D4.5

Guidelines and good practices for certification bodies

Under Review

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D4.5	Guidelines and good practices for certification bodies
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Partners short names

ENVI	Parco Scientifico Tecnologico Per L'ambiente Environment Park Torino Spa
IMI	Institute For Methods Innovation
IME	Fundacion IMDEA Energia
APRE	Agenzia per la Promozione della Ricerca Europea
CNH2	Centro Nacional Del Hidrogeno
RIGP	Regionalna Izba Gospodarcza Pomorza
CLUSTER TWEED	Cluster Tweed
BH2C	Balkanski Vodoroden Klaster

Abbreviations

BOP	Balance of Plant
CEI	Comitato Elettrotecnico Italiano
EEA	European Economic Area
FCEV	Fuel Cell Electric Vehicles
JTC	Joint Technical Committee
SAE	Society of Automotive Engineers
PED	Pressure Equipment Directive
P2G	Power-to-Gas
P2P	Power-to-Power
TC	Technical Committee
TPED	Transportable Pressure Directive
WI	Working Item

Executive Summary

This deliverable complements deliverable D2.3 "Certification requirements" in providing guidance in the certification requirements for hydrogen technologies.

D2.3 concluded that the certification requirements for hydrogen technologies are mostly governed by European Directives (many of which are being reviewed and recast as Regulations), hence providing a level-playing field for the hydrogen technologies stakeholders producing, importing or adopting hydrogen technologies, whichever the Country of origin.

The analysis provided in D2.3 has been reviewed in this deliverable to update the reference regulatory framework and the standardisation activity. Standards support stakeholders in obtaining certification of their product and also in implementing safety in the design, production, installation and operation of their devices. Much work is being undertaken by the standardisation bodies and other stakeholders' bodies to adapt existing standards to hydrogen's peculiarities, to develop ad-hoc standards and to provide guidance to the stakeholders.

The guideline is therefore organised so to provide information on the Directives/ Regulations and standards (harmonised or else) applicable to different hydrogen technologies and installations.D2.3 remain an important point of reference particularly for the examples of certification /standards adoptions by different hydrogen technology developers/adopters, while these Guidelines introduce the applicable Directives/regulations and supporting standards (harmonised and not harmonised) for the hydrogen value chain. The document also includes references to standards useful for the safety and environmental permitting of hydrogen installations.

1 Introduction

HYPOP project aims to raise public awareness and trust towards hydrogen technologies and their systemic benefits. The project aims to deliver a set of guidelines focusing on the permitting, safety and certification issues. These guidelines have been produced by collection of information through a desktop exercise and through direct engagement of stakeholders.

This document complements Deliverable D2.3 “Certification requirements” updating and rationalising the information collected within and since its drafting, so to provide an agile reference guide for hydrogen technologies’ producers, importers, adopters etc.

More specifically, starting from D2.3, the list of applicable Directives/Regulations has been reviewed and linked to the reference harmonised standards and supporting information. Further standards relevant to the different applications have been collected according to the latest developments by the different Technical Committees of the main standardisation bodies at European and international level. Further guidance and information have been sought from existing database of industrial standards.

Deliverable D2.3 remains an important reference document for an overview of the certification process and for examples of approaches adopted by stakeholders developing innovative hydrogen technologies/ applications.

2 General considerations for certification of hydrogen technologies

2.1 Introduction

In this section are described those aspects of certification valid for any hydrogen technology across the value chain, i.e. the CE marking and the Directives/ Regulations applicable.

2.2 CE Marking

The commercialization of products within the European single market is governed by a set of regulations and Directives aimed at ensuring consumers that **products** meet minimum requirements in terms of **safety, health, and environmental protection**. Products, regardless of their place of production, must comply with EU requirements and can be marketed within the European Economic Area only if they bear the **CE marking**. The CE Marking signify that products have been assessed to meet high safety, health, and environmental protection requirements, i.e., they conform to the EU regulatory framework in those areas.

All products must be subject to a conformity assessment procedure, as detailed in the Regulation (EC) No 765/2008 and in Council Decision No 768/2008/EC, with the range of Directives to be adhered to specific for the product. The process is discussed in detail in Deliverable 2.3, with this deliverable updating the regulatory framework of reference and the standards that might apply to hydrogen technologies. Please refer to Deliverable D2.3 for clarifications about the subsections titled CONFORMITY ASSESSMENT PROCEDURE in each of the following sections 2.4 to 2.10.

2.3 Application to hydrogen technologies

Hydrogen technologies – the systems as they are delivered, not the industrial installations or the locations where they will be placed - must comply with various directives and regulations for being CE marked. Being subject to a conformity assessment and certification is a fundamental step by the manufacturers to ensure also safety for adopters, installers and users of hydrogen technologies. Indeed, through the process, the manufacturer ensures that hazards have been identified and risks pertaining to its product are managed. The involvement of a Notified Body might be required for those technologies representing a higher risk.

2.3.1 EU Directives and Regulations applicable to hydrogen technologies

The following Table 1 lists the main EU Directives & Regulations that can be applicable to hydrogen technologies.

Table 1 EU Directives E Regulations for CE marking of Hydrogen technologies

Pressure Equipment Directive	Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of **pressure equipment**
Machinery Directive/ Regulations (from Jan 2027)	Directive 2006/42/EC of the European Parliament and Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC
Electromagnetic Compatibility Directive (EMC)	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast)

Low Voltage Directive	Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of **electrical equipment** designed for use within certain voltage limits
Gas Appliances regulations*	Regulation (EU) 2016/426 of the European Parliament and of the Council of 9 March 2016 on appliances burning gaseous fuels and repealing Directive 2009/142/EC
RoHS Directive	Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)

**Limited applicability to hydrogen burners for heating/hot water*

A separate section is dedicated to the ATEX Directive as it applies to hydrogen technologies in special cases but it applies to many components used within hydrogen technology system.

Many of the above pieces of legislation include also a set of harmonised standards, i.e. *"European standard developed by a recognised European Standards Organisation: CEN, CENELEC, or ETSI, created following a request from the European Commission to one of these organisations. Manufacturers, other economic operators, or conformity assessment bodies can use harmonised standards to demonstrate that products, services, or processes comply with relevant EU legislation."*[1]

Harmonised standards are available at the following links:

Table 2 Sources of information on harmonised standards related to Directives and Regulations above

Harmonised standards	
Pressure Equipment Directive	https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/pressure-equipment_en The link also contains Guidance on CE Marking and Guidelines on application of the Directive
Machinery Directive/ Regulations	https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/machinery-md_en At this further link: https://single-market-economy.ec.europa.eu/sectors/mechanical-engineering/machinery_en a Machinery Directive application guide and Recommendations for Use Sheets are made available
Electromagnetic Compatibility Directive (EMC)	https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/electromagnetic-compatibility-emc_en The link also contains Guidance on CE Marking and a guide as to assist with the common application of the Directive 2014/30/EU (also useful for CE Marking)
Low Voltage Directive	https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/low-voltage-lvd_en The link also contains Guidance on CE Marking and Guidelines on application and recommendations of the Low Voltage Directive

[1] https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards_en

Gas Appliances regulations	https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/gas-appliances_en The link also contains Guidance on CE Marking and guidance sheets on Gas Appliances Regulation:
RoHS Directive	https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/restriction-use-certain-hazardous-substances-rohs_en

These lists are useful starting point for manufacturers of hydrogen technologies but they do not always include standards specifically applicable to hydrogen systems. This means that manufacturers are required to identify which standards might be applicable. For this reason ,this guidance will identify the main harmonised standards that support conformity assessment and certification according to the above-mentioned regulatory framework. Furthermore, as the Standardisation bodies are progressing in the development of specific standards, these latter are mentioned in section 3. Indeed, harmonised European standards give the presumption of conformity. Where no harmonised standards exist, other standards likely to reflect the state of the art can be used as a basis for assessment.

