Regulation (EC) No 79/2009 of the European Parliament and of the Council of 14 January 2009 on type-approval of hydrogen-powered motor vehicles, and amending Directive 2007/46/EC (Text with EEA relevance)

ANNEX I

List of hydrogen components to be type-approved

Where fitted to a hydrogen-powered vehicle, the following hydrogen components must be type-approved:

(a) components designed to use liquid hydrogen:

1. container;
2. automatic shut-off valve;
3. check valve or non-return valve (if used as a safety device);
4. flexible fuel line (if upstream of first automatic shut-off valve or other safety devices);
5. heat exchanger;
6. manual or automatic valve;
7. pressure regulator;
8. pressure relief valve;
9. pressure, temperature and flow sensors (if used as a safety device);
10. refuelling connection or receptacle;
11. hydrogen leakage detection sensors;

(b) components designed to use compressed (gaseous) hydrogen with a nominal working pressure of over 3,0 MPa:

1. container;
2. automatic shut-off valve;
3. container assembly;
4. fittings;
5. flexible fuel line;
6. heat exchanger;
7. hydrogen filter;
8. manual or automatic valve;
9. non-return valve;
10. pressure regulator;
11. pressure relief device;
12. pressure relief valve;
13. refuelling connection or receptacle;
14. removable storage system connector;

15. pressure, temperature, hydrogen and flow sensors (if used as a safety device);

16. hydrogen leakage detection sensors.

ANNEX II

Applicable test procedures for hydrogen containers designed to use 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 designed to use liquid hydrogen must 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 during 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 specified fire conditions.

(c) Maximum filling level test: the purpose of the test is to provide evidence that the system, which prevents overfilling of the container, works adequately and 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 is pressurised to a given value for a specified time. After the test the container must 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 specified conditions. In order to prove this, the container is pressurised to its nominal working pressure. It must 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 to use liquid hydrogen

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

Subject to specific requirements in relation to any of the hydrogen components, the test procedures to be applied for the type-approval of hydrogen components, other than containers, designed to use liquid hydrogen must include:

(a) Pressure test: the purpose of the test is to provide evidence that the hydrogen components can withstand a level of pressure which is higher than the working pressure of the component. The hydrogen components must not show any visible evidence of leak, deformation, rupture or cracks when the pressure is increased to a certain level.

(b) External leakage test: the purpose of the test is to provide evidence that the hydrogen components are free from external leakage. The hydrogen components must not show evidence of porosity.

(c) Endurance test: the purpose of the test is to provide evidence that the hydrogen components are capable of continuous reliable operation. The test consists of carrying out a specific number of test cycles for the hydrogen component under specified 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 are submitted to contact with specified chemicals.

(f) Resistance to dry-heat test: 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 are exposed to air at the maximum operating temperature.

(g) Ozone ageing test: 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 are 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 are 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 are submitted to a pressure change from atmospheric pressure to the maximum allowable working pressure (MAWP) and then back 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 must 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 to use compressed (gaseous) hydrogen

Type of test	**Applicable to container type**			
	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 hydrogen containers designed to use 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 hydrogen containers designed to use compressed (gaseous) hydrogen must include:

(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 is pressurised to a given value, which must be higher than the nominal working pressure of the container. The burst pressure of the container must exceed a specified pressure. The burst pressure of the container must be recorded and 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 are 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 must not fail before reaching a specified number of cycles. The number of cycles to failure, along with the location and description of the failure, must be documented. The manufacturer must 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 are carried out on the container by increasing and decreasing

the pressure to a specified value. The containers tested must either fail by leakage or exceed a specified number of test cycles without failure. The number of cycles to failure, along with the location and description of the failure, must 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 specified fire conditions. The container, pressurised to working pressure, must only vent through the pressure relief device and must 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 is pressurised and penetrated by a bullet. The container must not rupture.

