (e) **Leak test:** The purpose of the test is to provide evidence that the hydrogen container does not show evidence of leakage under the specified conditions. In order to prove this, the container shall be pressurized to its nominal working pressure. It shall not show any evidence of leakage detected through cracks, pores or other similar defects.

### ANNEX III

#### Applicable test procedures for hydrogen components other than containers designed for the use of liquid hydrogen

HYDROGEN COMPONENT	TYPE OF TEST										
	Pressure test	External leakage test	Endurance test	Operational test	Corrosion resistance test	Resistance to dry-heat test	Ozone ageing	Temperature cycle test	Pressure cycle test	Hydrogen compatibility test	Seat leakage test
Pressure relief devices	✓	✓		✓	✓			✓		✓	
Valves	✓	✓	✓		✓	✓	✓	✓		✓	✓
Heat exchangers	✓	✓			✓	✓	✓	✓		✓	
Refuelling connections	✓	✓	✓		✓	✓	✓	✓		✓	✓
Pressure regulators	✓	✓	✓		✓	✓	✓	✓		✓	✓
Sensors	✓	✓			✓	✓	✓	✓		✓	
Flexible fuel lines	✓	✓			✓	✓	✓	✓	✓	✓	

Subject to specific requirements for any of the hydrogen components, the test procedures to be applied for the type-approval of hydrogen components other than containers shall include:

- (a) Pressure test: The purpose of the test is to provide evidence that the hydrogen containing components can withstand a pressure, which is higher than the working pressure of the component. A hydrogen component shall not show any visible evidence of leak, deformation, rupture or cracks when the pressure is increased to a certain rate.
- (b) External leakage test: The purpose of the test is to provide evidence that the hydrogen components are free from external leakage and shall not show evidence of porosity.
- (c) Endurance test: The purpose of the test is to provide evidence that the hydrogen components are capable of reliable operation continuously. The test consists of carrying out a specific number of test cycles for the hydrogen component under various temperature and pressure conditions. A test cycle means the normal operation (i.e. one opening and one closing) of the hydrogen component.
- (d) Operational test: The purpose of the test is to provide evidence that the hydrogen components are capable of operating reliably.
- (e) Corrosion resistance test: The purpose of the test is to provide evidence that the hydrogen components are capable of resisting corrosion. In order to prove this, the hydrogen components shall be submitted to contact with specified chemicals.
- (f) Resistance to dry-heat: The purpose of the test is to provide evidence that the non-metallic hydrogen components are capable of resisting high temperature. In order to prove this, the components shall be exposed to air at the maximum operating temperature.
- (g) Ozone ageing: The purpose of the test is to provide evidence that the non-metallic hydrogen components are capable of resisting ageing due to ozone. In order to prove this, the components shall be exposed to air with high ozone concentration.
- (h) Temperature cycle test: The purpose of the test is to provide evidence that the hydrogen components are capable of resisting high variations of temperature. In order to prove this, the hydrogen components shall be submitted to a temperature cycle of specified duration from the minimum operating temperature up to the maximum operating temperature.
- (i) Pressure cycle test: The purpose of the test is to provide evidence that the hydrogen components are capable of resisting high variations of pressure. In order to prove this, the hydrogen components shall be submitted to a pressure change from atmospheric pressure to the Maximum Allowable Working Pressure (MAWP) and shall decrease to atmospheric pressure within a short period of time.
- (j) Hydrogen compatibility test: The purpose of the test is to provide evidence that metallic hydrogen components (i.e. cylinders and valves) are not susceptible to hydrogen embrittlement. In hydrogen components that are subjected to frequent load cycles, conditions that can lead to local fatigue and the initiation and propagation of fatigue cracks in the structure shall be avoided.
- (k) Seat leakage test: The purpose of the test is to provide evidence that hydrogen components are free from leakage while installed in the hydrogen system.