2.4 The Pressure Equipment Directive (PED)

The **Pressure Equipment Directive 2014/68/EU (PED Directive) falls within a broader framework that also includes the Simple Pressure Vessels Directive 2014/29/EU and the Transportable Pressure Equipment Directive 2010/35/EC.** Harmonised standards set the minimum requirements that need to be fulfilled by the manufacturers as they will be the base of the conformity assessment carried out by Notified Bodies [2].

2.4.1 APPLICATION TO HYDROGEN TECHNOLOGIES

This legislation is primarily considered for the certification of hydrogen storage systems but generally also addresses other hydrogen technologies such as electrolysers and fuel cells, as they are technologies for which there is a risk related to maximum pressures allowed exceeding 0.5 bar above atmospheric pressure.

2.4.2 CLASSIFICATION APPLICABLE TO HYDROGEN TECHNOLOGIES

The classification of product into increasingly hazardous categories going from category I to IV is based on the criteria outlined in the related Annexes of the Directive. Specifically, for classification into the four categories mentioned, the following factors are considered:

- The maximum allowable pressure of the container holding the fluid (PS);
- The container's own volume (V) or nominal size (DN) in case of pipes;
- The fluid's group classification. Generally, gaseous hydrogen falls into group 1 as it is a flammable gas of category 1 and 2 (Gases that, at a temperature of 20 °C and a normal pressure of 101.3 kPa:
    - a) are flammable when mixed at 13% or less (by volume) with air; or
    - b) have a flammability range with air of at least 12 percentage points, regardless of their lower flammability limit as defined by Table 2.2.1 of EC Regulation n.1272/2008.)

[2] Harmonised standards for Pressure Equipment Directive: https://ec.europa.eu/docsroom/documents/51457

It is important to consider the technical requirements that apply to containers intended to hold gases whose vapour pressure at the container's maximum allowable temperature is at least 0.5 bar above the normal atmospheric pressure. In this case, for fluid groups of type 1 when the container's volume is more than 1 litre and the PS-V product exceeds 25 bar-L, and when the PS pressure - maximum allowable pressure of the container holding the fluid, is over 200 bar, the provisions of Annex II apply (Figure 1).

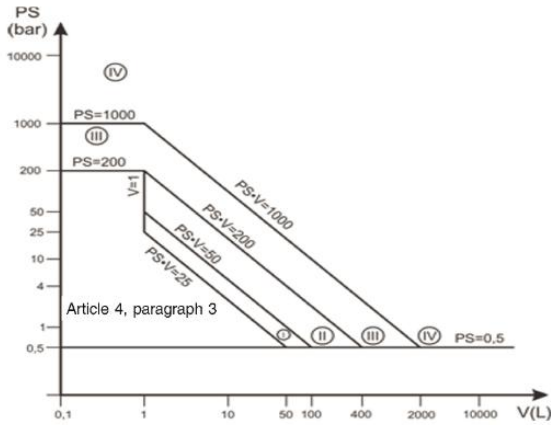

Table 1

Vessels referred to in Article 4(1)(a)(i), first indent

Figure 1 PS-V diagram for categorization of Pressure Equipment

The following references are made specifically to hydrogen storage systems:

- **Solid storage in metal hydrides where the operating pressure is about 30 bar**. Depending on the storage's own volume, these systems can fall into categories ranging from category I upwards;
- **For hydrogen gas storage systems at 200 bar**, regardless of the storage's own volume, the reference category can be III or IV.

Other hydrogen technologies such as electrolysers and fuel cells must also meet the requirements of the PED regulation and can be connected to the storage system and to each other through piping, which is also defined by the regulation as pressure equipment where the maximum allowable pressure can be above 0.5 bar. In the case of pipes intended to contain gas whose vapour pressure at the maximum allowable temperature is above 0.5 bar of normal atmospheric pressure (1013 mbar), for group 1 fluids, when the **Nominal Size (DN)** is greater than 25, the provisions reported in Annex II apply (Figure 2).

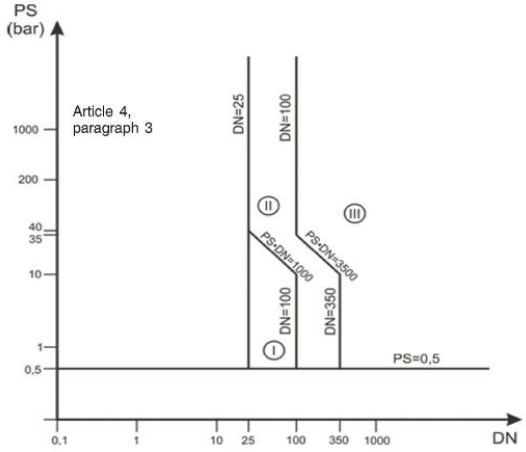

Table 6

Piping referred to in Article 4(1)(c)(i), first indent

Figure 2 PS- DN diagram for categorization of Pressure Equipment

2.4.3 CONFORMITY ASSESSMENT PROCEDURE

As with the Machinery Directive, the conformity assessment procedure leading to the Declaration of Conformity and CE Marking can be performed directly by the manufacturer if the hydrogen technology is category I according to internal production control protocols (Module A). This is also valid for hydrogen equipment.

For pressure equipment, including hydrogen technologies, falling within category II, III, and IV, the involvement of a notified body is required to certify it according to the PED Directive and within the national territory of interest.

Involving a Notified Body increases the complexity of the assessment procedure and the safety conditions ensured as well. Specifically, the number of modules with the information to be provided and the assessment procedures grows with the associated risk of the pressure equipment. Except for Category I, all other cases, where a hydrogen technology falls within Categories II, III, IV, must involve a Notified Body

The conformity assessment procedures to be applied for the different categories are as follows:

Table 3 Correlation between modules needed for the conformity assessment and hazard category of the Pressure Equipment

Category	Modules
I	Module A
II	Modules A2 (analogous in terms of content to Module A with the addition of official checks on pressure equipment conducted at random and unannounced intervals by the notified body), D1 (quality assurance of the production process), E1 (Quality assurance of final product inspection and testing)
III	Modules B (EU type-examination of design) + D, Modules B (EU type-examination of design) + F, Modules B (type of production) + E, Modules B (EU type-examination of production) + C2 (conformity to type based on internal production control combined with testing of pressure equipment under official control at random intervals), Module H (conformity based on full quality assurance);

Category	Modules
IV	Modules B (type of production) + D, Modules B (type of production) + F, Module G, Module H1 (conformity based on full quality assurance with design control).