(f) Chemical exposure test: the purpose of the test is to provide evidence that the container can withstand exposure to specified chemical substances. In order to prove this, the container is exposed to various chemical solutions. The pressure of the container is increased to a given value and a burst test as referred to under point (a) is carried out. The container must achieve a specified burst pressure, which must 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 are cut into the container sidewall and a specified number of pressure cycles carried out. The container must 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, must 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 is exposed for a specified time to specified pressure and temperature conditions, and subsequently undergoes a burst test as referred to under point (a). The container must 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, is hydrostatically cycle tested by being subjected to extreme ambient conditions, and subsequently undergoes a burst test and a leak test as referred to under points (a) and (k). When cycle tested, the containers must not show evidence of rupture, leakage or fibre unravelling. The containers must 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 being submitted to the specified mechanical impacts. In order to prove this, the container is subjected to a drop test, and a specified number of pressure cycles are carried out. The container must 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 is pressurised to its nominal working pressure. It must 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 is pressurised 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 is applied to the container from different directions. Then a burst test and a leak test as referred to under points (a) and (k) are carried out. The container must meet the burst and leak test requirements. The applied torque, leakage and burst pressure must 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 is subjected to a number of pressure cycles with the use of hydrogen gas and a leak test as referred to under point (k). Deteriorations, such as fatigue cracking or electrostatic discharge of the container, are inspected. The container must meet leak test requirements. The container must be free of any deterioration, such as fatigue cracking or electrostatic discharge.

ANNEX V

Applicable test procedures for hydrogen components, other than containers, designed to use compressed (gaseous) hydrogen

	TYPE OF TEST					
HYDROGEN COMPONENTS	**Material tests**	**Corrosion resistance test**	**Endurance test**	**Pressure cycle test**	**Internal leakage test**	**External leakage test**
Pressure relief devices	↘	↘	↘	↘	↘	↘
Automatic valves	↘	↘	↘	↘	↘	↘
Manual valves	↘	↘	↘	↘	↘	↘
Non-return valves	↘	↘	↘	↘	↘	↘
Pressure relief valves	↘	↘	↘	↘	↘	↘
Heat exchangers	↘	↘		↘		↘
Refuelling connections	↘	↘	↘	↘	↘	↘

or 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, designed to use compressed (gaseous) hydrogen must include:

1. Material tests:

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

1.2. 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.

1.3. 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.

2. Corrosion resistance test set out in point (e) of Annex III.

3. Endurance test set out in point (c) of Annex III.

4. Pressure cycle test set out in point (i) of Annex III. The hydrogen components must not show visible signs of deformation or extrusion and must fulfil the requirements of the internal and external leakage tests.

5. Internal leakage test: the purpose of the test is to provide evidence that the specified hydrogen components are free from internal leakage. In order to prove this, the hydrogen components are pressurised under different temperature conditions and observed for leakage. The hydrogen components must stay bubble free and must not leak internally at a higher rate than a specified number.

6. 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 must be installed in such a way that it is protected against damage.

It must be isolated from heat sources in the vehicle.

2. The hydrogen container may only be removed for replacement with another hydrogen container, for the purpose of refuelling or for maintenance.

In the case of an internal combustion engine, the container must not be installed in the engine compartment of the vehicle.

It must be adequately protected against all kinds of corrosion.

3. Measures must be taken to prevent misfuelling of the vehicle and hydrogen leakage during refilling and to make sure that the removal of a removable hydrogen storage system is done safely.

4. The refuelling connection or receptacle must be secured against maladjustment and protected from dirt and water. The refuelling connection or receptacle must be integrated with a non-return valve or a valve with the same function. If the refuelling connection is not mounted directly on the container, the refuelling line must be secured by a non-return valve or a valve with the same function which is mounted directly on or within the container.

5. The hydrogen container must be mounted and fixed so that the specified accelerations can be absorbed without damage to the safety related parts when the hydrogen containers are full.

6. The hydrogen fuel supply lines must be secured with an automatic shut-off valve mounted directly on or within the container. The valve shall close if a malfunction of the hydrogen system so requires 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 must be switched off and remain closed until the system is required to operate.

7. In the event of an accident, the automatic shut-off valve mounted directly on or within the container shall interrupt the flow of gas from the container.

8. Hydrogen components, including any protective materials that form part of such components, must not project beyond the outline of the vehicle or protective structure. This does not apply to a hydrogen component which is adequately protected and no part of which is located outside this protective structure.