## ANNEX IV

### Applicable test procedures for hydrogen containers designed for the use of compressed (gaseous) hydrogen

Type of test	Applicable To <i>Container Type</i>			
	1	2	3	4
Burst Test	✓	✓	✓	✓
Ambient Temperature Pressure Cycle Test	✓	✓	✓	✓
LBB Performance Test	✓	✓	✓	✓
Bonfire Test	✓	✓	✓	✓
Penetration Test	✓	✓	✓	✓
Chemical Exposure Test		✓	✓	✓
Composite Flaw Tolerance Test		✓	✓	✓
Accelerated Stress Rupture Test		✓	✓	✓
Extreme Temperature Pressure Cycle Test		✓	✓	✓
Impact Damage Test			✓	✓
Leak Test				✓
Permeation Test				✓
Boss Torque Test				✓
Hydrogen Gas Cycle Test				✓

1. Classification of containers designed for the use of compressed (gaseous) hydrogen:
  - Type 1     Seamless metallic container
  - Type 2     Hoop wrapped container with a seamless metallic liner
  - Type 3     Fully wrapped container with a seamless or welded metallic liner
  - Type 4     Fully wrapped container with a non-metallic liner.
2. The test procedures to be applied for the type-approval of those containers:
  - (a) Burst test: The purpose of the test is to provide the value of the pressure at which the container bursts. In order to prove this, the container shall be pressurized to a given value, which should be higher than the nominal working pressure of the container. The burst pressure of the container shall exceed a specified pressure. The burst pressure of the container shall be recorded and shall be kept by the manufacturer throughout the service life of the container.

- (b) Ambient temperature pressure cycle test: The purpose of the test is to provide evidence that the hydrogen container is capable of resisting high variations of pressure. In order to prove this, pressure cycles shall be carried out on the container until a failure occurs or until a specified number of cycles is reached by increasing and decreasing the pressure to a specified value. The containers shall not fail before reaching a specified number of cycles. The number of cycles to failure, along with the location and description of the failure shall be documented. The manufacturer shall keep the results throughout the service life of the container.
- (c) leak before break (LBB) performance test: The purpose of the test is to provide evidence that the hydrogen container fails by leakage before rupture. In order to prove this, pressure cycles shall be carried out on the container by increasing and decreasing the pressure to a specified value. The containers tested shall either fail by leakage or shall exceed a specified number of test cycles without failure. The number of cycles to failure, along with the location and description of the failure shall be recorded.
- (d) Bonfire test: The purpose of the test is to provide evidence that the container with its fire protection system does not burst when tested under the specified fire conditions. The container, pressurized to working pressure shall only vent through the pressure relief device and shall not rupture.
- (e) Penetration test: The purpose of the test is to provide evidence that the container does not rupture when penetrated by a bullet. In order to prove this, the complete container with its protective coating shall be pressurized and penetrated by a bullet. The container shall not rupture.
- (f) Chemical exposure test: The purpose of the test is to provide evidence that the container can withstand exposure to the specified chemical substances. In order to prove this, the container shall be exposed to various chemical solutions. The pressure of the container shall be increased to a given value and a burst test shall be carried out. The container shall achieve a specified burst pressure, which shall be recorded.
- (g) Composite flaw tolerance test: The purpose of the test is to provide evidence that the hydrogen container is capable of resisting exposure to high pressure. In order to prove this, flaws of specified geometry shall be cut into the container sidewall and a specified number of pressure cycles shall be carried out. The container shall not leak or rupture within a number of cycles, but may fail by leakage during the remaining test cycles. The number of cycles to failure, along with the location and description of the failure shall be recorded.
- (h) Accelerated stress rupture test: The purpose of the test is to provide evidence that the hydrogen container is capable of resisting exposure to high pressure and high temperatures at the limit of the allowable operating range for an extended period of time. In order to prove this, the container shall be exposed for a specified time to specified pressure and temperature conditions, and subsequently undergo a burst test as referred to under a). The container shall achieve a specified burst pressure.
- (i) Extreme temperature pressure cycle test: The purpose of the test is to provide evidence that the hydrogen container can withstand variations of pressure under different temperature conditions. In order to prove this, the container,

free of any protective coating shall be hydrostatically cycle tested by subjecting it to extreme ambient conditions and then carrying out a leak test and a burst test as referred to under k) and a). The containers shall be cycle tested without showing evidence of rupture, leakage or fibre unravelling. The containers shall not burst at a specified pressure.