Compared to Module B EU type-examination of design, EU type-examination of production adds the examination of a specimen, representative of the production envisaged, of the complete pressure equipment.

2.4.4 APPLICABLE STANDARDS

Some examples of the harmonised standards applicable to hydrogen technologies are reported below.

Table 4 Examples of Harmonised standards under Pressure Equipment Directive for hydrogen technologies above 0,5 bar

Harmonised standards for Pressure Equipment Directive	
EN 764-1 to -7	Pressure equipment, in particular EN 764-7 : Part 7 : safety systems for unfired pressure equipment
EN 1349	Industrial process control valves
EN 13445 1- to -6 and -8 to -14	Unfired pressure vessels (General; Design; Materials; Fabrication; Inspection and Testing; of specific materials)
EN 13480-1 to 8 (part 9 under development)	Metallic industrial piping

2.5 The Machinery Directive (soon to be repealed by the Machinery Regulations)

Directive 2006/42/EC on machinery has been recently replaced by EU Regulation 2023/1230, as the experience gained in applying Directive 2006/42/EC highlighted deficiencies and inconsistencies in product coverage and conformity assessment procedures. The Machinery Directive is considered repealed from January 14, 2027; thus, until that date, it remains a regulatory reference for all aspects of certification, including those for hydrogen technologies. The Machinery Directive sets relevant certification requirements for various application fields, including industrial, mobility, and residential sectors.

2.5.1 APPLICATION TO HYDROGEN TECHNOLOGIES

Hydrogen systems fall within the framework of Machinery Directive because they can be defined as machinery assemblies, because they integrate, as essential part of their operation, compressors, pumps, fans and this apply to most of the hydrogen technologies[3].

2.5.2 CLASSIFICATION APPLICABLE TO HYDROGEN TECHNOLOGIES

N/A

2.5.3 CONFORMITY ASSESSMENT PROCEDURE

Generally, the Machinery Directive allows for internal testing even if the product falls within the Directive's list, provided that the tests conform to a harmonized European standard that includes all relevant health and safety requirements. Moreover, the manufacturer of hydrogen technologies like compressors and pumps should provide technical documentation including a general description of

[3] FRENCH GUIDE TO CONFORMITY ASSESSMENT AND CERTIFICATION OF HYDROGEN SYSTEMS, available at https://hysafe.info/uploads/papers/2021/171.pdf

the machine, documentation related to risk assessment, references to applied standards and technical specifications, and technical reports with results of internal tests conducted (analogy to Module A conformity assessment).

2.5.4 APPLICABLE STANDARDS

Some examples of harmonised standards that might apply to hydrogen technologies are reported below.

Table 5 Examples of Harmonised standards under Machinery Directive

Harmonised standards for Machinery Directive	
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 614-2 and -3	Safety of machinery - Ergonomic design principles
EN 1012- 3	Compressors and vacuum pumps – Safety requirements - Part 3: process compressors
EN 1127-1	Explosive atmospheres – Explosion prevention and protection - Part 1: Basic concepts and methodology
EN IEC 60204 series	Safety of machinery -Electrical equipment of machines
EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN ISO 13849-2	Safety of machinery - Safety-related parts of control systems - Part 2: Validation
EN ISO 19353	Safety of machinery - Fire prevention and fire protection

2.6 The Electromagnetic Compatibility Directive (EMC)

Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast) applies to electric appliances or assembly of appliances that are likely to generate electromagnetic disturbance or might be affected by electromagnetic disturbances. It is generally agreed that an assembly of properly assembled EMC certified components answers the requirements of the EMC directive.

2.6.1 APPLICATION TO HYDROGEN TECHNOLOGIES

Most hydrogen system incorporate electronic appliances playing a role in process regulation or safety. For this reason, they fall under the scope of the EMC directive. They also sometimes can be the source of electromagnetic disturbances due to high intensity the electric currents[4].

2.6.2 CLASSIFICATION APPLICABLE TO HYDROGEN TECHNOLOGIES

N/A

2.6.3 CONFORMITY ASSESSMENT PROCEDURE

The intervention of a notified body is not required but it can be requested by the manufacturer on its own choice[5].

[4] FRENCH GUIDE TO CONFORMITY ASSESSMENT AND CERTIFICATION OF HYDROGEN SYSTEMS, available at https://hysafe.info/uploads/papers/2021/171.pdf

[5] FRENCH GUIDE TO CONFORMITY ASSESSMENT AND CERTIFICATION OF HYDROGEN SYSTEMS, available at https://hysafe.info/uploads/papers/2021/171.pdf

2.6.4 APPLICABLE STANDARDS

Table 6 Examples of Harmonised standards under the EMC Directive

Harmonised standards for the EMC Directive	
EN IEC 61000 series	Electromagnetic compatibility (EMC)

2.7 The Low Voltage Directive

Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits applies to electrical equipment designed for use with a **voltage rating of between 50 and 1 000 V for alternating current and between 75 and 1 500 V for direct current**.

2.7.1 APPLICATION TO HYDROGEN TECHNOLOGIES

The Directive is **applicable to most of the hydrogen systems and technologies. In fuel cells**, for example, voltage for alternating current is around 200 to 450 V according to the size of the technology. These products shall comply to the requirements described in the Directive to ensure public safety from physical injury, temperatures and radiation.

2.7.2 CLASSIFICATION APPLICABLE TO HYDROGEN TECHNOLOGIES

N/A

2.7.3 CONFORMITY ASSESSMENT PROCEDURE

Manufacturers do not need to involve a Notified Body in the conformity assessment. It is only required to comply with the information required in the **Module A for the Internal production control**. Specifically, technical documentation should contain (as an example): a general description of the electrical equipment; conceptual design and manufacturing drawings and schemes of components, sub-assemblies, circuits, etc.; a list of the harmonised standards[6] applied in full or in part; results of design calculations made, examinations carried out, etc.; and test reports.

2.7.4 APPLICABLE STANDARDS

Table 7 Examples of Harmonised standards under the Low Voltage Directive

Harmonised standards for Low Voltage Directive	
EN 61349-1	Low-voltage switchgear and control gear assemblies Part 1: general rules

2.8 Gas Appliances Regulations (GAR)

Regulation (EU) 2016/426 of the European Parliament and of the Council of 9 March 2016 on appliances burning gaseous fuels and repealing Directive 2009/142/EC (GAR) covers appliances and fittings used for cooking, heating, refrigeration, air conditioning etc. that burn gaseous fuels. Gaseous fuel, according to Art. 2(6) is “any fuel which is in a gaseous state at a temperature of 15 °C under an absolute pressure of 1 bar”.

[6] Harmonised standards for Low Voltage Directive: https://ec.europa.eu/docsroom/documents/59094

2.8.1 APPLICATION TO HYDROGEN TECHNOLOGIES

The GAR applies to fuel cells used for space heating/ hot water generation and also to appliances burning hydrogen or mixtures of hydrogen and natural gas, as explicitly mentioned in the V4 of the GAR Guidance Sheet[7]. However, the regulations DO NOT cover appliances for use in industrial processes carried out on industrial premises, for use in aircrafts and railways and for temporary use in laboratories for research purposes.