9. The hydrogen system must be installed in such a way that it is protected against damage so far as is reasonably practicable, such as damage due to moving vehicle components, impacts, grit, the loading or unloading of the vehicle or the shifting of loads.

10. Hydrogen components must not be located near the exhaust of an internal combustion engine or other heat source, unless such components are adequately shielded against heat.

11. The ventilating or heating system for the passenger compartment and places where leakage or accumulation of hydrogen is possible must be designed so that hydrogen is not drawn into the vehicle.

12. In the event of an accident, it must 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 must be adequately protected against dirt and water.

13. The passenger compartment of the vehicle must be separated from the hydrogen system in order to avoid accumulation of hydrogen. It must be ensured that any fuel leaking from the container or its accessories does not escape to the passenger compartment of the vehicle.

14. Hydrogen components that could leak hydrogen within the passenger or luggage compartment or other non-ventilated compartment must be enclosed by a gas-tight housing or by an equivalent solution as specified in the implementing measures.

15. Electrically operated devices containing hydrogen must 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 must have electrical continuity with the vehicle's earth.

16. Labels or other means of identification must be used to indicate to rescue services that the vehicle is powered by hydrogen and that liquid or compressed (gaseous) hydrogen is used.

ANNEX VII

Amendments to Directive 2007/46/EC

Directive 2007/46/EC is hereby amended as follows:

1. In Part I of Annex IV, the following row shall be added to the table:

Item	Subject	Regulatory act reference	Official Journal reference	Applicability									
				M_1	M_2	M_3	N_1	N_2	N_3	O_1	O_2	O_3	O_4
'62	Hydrogen system	Regulation (EC) No 79/2009	L 35, 4.2.2009, p. 32	X	X	X	X	X	X'				

2. In the Appendix to Part I of Annex IV, the following row shall be added to the table:

	Subject	Regulatory act reference	Official Journal reference	M_1

'62	Hydrogen system	Regulation (EC) No 79/2009	L 35, 4.2.2009, p. 32	X'

3. In the Appendix to Annex VI, the following row shall be added to the table:

	Subject	**Regulatory act reference ([1])**	**As amended by**	**Applicable to versions**
'62.	Hydrogen system	Regulation (EC) No 79/2009'		

4. In Appendix 1 to Annex XI, the following row shall be added to the table:

Item	**Subject**	**Regulatory act reference**	**$M_1 \leq 2$ 500 ([1]) kg**	**$M_1 > 2$ 500 ([1]) kg**	**M_2**	**M_3**
'62	Hydrogen system	Regulation (EC) No 79/2009	Q	G + Q	G + Q	G + Q'

5. In Appendix 2 to Annex XI, the following row shall be added to the table:

Item	**Subject**	**Regulatory act reference**	**M_1**	**M_2**	**M_3**	**N_1**	**N_2**	**N_3**	**O_1**	**O_2**	**O_3**	**O_4**
'62	Hydrogen system	Regulation (EC) No 79/2009	A	A	A	A	A	A'				

6. In Appendix 3 to Annex XI, the following row shall be added to the table:

Item	**Subject**	**Regulatory act reference**	**M_1**
'62	Hydrogen system	Regulation (EC) No 79/2009	X'

7. In Appendix 4 to Annex XI, the following row shall be added to the table:

Item	**Subject**	**Regulatory act reference**	**M_2**	**M_3**	**N_1**	**N_2**	**N_3**	**O_1**	**O_2**	**O_3**	**O_4**
'62	Hydrogen system	Regulation (EC) No 79/2009	Q	Q	Q	Q	Q'				

8. In Appendix 5 to Annex XI, the following row shall be added to the table:

Item	**Subject**	**Regulatory act reference**	**Mobile crane of category N_3**
‘62	Hydrogen system	Regulation (EC) No 79/2009	X’

Status:
Point in time view as at 31/12/2020.

Changes to legislation:
There are outstanding changes not yet made to Regulation (EC) No 79/2009 of the European Parliament and of the Council. Any changes that have already been made to the legislation appear in the content and are referenced with annotations.