- (j) Impact damage test: The purpose of the test is to provide evidence that the hydrogen container remains operational after submitting it to the specified mechanical impacts. In order to prove this, the container shall be subjected to a drop test and a specified number of pressure cycles shall be carried out. The container shall not leak or rupture within a specified number of cycles, but may fail by leakage during the remaining test cycles.
- (k) Leak test: The purpose of the test is to provide evidence that the hydrogen container does not show evidence of leakage under the specified conditions. In order to prove this, the container shall be pressurised to its nominal working pressure. It shall not show any evidence of leakage detected through cracks, pores or similar defects.
- (l) Permeation test: The purpose of the test is to provide evidence that the hydrogen container does not permeate more than a specified rate. In order to prove this, the container shall be pressurized with hydrogen gas to nominal working pressure and then monitored for permeation in a closed chamber for a specified time under specified temperature conditions.
- (m) Boss torque test: The purpose of the test is to provide evidence that the hydrogen container is capable of resisting the specified torque. In order to prove this, a torque shall be applied to the container from different directions. Then, a leak test and a burst test as referred to under k) and a) above shall be carried out. The container shall meet the burst and leak test requirements. The applied torque, leakage and burst pressure shall be recorded.
- (n) Hydrogen gas cycle test: The purpose of the test is to provide evidence that the hydrogen container is capable of resisting high variations of pressure when hydrogen gas is used. In order to prove this, the container shall be subject to a number of pressure cycles with the use of hydrogen gas and a leak test as referred to under k) above. The deteriorations, such as fatigue cracking or electrostatic discharge of the container shall be inspected. The container shall meet leak test requirements. The container shall be free of any deterioration, such as fatigue cracking or electrostatic discharge.

## ANNEX V

### Applicable test procedures for hydrogen components other than containers designed for the use of compressed (gaseous) hydrogen

HYDROGEN COMPONENT	TYPE OF TEST					
	Material tests	Corrosion resistance test	Endurance test	Hydraulic pressure cycle test	Internal leakage test	External leakage test
Pressure relief devices	✓	✓	✓	✓	✓	✓
Automatic valves	✓	✓	✓	✓	✓	✓
Manual valves	✓	✓	✓	✓	✓	✓
Non-return valves	✓	✓	✓	✓	✓	✓
Pressure relief valves	✓	✓	✓	✓	✓	✓
Heat exchangers	✓	✓		✓		✓
Receptacles	✓	✓	✓	✓	✓	✓
Pressure regulators	✓	✓	✓	✓	✓	✓
Sensors for hydrogen systems	✓	✓	✓	✓		✓
Flexible fuel lines	✓	✓	✓	✓		✓
Fittings	✓	✓	✓	✓		✓
Hydrogen filters	✓	✓		✓		✓
Removable storage system connectors	✓	✓	✓	✓		✓

Subject to specific requirements for any of the hydrogen components, the test procedures to be applied for the type-approval of hydrogen components other than containers shall include:

Material tests:

- 2.1. Hydrogen compatibility test set out in point (j) of Annex III.

- 2.2. Ageing test: The purpose of the test is to check, whether the non-metallic material used in a hydrogen component can withstand ageing. No visible cracking of the test samples is allowed.
- 2.3. Ozone compatibility test: The purpose of the test is to check, whether the elastomer material of a hydrogen component is compatible with ozone exposure. No visible cracking of the test samples is allowed.
3. Corrosion resistance test set out in point (e) of Annex III.
4. Endurance test set out in point (c) of Annex III.
5. Hydraulic pressure cycle test set out in point (i) of Annex III. The hydrogen components shall not show visible sign of deformation or extrusion and shall fulfil the requirements of the internal and external leakage test.
6. Internal leakage test: The purpose of the internal leakage test is to provide evidence that the specified hydrogen components are free from internal leakage. In order to prove this, the hydrogen components shall be pressurized under different temperature conditions and observed for leakage. The hydrogen component shall stay bubble free and shall not leak internally at a higher rate than a specified number.
7. External leakage test set out in point (b) of Annex III.

## ANNEX VI

### Requirements for the installation of hydrogen components and systems

1. The hydrogen system shall be installed such that it is protected against damage.  
It should be isolated from heat sources in the vehicle.
2. The hydrogen container may only be removed for replacement with a hydrogen container for the purpose of refuelling or for maintenance.  
  
In the case of internal combustion engine, the container shall not be installed in the engine compartment of the vehicle.  
  