2.8.2 CONFORMITY ASSESSMENT PROCEDURE

The GAR always requires third party involvement in the conformity assessment of products.

2.8.3 APPLICABLE STANDARDS

Table 8 Examples of Harmonised standards under the GAR

Harmonised standards for GAR	
EN 88	Safety and control devices for gas burners and gas burning appliances - Part 1: Pressure regulators for inlet pressures up to and including 50 kPa
EN 1854	Safety and control devices for burners and appliances burning gaseous and/or liquid fuels - Pressure sensing devices for gas burners and gas burning appliances
EN 16898	Safety and control devices for gas burners and gas burning appliances - Gas filters having a maximum working pressure up to and including 600 kPa

2.9 The Restriction of Hazardous Substances (RoHS) Directive

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) applies to equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1000 volts for alternating current and 1500 volts for direct current. The directive targets the elimination of certain hazardous substances from electrical and electronic appliances, such as lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE), bis(2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP) and diisobutyl phthalate (DIBP). The Directive is under review, with inclusion of the proposal to re-attribute scientific and technical tasks under the RoHS Directive to the European Chemicals Agency, which is already in charge of many regulations including the REACH (Registration, Evaluation, Authorisation, and Restriction of Chemicals) regulations.

2.9.1 APPLICATION TO HYDROGEN TECHNOLOGIES

RoHS Directive applies to hydrogen technologies when they contain EEE.

2.9.2 CONFORMITY ASSESSMENT PROCEDURE

The intervention of a notified body is not required.

[7] https://ec.europa.eu/docsroom/documents/60254 accessed Aug 2025; the latest version of the guidance sheets must be accessed from https://single-market-economy.ec.europa.eu/sectors/pressure-equipment-and-gas-appliances/gas-appliances-sector/gas-appliances-regulation_en

2.9.3 APPLICABLE STANDARDS

Table 9 Examples of Harmonised standards under the RoHS Directive

Harmonised standards for RoHS Directive	
EN IEC 63000	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

2.10 ATEX 114 « equipment » Directive

Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres, also called ATEX 114 "equipment" Directive, applies to hydrogen technologies **ONLY if the system does generate an explosive atmosphere outside (but not accidentally, e.g. because of leaks) or it is used in an explosive atmosphere**; internal components used in hydrogen technology systems however must be classified ATEX as they work in the (internal) explosive atmosphere.

Potentially explosive atmospheres are those where gases, vapours, or flammable dusts can mix with air and therefore explode under certain conditions. The **ATEX "equipment" Directive sets requirements for equipment and protection systems intended for use in potentially explosive atmospheres**, **including electrical equipment used on the surface, underground, and in fixed offshore installations.** Additionally, the ATEX Directive is extended to all safety, control, and regulation devices not used within an explosive atmosphere but necessary for the operation of the systems.

To achieve compliancy under this Directive, there are several Harmonised standards that can be applied, and they are listed at the link provided below.

Harmonised standards	
ATEX Equipment Directive (ATEX 114)	https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/equipment-explosive-atmospheres-atex_en The link also contains Guidance on CE Marking and Guidelines on application of the Directive

2.10.1 APPLICATION TO HYDROGEN TECHNOLOGIES

Hydrogen, being a flammable gas, requires careful risk management, and compliance with the ATEX Directive is essential to ensure safety in environments where this fuel is used. **The ATEX directive applies, but it is not limited to, electrolysers, fuel cells, and storage systems**. Thus, **it is a fundamental reference for the certification of hydrogen technologies to be employed in industrial fields and, where necessary, also for mobility sector**. Exceptions must be considered as in some cases products are excluded from the scope of this directive, for example, if intended for:

- Use in a domestic and non-commercial environment, where a potentially explosive atmosphere can rarely be caused and only by an accidental gas leak;
- Maritime ships and mobile offshore units, as well as the equipment used on board such ships or units;
- Means of transport, such as vehicles and their trailers, intended solely for the transportation of people by air, on road networks, railways, or via waterways, and means of transporting goods by air, on road networks or railways, or via waterways; however, vehicles intended to

be used in potentially explosive atmospheres are not excluded from the scope of the ATEX regulations.

In the case of the ATEX Directive, it is not the type of hydrogen device but where it is used that determines the classification.

2.10.2 CLASSIFICATION APPLICABLE TO HYDROGEN TECHNOLOGIES

Hydrogen technologies fall within the classification "Group II devices" as devices intended to be used in "other sites" liable to be endangered by explosive atmospheres.

In this ATEX classification, within Group II, categories 1, 2, and 3 are distinguished. These categories are associated with the level of safety a product can guarantee and the related risk on the environment. Group II devices are further distinguished based on the type of substances present in the explosive atmosphere. **If there is not a risk of a potentially explosive atmosphere outside, the ATEX Directive applies in any case to components that should be used inside the technology.**

The category depends on the required safety level and the environment in which hydrogen technology operates. To define such categories, zoning is necessary and the technical standard EN 60079 -10-1 is used for this scope. For example, in Italy the classification of dangerous zones is reported in the CEI EN 60079-10-1 Standard. According to this technical standard, dangerous areas can be classified based on the frequency and duration of occurrence of explosive atmospheres into the defined zones:

- **Zone 0**: An area where an explosive atmosphere consisting of a mixture of air and flammable substances in the form of gas, vapor, or mist is present continuously/ for long periods/ frequently;
- **Zone 1**: An area where, during normal activities, the formation of an explosive atmosphere consisting of a mixture of air and flammable substances in the form of gas, vapours, or mist is likely;
- **Zone 2**: An area where, during normal activities, the formation of an explosive atmosphere consisting of a mixture of air and flammable substances in the form of gas, vapor, or mist is not likely and, if it does occur, it is only of short duration.

2.10.2.1 CATEGORY 1

If a hydrogen technology device is intended for environments where an explosive atmosphere due to mixtures of air and gas, vapours, mists, or air and dust mixtures is always, often, or for long periods present, then the classification requires the highest safety requirements (category 1). Devices in this category must meet additional requirements. In particular, in the case of gas, vapour, or mist atmospheres, the following information may be of interest to authorities involved in safety aspects. The device:

- must be equipped with independent protection features;
- the temperature of surfaces that can heat up must be kept below the maximum prescribed;
- must be designed so that the parts that can constitute a source of ignition can only be opened in the absence of energy or in conditions of intrinsic safety. If it is not possible to deactivate the devices, the manufacturer must affix a warning label on the accessible parts of the devices. If necessary, the devices must be equipped with suitable additional opening mechanisms.

2.10.2.2 CATEGORY 2

Devices classified as category 2 are intended for environments where explosive atmospheres due to gas, vapours, mists, or mixtures of air and dust are likely to occur. Devices in this category must

also meet additional requirements. For example, requirements concern the temperature of heating surfaces and access to parts of the plant that can constitute an ignition source.

2.10.2.3 CATEGORY 3

Devices classified as category 3 are intended for environments where there is a low probability of explosive atmospheres due to gas, vapours, mists, or mixtures of air and dust occurring, and if it does occur, it is only for a short duration. Devices in this category must meet additional requirements. In particular, surface temperatures must not exceed the maximum temperatures indicated by the manufacturer. Exceeding is tolerable, in exceptional cases, if the manufacturer adopts additional special protection measures.

2.10.3 CONFORMITY ASSESSMENT PROCEDURE

The conformity assessment procedures for Group II devices and the different categories 1,2,3 vary according to the component of risk. Regarding the modules to be submitted, ATEX directive requires the Module C1: conformity to the type based on Internal production control plus supervised product testing. In this case, together with the technical documentation, the manufacturer should test for each individual product under all those aspects considered relevant. The Notified Body is present to supervise and control such tests.

Furthermore, for Group II and category 1 devices, the conformity assessment procedure requires the involvement of a notified body and consists of the EU type examination procedure (Module B) plus one of the following procedures:

- conformity to type procedure based on the quality assurance of the production process (Module D); or
- conformity to type procedure based on product verification (Module F).

For hydrogen technologies configured as category 2 devices, the conformity assessment procedure is structured as follows:

- for internal combustion engines and electrical devices belonging to Group II and category 2, the EU type examination procedure (Module B) must be followed, combined with one of the following procedures:
    - conformity to type based on internal production control combined with product testing under official control (Module C1), or
    - conformity to type based on product quality assurance (Module E);
- for other devices belonging to Group II and category 2, the internal production control (Module A) and submission to a notified body of the technical documentation must be done.

For Group II devices, category 3, the conformity assessment procedure consists of the internal production control (Module A). For Group II devices, in addition to the previously described procedures, it is possible to follow the conformity assessment procedure based on unit verification (Module G).

2.10.4 APPLICABLE STANDARDS

The table below shows some of the standards that apply to hydrogen technologies.

Table 10 Examples of Harmonised standards under ATEX Directive for electrolysers, storage systems and fuel cells

Harmonised standards for ATEX Directive	
EN 1127-1	Explosive atmospheres – Explosion prevention and protection - Part 1: Basic concepts and methodology
EN 60079-0 to -32	Explosive atmospheres - Explosive atmospheres, in particular Part 0 : equipment - General requirements; Part 29-1: Gas detectors - Performance requirements of detectors for flammable gases; Part 30: Electrical resistance trace heating - General and testing requirements
EN ISO/IEC 80079-34 and -36	Explosive atmospheres - Part 34: Application of quality systems for equipment manufacture; Part 36 : non-electrical equipment for use in explosive atmospheres - Basic methods and requirements

2.11 ATEX 137 « workplace » Directive

Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres is relevant for the operation of hydrogen technologies, and, specifically, for the protection of the operators themselves.

A useful standardisation document has been produced by the European Industrial Gases Association (EIGA): Doc 250, Standard Procedures for Hydrogen Supply Systems[8]. This is part of an effort of harmonisation of the industry standards and it is intended to be used worldwide by the members of the European, Asia, Japan and American Gas Associations.

[8] https://www.eiga.eu/uploads/documents/DOC250.pdf

2.12 Summary of applicable Directives/ Regulations by hydrogen technology /systems

The table below maps the applicability of the Directives and Regulations vs hydrogen technologies /systems, summarising the information provided in the sections above.

Table 11 Summary of applicability of Directives /Regulations to hydrogen technologies

	Pressure Equipment Directive and harmonised standards[9]	Machinery Directive/ Regulations (from Jan 2027) and harmonised standards[10]	Electromagnetic Compatibility Directive (EMC) and harmonised standards[11]	Low Voltage Directive and harmonised standards[12]	Gas Appliances regulations and harmonised standards[13]	RoHS Directive and harmonised standards[14]	ATEX equipment Directive and harmonised standards[15]
General components	✓ (if pressurised)	✓	✓	✓		✓	✓
Hydrogen storage	✓	✓	✓	✓		✓	
Electrolysers	✓	✓	✓	✓		✓	
Fuel Cells	✓	✓	✓	✓		✓	
Compressors	✓	✓	✓	✓		✓	
Residential and industrial appliances burning gaseous fuels		✓	✓	✓	✓	✓	

Please refer to Section 3 for additional, non-harmonised standards that might support the certification of hydrogen components/ devices/ systems.

[9] https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/pressure-equipment_en

[10] https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/machinery-md_en

[11] https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/electromagnetic-compatibility-emc_en

[12] https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/low-voltage-lvd_en

[13] https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/gas-appliances_en

[14] https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/restriction-use-certain-hazardous-substances-rohs_en

[15] https://single-market-economy.ec.europa.eu/single-market/goods/european-standards/harmonised-standards/equipment-explosive-atmospheres-atex_en

3 Specific standards applicable to hydrogen technologies, including standards for safety of installation and operation of systems

In this section are collected the references to all standards and codes that specifically refer to hydrogen and its technologies, including technical documents dealing with installation and operation of the hydrogen technologies. Where specifically indicated by the issuer, the standards to be used for certification purposes have been identified with "CERT".

This table has been compiled mostly on the basis of the Hysafe project documentation[16], the experience presented in D2.3, the European Hydrogen Observatory[17], and recent standardisation activity being conducted by the standardisation bodies, starting from the CEN-CENELEC[18]. Only SPECIFIC, non-harmonised standards are included, and examples of those for which development is known (or reference working groups within standard organisations); for harmonised standards, reference must be made to the lists linked from Table 2.

Further references are provided to available industrial codes and guidance being applied, taking as main reference, but not limiting to, European-based associations. These Codes of practice and guidance documents are based on experience by members of the associations but do not undertake the same validation process as standards from standardisation bodies, hence their application is voluntary with no liability by the issuers of the documents themselves. Furthermore, the information provided is updated at August 2025 but must be checked by the users for validity and latest updates.

The European Industrial Gases Association, together with the sister associations from Asia (AIGA), US and Canada (CGA) and Japan (JIMGA) have developed the H2safety web platform[19], which constitutes an important reference point for hydrogen standards and codes with a specific attention to safety. These have been incorporated in the table below and highlighted with an asterisk.

[16] https://hysafe.info/uploads/papers/2021/171.pdf
[17] https://observatory.clean-hydrogen.europa.eu/hydrogen-landscape/policies-and-standards/codes-and-standards
[18] https://www.cencenelec.eu/areas-of-work/cen-sectors/energy-and-utilities-cen/hydrogen/ and the Hydrogen Standardisation Landscape version June 2025 https://www.cencenelec.eu/media/CEN-CENELEC/AreasOfWork/CEN%20sectors/Energy%20and%20Utilities/annex-1_hydrogen-standardization-landscape_2025-06-25.pdf
[19] https://www.h2safety.info/

Table 12 List of standards and codes specifically developed/including specific reference to hydrogen.