It shall be adequately protected against any kind of corrosion.
3. Measures have to be taken to prevent hydrogen leakage during refilling and to make sure that the removal of a removable hydrogen storage system is done safely.
4. The refuelling connection shall be secured against maladjustment and shall be protected from dirt and water.
5. The hydrogen container shall be mounted and fixed so that the specified accelerations can be absorbed without damage of the safety related parts when the hydrogen containers are full.
6. The hydrogen fuel supply lines shall be secured with an automatic valve. The refuelling line shall be secured with a valve. The valves shall close if a malfunction of the hydrogen system requires so or any other event that results in the leakage of hydrogen occurs. When the propulsion system is switched off, the fuel supply from the container to the propulsion system shall be switched off and remain closed until the system is required to operate.
7. No hydrogen component, including any protective materials that form part of such components, shall project beyond the outline of the vehicle or protective structure. This shall not apply if a hydrogen component is adequately protected and no part of the hydrogen component is located outside this protective structure.
8. The hydrogen system shall be installed such that it is protected against damage so far as is reasonably practical, such as damage due to moving vehicle components, impacts, grit or due to the loading or unloading of the vehicle or the shifting of loads.
9. No hydrogen component shall be located near the exhaust of an internal combustion engine or other heat source, unless such components are adequately shielded against heat.
10. The ventilating or heating system for the passenger compartment and places where leakage or accumulation of hydrogen is possible shall be designed so that hydrogen is not drawn into the vehicle.
11. In the event of accidents, it shall be ensured so far as is reasonably practicable that the pressure relief device and the associated venting system remain capable of functioning. The venting system of the pressure relief device shall be adequately protected against dirt and water.
12. The passenger compartment of the vehicle shall be separated from the hydrogen system in order to avoid accumulation of hydrogen. It shall be ensured that any fuel leaking from the container or its accessories does not escape to the passenger compartment of the vehicle.

13. Hydrogen components that could leak hydrogen within the passenger or luggage compartment or other non-ventilated compartment shall be enclosed by a gas tight housing or by an equivalent solution as specified in the implementing legislation.
14. Electrically operated devices containing hydrogen shall be insulated in such a manner that no current passes through hydrogen containing parts, in order to prevent electric sparks in the case of a fracture.  
  
Metallic components of the hydrogen system shall have electrical continuity with the vehicles earth.
15. Labels may be used to indicate to rescue services that liquid or compressed (gaseous) hydrogen is used.

**ANNEX VII**

**Amendments to Directive 2007/46/EC**

1. In Annex IV, part I, in point 62 the following new line shall be added to the table:

Subject	Regulatory act reference	Official Journal reference	Applicability									
			M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	O <sub>1</sub>	O <sub>2</sub>	O <sub>3</sub>	O <sub>4</sub>
62. Hydrogen system	[.../.../EC]	L ..., ..., p. ...	X	X	X	X	X	X				

2. In the Appendix to Annex IV, part I in point 62 the following new line shall be added to the table:

	Subject	Regulatory act reference	Official Journal reference	M <sub>1</sub>
62	Hydrogen system	[.../.../EC]		X

3. In the Appendix to Annex VI in point 62 the following new line shall be added to the table:

Subject	Regulatory act reference	As amended by	Applicable to Variants
62. Hydrogen system	[.../.../EC]		

4. In Annex XI, Appendix 1, in point 62 the following new line shall be added to the table:

Item	Subject	Regulatory act reference	M <sub>1</sub> ≤ 2 500 (1) kg	M <sub>1</sub> > 2 500 (1) kg	M <sub>2</sub>	M <sub>3</sub>
62	Hydrogen system	[.../.../EC]	Q	G+Q	G+Q	G+Q

5. In Annex XI, Appendix 2 in point 62 the following new line shall be added to the table:

Item	Subject	Regulatory act reference	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	O <sub>1</sub>	O <sub>2</sub>	O <sub>3</sub>	O <sub>4</sub>
62	Hydrogen system	[.../.../EC]	A	A	A	A	A	A				

6. In Annex XI, Appendix 3 in point 62 the following new line shall be added to the table:

Item	Subject	Regulatory act reference	M <sub>2</sub>	M <sub>3</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	O <sub>1</sub>	O <sub>2</sub>	O <sub>3</sub>	O <sub>4</sub>
62	Hydrogen system	[.../.../EC]	Q	Q	Q	Q	Q				

7. In Annex XI, Appendix 4 in point 62 the following new line shall be added to the table:

<i>Item</i>	<i>Subject</i>	<i>Regulatory act reference</i>	<i>Mobile crane of category N3</i>
62	<i>Hydrogen system</i>	<i>[.../.../EC]</i>	<i>X</i>