Key:
- "*" mostly related to safety; sourced from the H2safety.info website and the Publication area of the EIGA https://www.eiga.eu/publications
- (CER) can be used for certification purposes;
- (UNDER DEVELOPMENT) or (UNDER REVISION) refer to standards not yet finalised or under review; f
- for all other standards, the latest version MUST be used

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
Hydrogen and hydrogen technologies/systems: generalities including safety aspects also during operation	EN ISO 24078 Hydrogen in energy systems – Vocabulary ISO/TS 15916 Hydrogen technologies — Basic considerations for the safety of hydrogen systems (UNDER DEVELOPMENT) EN 1839 Determination of the explosion limits and the limiting oxygen concentration(LOC) for flammable gases and vapours EN 15198 Methodology for the risk assessment of non-electrical equipment and components for intended use in potentially explosive atmospheres (UNDER DEVELOPMENT) EN 15967 Determination of maximum explosion pressure and the maximum rate of pressure rise of gases and vapours EN 17624 Determination of explosion limits of gases and vapours at elevated pressures, elevated temperatures or with oxidizers other than air EN ISO/IEC 80079-20 and -49 Explosive atmospheres – Part Part 20-1: Material characteristics for gas and vapour classification and Part 49: Flame arresters EN 1776 Gas infrastructure - Gas measuring systems – Functional requirements

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	ISO 13734 Natural gas -- Organic components used as odorants -- Requirements and test methods OIML R 81 Dynamic measuring devices and systems for cryogenic liquids EIGA DOC 255 / 24 - EIGA Cryogenic Gases Couplings for Tanker Filling* EIGA DOC 252 / 24 - Safety Critical Devices* EIGA DOC 250 / 24 - Standard Procedures for Hydrogen Supply Systems* EIGA DOC 243 / 22 - Guideline on Remedial Actions for HYCO Plant Components Subject to High Temperature Hydrogen Attack* EIGA DOC 238 / 22 - Prevention of Plant Instrument and Utility Gas System Cross Contamination* EIGA DOC 233 / 20 - Emergency Response Planning* EIGA DOC 215 / 18 - HYCO Plant Gas Leak Detection and Response Practices* EIGA DOC 190 / 21 - Plant Integrity Management* EIGA DOC 10201 / 20 - Listing of Safety Audit Assessment Tools *and referred documents thereof** EIGA DOC 15 / 21 - Gaseous Hydrogen Installations* EIGA DOC 6 / 19 - Safety in Storage, Handling and Distribution of Liquid Hydrogen* NFPA 2, Hydrogen Technologies Code* NFPA 55, Compressed Gases and Cryogenic Fluids Code* *See also specific technologies/ systems*

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
Hydrogen technologies and applications, environmental assessments	EN ISO 19870 series: Hydrogen technologies - Methodology for determining the greenhouse gas emissions associated with the hydrogen supply chain (UNDER DEVELOPMENT) ISO 52000 series Energy performance of buildings -- Overarching EPB assessment EIGA DOC 220 / 19 - Environmental Guidelines for Permitting Hydrogen plants producing less than 2 tonnes per day* EIGA DOC 122 / 18 - Environmental Impacts of Hydrogen Plants* EIGA TP019 Hydrogen Plants Environmental Issues *See also specific applications, namely: hydrogen-fuelled vehicles*
Hydrogen quality	EN 16325 Guarantees of origin related to energy EN 17124 Hydrogen fuel - Product specification and quality assurance - Proton exchange membrane (PEM) fuel cell applications for road vehicles EN 16726 Gas infrastructure - Quality of gas - Group H (UNDER DEVELOPMENT) CEN/TS 17977 Gas infrastructure - Quality of gas - Hydrogen used in rededicated gas systems ISO 19229 Gas analysis — Purity analysis and the treatment of purity data ISO 14687 Hydrogen fuel quality — Product specification
Pipelines/ distribution network	EN 13942 Petroleum and natural gas industries - Pipeline transportation systems - Pipeline valves (modified version of the ISO below) ISO 14313 Oil and gas industries including lower carbon energy — Pipeline transportation systems — Pipeline valves

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	EN ISO 4126 series Safety devices for protection against excessive pressure EN ISO 7539-11 Corrosion of metals and alloys - Stress corrosion testing – Part 11: Guidelines for testing the resistance of metals and alloys to hydrogen embrittlement and hydrogen-assisted cracking EN 13774 Valves for gas distribution systems with maximum operating pressure less than or equal to 16 bar – Performance requirements EN 14141Valves for natural gas transportation in pipelines - Performance requirements and tests ISO/TS 16922 2022 Natural gas — Odorization EIGA DOC 254 / 24 - Guidelines for Pressure Testing of Field-Installed Piping and Equipment* EIGA DOC 235 / 21 - Industrial Gas Pipeline Integrity Management* EIGA DOC 121 / 14 - Hydrogen Pipeline Systems* *See also Piping below*

Hydrogen and hydrogen technology/device/system		Relevant specific standards and codes
Gas cylinders	Generic	Please see the latest version of "Hydrogen standardization landscape - Technical Committees and Standards EN ISO" published regularly by the CEN/CENEL at : https://www.cencenelec.eu/areas-of-work/cen-sectors/energy-and-utilities-cen/hydrogen/ and the European Hydrogen Observatory data base https://observatory.clean-hydrogen.europa.eu/hydrogen-landscape/policies-and-standards/codes-and-standards EIGA DOC 100 / 20 - Hydrogen Cylinders and Transport Vessels* This field is already well-developed, being hydrogen a well-known technical gas that is commonly stored in cylinders.
	Transportable (might be additional to standards above)	Please see the latest version of "Hydrogen standardization landscape - Technical Committees and Standards EN ISO" published regularly by the CEN/CENEL at : https://www.cencenelec.eu/areas-of-work/cen-sectors/energy-and-utilities-cen/hydrogen/ and the European Hydrogen Observatory data base https://observatory.clean-hydrogen.europa.eu/hydrogen-landscape/policies-and-standards/codes-and-standards EIGA DOC 100 / 20 - Hydrogen Cylinders and Transport Vessels* This field is already well-developed, being hydrogen a well-known technical gas that is commonly transported in cylinders.
Generic components, also including safety aspects at installation:	Vents (applicable to vent systems of hydrogen installations with capacity less than 5000 Nm3/hr of hydrogen, including: • A fixed or transportable gaseous storage	EIGA DOC 211/24 Hydrogen vent systems for customer applications[20]* CGA G-5.5-2021 Standard for Hydrogen Vent Systems - 4th Edition*

[20] https://www.eiga.eu/ct_documents/doc211-pdf/ accessed Aug 2025

Hydrogen and hydrogen technology/device/system		Relevant specific standards and codes
	connected to a piping distribution network at low or high pressure through a gas pressure release system; • A fixed or transportable liquid storage connected to a piping distribution network at low or high pressure through a pump / vaporizer; • A gaseous compressor to increase hydrogen pressure up to 1000 bar; • A high pressure hydrogen storage up to 1000 bar; • One or more hydrogen dispensing systems to fuel hydrogen powered vehicles; and • Stationary fuel cells systems.)	
	Piping/ tubes and connections	EN 1555 series: Plastics piping systems for the supply of gaseous fuels -Polyethylene *including* CEN/TS 1555-7 Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 7: Guidance for the assessment of conformity (CER) EN ISO 10931 Plastics piping systems for industrial applications - Poly(vinylidene fluoride) (PVDF) - Specifications for components and the system

Hydrogen and hydrogen technology/device/system		Relevant specific standards and codes
		EN ISO 15493 Plastics piping systems for industrial applications — Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) and chlorinated poly(vinyl chloride) (PVC-C) — Specifications for components and the system — Metric series EN ISO 15494 Plastics piping systems for industrial applications – Polybutene (PB), polyethylene (PE), polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X), polypropylene (PP) - Metric series for specifications for components and the system EN ISO 16486 series Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing – *includes* EN ISO 16486-7 Part 7 - Assessment of conformity (CER) EN 10216 series Seamless steel tubes for pressure purposes – Technical delivery conditions EN 10217 series Welded steel tubes for pressure purposes - Technical delivery conditions EN 549+A2 Rubber materials for seals and diaphragms for gas appliances and gas equipment EN 682 Elastomeric seals -- Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids EN 751 series Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water EN ISO 15330 Fasteners -- Preloading test for the detection of hydrogen embrittlement -- Parallel bearing surface method

Hydrogen and hydrogen technology/device/system		Relevant specific standards and codes
		EN 1594 Gas infrastructure - Pipelines for maximum operating pressure over 16 bar - Functional requirements EN 12007 series Gas infrastructure - Pipelines for maximum operating pressure up to and including 16 bar EN 15001-1 Gas Infrastructure - Gas installation pipework with an operating pressure greater than 0,5 bar for industrial installations and greater than 5 bar for industrial and non-industrial installations ISO 21036 Plastics piping systems for industrial applications — Unplasticized Polyamide (PA-U) — Metric series for specifications for components and system *Please see also Cylinders section as many cylinders standards might apply*
	Industrial burners (might also be applied to residential appliances)	EN 298 Automatic burner control systems for burners and appliances burning gaseous or liquid fuels EN 12067 – 2 Safety and control devices for burners and appliances burning gaseous or liquid fuels - Control functions in electronic systems - Part 2: Fuel/air ratio control / supervision of the electronic type EN 13611 Safety and control devices for burners and appliances burning gaseous and/or liquid fuels - General requirements EN 16340 Safety and control devices for burners and appliances burning gaseous or liquid fuels - Combustion product sensing devices EN 676 Forced draught burners for gaseous fuels
	Valves	EN 12266-1 Industrial valves — Testing of valves — Part 1: Pressure tests, test procedures and acceptance criteria – Mandatory requirements

Hydrogen and hydrogen technology/device/system		Relevant specific standards and codes
		EN 331 Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings EN 334+A1 Gas pressure regulators for inlet pressure up to 10 MPa (100 bar) EN 14382+A1 Gas safety shut-off devices for inlet pressure up to 10 MPa (100 bar) EN ISO 15848 (series) Industrial valves - Measurement, test and qualification procedures for fugitive emissions ISO 21011 Cryogenic vessels — Valves for cryogenic service
	Detection systems	ISO 26142 Hydrogen detection apparatus — Stationary applications (CERT)
Industrial applications		EN 746 series Industrial thermoprocessing equipment EN ISO 13577- 2 and -4 Industrial furnaces and associated processing equipment — Safety EN ISO 21789 Gas turbine – Safety EN 12309 series Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW ISO 2314 Gas turbines — Acceptance tests ISO 3977 (series) Gas turbines – Procurement ISO 11042 (series) Gas turbines — Exhaust gas emissions ISO 11086 Gas turbines — Vocabulary

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	ISO 18888 2017 Gas turbine combined cycle power plants — Thermal performance tests (UNDER REVISION) ISO 19372 2015 Microturbines applications — Safety Industrial application ISO 19859 2016 Gas turbines — Power generation applications ISO 19860 2005 Gas turbines — Data acquisition and trend monitoring system requirements for gas turbine installations ISO 3046 (series) Reciprocating internal combustion engines — Performance ISO 15550 2016 Internal combustion engines — Determination and method for the measurement of engine power — General requirements
Electrolysers and other systems connected with production, other production methods	ISO 22734 Hydrogen generators using water electrolysis process - Industrial, commercial, and residential applications ISO/TS 22734-2 Hydrogen generators using water electrolysis — Part 2: Testing guidance for performing electricity grid service (UNDER DEVELOPMENT) ISO 16110 series Hydrogen generators using fuel processing technologies ISO/TS 19883 Safety of pressure swing adsorption systems for hydrogen separation and purification EIGA DOC 246/23 Guideline for small scale hydrogen production* EIGA DOC 242 / 22 - Safety of Hydrogen, HyCO production and Carbon Capture* EIGA DOC 210 / 23 - Hydrogen Pressure Swing Adsorber (PSA) Mechanical Integrity Requirements* EIGA DOC 185 / 20 - Safe Start Up and Shutdown Practices for Steam Reformers*

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	EIGA DOC 172 / 24 - Combustion Safety for Steam Reformer Operation* EIGA DOC 155 / 21 - Best Available Techniques for Hydrogen Production by Steam Methane Reforming*
Compressors, pumps	EIGA DOC 244 / 23 - Reciprocating Cryogenic Pumps and Pump Installations for Hydrogen and Liquified Natural Gas* EIGA DOC 102 Safety Audit /Assessment Tool – Hydrogen Compression, Purification and Cylinder Filling
High pressure storage	EN 17533 Gaseous hydrogen - Cylinders and tubes for stationary storage
Storage as metal hydrides	ISO 16111 Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride (only applicable to transportable storage systems)
Other storage[21]	ISO 19888 Hydrogen Technologies — Aerial Vehicles — Part 1: Liquid Hydrogen Fuel Storage System EN 13371 Cryogenic vessels - Couplings for cryogenic service EIGA DOC 171 / 23 - Storage of Hydrogen in Systems Located Underground* EIGA DOC 006 Safety in Storage, Handling and Distribution of Liquid Hydrogen* *See also Hydrogen- fuelled vehicles incl. ships and railway vehicles*
Fuel cells	EN IEC 62282 series: Fuel cell technologies *See also Hydrogen- fuelled vehicles incl. ships and railway vehicles*

[21] Standards related to storage in aquifers, oil& gas depleted field, salt mines etc has not been considered here

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
Hydrogen refuelling stations	EN 17127: Outdoor hydrogen refuelling points dispensing gaseous hydrogen and incorporating filling protocols EN ISO 17268 : Gaseous hydrogen land vehicle refuelling connection devices (UNDER DEVELOPMENT) ISO 19880-1 to 8 series : Gaseous hydrogen - Fuelling stations (only part 1, 3, 5 and 8 have been published, the other are still work in progress at ISO TC 197) ISO 19885 series Gaseous hydrogen — Fuelling protocols for hydrogen-fuelled vehicles ISO 13984 Liquid hydrogen -- Land vehicle fuelling system interface N ___ (00268090) Outdoor hydrogen refuelling points dispensing liquified hydrogen and incorporating filling protocols (UNDER DEVELOPMENT) EN ___ (00268091) Specifications for gaseous hydrogen refuelling points for maritime and inland waterways vessels (UNDER DEVELOPMENT) The following SAE standards are cited as reference in ISO 19880- 1 and EN 17127 for interoperability and management of the fuelling protocols SAE J2600-2015 Compressed Hydrogen Surface Vehicle Fuelling Connection Devices SAE J2601 Series : SAE J2601-2020 Fuelling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles SAE J2601-2-2014 Fuelling Protocol for Gaseous Hydrogen Powered Heavy Duty Vehicles

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	SAE J2601-3-2013 Fuelling Protocol for Gaseous Hydrogen Powered Industrial Trucks SAE J2799-2019 Hydrogen Surface Vehicle to Station Communications Hardware and Software *See also Hydrogen vehicles*
Hydrogen- fuelled vehicles incl. ships and railway vehicles	ISO 12619 series Road Vehicles -- Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components ISO 15500 series Road Vehicles -- Compressed natural gas (CNG) fuel system components ISO/TR 11954 Fuel cell road vehicles -- Performance measurement -- Vehicles fuelled with compressed hydrogen ISO 23273 Fuel cell Road Vehicles -- Safety specifications -- Protection against hydrogen hazards for vehicles fuelled with compressed hydrogen OIML R139-1 Compressed gaseous fuel measuring systems for vehicles ISO 19881 Gaseous hydrogen — Land vehicle fuel containers ISO 19882 Gaseous hydrogen Thermally activated pressure relief devices for compressed hydrogen vehicle fuel containers ISO 13985 Liquid hydrogen — Land vehicle fuel tanks ISO 19887-1 Gaseous Hydrogen -- Fuel system components for hydrogen-fuelled vehicles -- Part 1: Land vehicles

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	ISO 23828 Fuel cell road vehicles -- Energy consumption measurement -- Vehicles fuelled with compressed hydrogen ISO/TR 8713 Electrically propelled road vehicles -- Vocabulary ISO 21498-2 Electrically propelled road vehicles -- Electrical specifications and tests for voltage class B systems and components -- Part 2: Electrical tests for components ISO 21782 series Electrically propelled Road Vehicles -- Test specification for electric propulsion components ISO 6469 series Electrically propelled road vehicles -- Safety specifications ISO 8714 Electric road vehicles -- Reference energy consumption and range -- Test procedures for passenger cars and light commercial vehicles ISO 8715 Electric Road Vehicles -- Road operating characteristics ISO/TS 5474-5 Electrically propelled road vehicles -- Functional and safety requirements for power transfer between vehicle and external electric circuit -- Part 5: Automatic conductive power transfer ISO 18243 Electrically propelled mopeds and motorcycles -- Test specifications and safety requirements for lithium-ion battery systems ISO 23274 series Hybrid-electric road vehicles -- Exhaust emissions and fuel consumption measurements EN 45545-7 Railway applications - Fire protection on railway vehicles – Part 7: Fire safety requirements for flammable liquid and flammable gas installations IEC 63341-3 Railway applications - Fuel cell systems for rolling stock – Part 3: Performance test methods for fuel cell power systems

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	EN IEC 63341-1 Railway applications - Rolling stock - Fuel cell systems for propulsion - Part 1: Fuel cell system EN IEC 63341-2 Railway applications - Hydrogen and fuel cell systems for rolling stock - Part 2: Hydrogen fuel system EN ISO 20519 2022 Ships and marine technology — Specification for bunkering of liquefied natural gas fuelled vessels EN ISO 21593 Ship and marine technology - Technical requirements for dry-disconnect/connect couplings for bunkering liquefied natural gas ISO 24132 Ships and marine technology — Design and testing of marine transfer arms for liquefied hydrogen (UNDER REVISION) ISO 11326 Ships and marine technology — Test procedures for liquid hydrogen storage tank of hydrogen ships
Hydrogen technologies in the built environment (residential and stationary applications) – generic, safety	CEN/TR (WI JT006002) Safe use of hydrogen in built constructions (UNDER DEVELOPMENT) CEN/TS (WI J006004) Hydrogen Gas Safety in Enclosed Spaces (UNDER DEVELOPMENT) CEN/TR 17924 Safety and control devices for burners and appliances burning gaseous and/or liquid fuels - Guidance on hydrogen specific aspects EN 125+A1 Flame supervision devices for gas burning appliances - Thermoelectric flame supervision devices EN 126 Safety and control devices for burners and appliances burning gaseous fuels - Multifunctional controls

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	EN 50194 (series) Electrical apparatus for the detection of combustible gases in domestic premises (to revise for H2) EN 437 Test gases - Test pressures - Appliance categories EN 15069 Safety gas connection valves for metal hose assemblies used for the connection of domestic appliances using gaseous fuel IEC 62932 Flow battery energy systems for stationary applications -- Part 1: Terminology and general aspects *See also Generic components, also including safety aspects at installation:*
Heat pumps	EN 16905 - 2 Gas-fired endothermic engine driven heat pumps - Part 2: Safety (UNDER REVISION)
Gas appliances incl. domestic cooking appliances, decorative appliances, space heaters	EN 50465+A1 Gas appliances - Combined heat and power appliance of nominal heat input inferior or equal to 70 kW EN 509 Decorative fuel-effect gas appliances EN 30-1-2 Domestic cooking appliances burning gas - Part 1-2: Safety - Appliances having forced-convection ovens EN 13278 Open fronted gas-fired independent space heaters EN 14829 Independent gas-fired flueless space heaters for nominal heat input not exceeding 6 kW EN 14438 Gas-fired insets for heating more than one room EN 1266 Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases

Hydrogen and hydrogen technology/device/system	Relevant specific standards and codes
	See also Industrial burners above
Water heaters (instantaneous and storage)	EN 26 Gas-fired instantaneous water heaters for the production of domestic hot water EN 89 Gas-fired storage water heaters for the production of domestic hot water *See also Industrial burners above*
Heating boilers	EN 303 1-6 Heating boilers EN 15502 series – Gas-fired heating boilers (UNDER DEVELOPMENT) *and specifically:* CEN/TS 15502-3-3 Gas-fired central heating boilers — Part 3-3: Hydrogen —Expansion of EN 15502—1 Safety and -2 Specific standards for type B1 appliances *See also Industrial burners above*

Key:
- "*" mostly related to safety; sourced from the H2safety.info website and the Publication area of the EIGA https://www.eiga.eu/publications
- (CER) can be used for certification purposes;
- (UNDER DEVELOPMENT) or (UNDER REVISION) refer to standards not yet finalised or under review; f
- or all other standards, the latest version MUST be used

4 Conclusions

Project HYPOP interacted with stakeholders, more specifically manufacturers and developers of innovative technologies, to understand how they achieved or worked to achieve CE marking.

The most relevant Directives and Regulations for hydrogen technologies have been identified, on the basis of the experience shared and a desktop review of the main reference tools on standards relevant to hydrogen. Such Directives and Regulations are widely applied in Europe as they support the single market: CE marking is indeed a prerequisite for the commercialisation of any product within Europe.

The common regulatory framework and the experience of manufacturers and certifying bodies with pre-existing Directives and Regulations means that a strong reference base exists for the certification of hydrogen systems, including for innovative systems. The body of harmonised standards is also complemented by specific standards and industry guidance being developed (or existing standards to be revised) to take into account the specificities of hydrogen.

Significant ongoing effort among various standardisation bodies to address sector-specific needs while ensuring that hydrogen technologies can be safely integrated into existing and new markets. The collaboration between these technical committees and stakeholders is crucial for the innovative and safe expansion of hydrogen technology applications across residential, mobility, and industrial sectors. This cooperative approach not only addresses the current regulatory and safety challenges but also prepares the hydrogen economy for future growth and integration into diverse markets.

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