

Chapter 4 Standards
September 2020



This report is based on data gathered as part of the Fuel Cells and Hydrogen Observatory as at 31 December 2019. The authors believe that this information comes from reliable sources, but do not guarantee the accuracy or completion of this information. The Observatory and information gathered within it will continue to be revised. These revisions will take place annually and can also be done on a case by case basis. As a result, the information used as of writing of this report might differ from the changing data in the Observatory.

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Executive Summary

Summary of the patents report is shown as follows:

Purpose:	<i>The Standards module of the FCHO presents a large number of standards relevant for the deployment of hydrogen and fuel cells. The standards are categorized in order to enhance ease of access and usability. The development of sector-relevant standards facilitates and enhances economies of scale, interoperability, comparability, safety, and many other issues.</i>
Scope:	<i>The database presents European and International standards. Standards from the following standards developing organizations are included: CEN, CENELEC, ISO, IEC, OIML. The report spans January 2019 – December 2019.</i>
Key Findings:	<i>The development of sector relevant standards on an international level continued to grow in 2019, on European level many standards are still in the process of being drafted. The recently established CEN-CLC JTC 6 (Hydrogen in energy systems) has not published standards yet, but is working on drafting standards on, for example, Guarantees of Origin.</i>

1. Standards

1.1. Introduction

The Standards data stream aims to provide users of the Fuel Cells and Hydrogen Observatory with all relevant European and international European Standards and other technical specifications for a wide range of fuel cell and hydrogen related applications. Standards are voluntary jointly applicable agreements on any given topic between all parties concerned. Standardization refers to the consensus-driven processes outside of government¹ which solve a myriad of problems, from safety to compatibility. A standard can address a process, a product or a service. An agreement on any topic is reached when all stakeholders at the table reach a consensus. All relevant stakeholders can participate in the process of drafting the standard. Standardization occurs on a national level, regional (e.g. European) level and international level.

1.2. Recent developments & trends

This paragraph describes relevant standardization-related developments on a European level, it includes:

- CEN-CENELEC Sector Forum Energy Management Working Group Hydrogen
- CEN / CLC / JTC 6 “Hydrogen in energy systems”
- Standardization Request from the European Commission to CEN / CENELEC Management Center for Hydrogen
- CEN Project “Pre normative research on hydrogen in natural gas and natural gas infrastructure”

For an up to date and current overview of all Working Programs and all published standards per relevant Technical Committee, please consult the table below and use the hyperlinks:

Standardization Organization	Technical committee	Committee title	Link to TC Work Programme	Link to TC Published standards
CEN	CEN/TC 23	Transportable gas cylinders	CEN/TC 23 Work Programme	CEN/TC 23 Published Standards
CEN	CEN/TC 49	Gas cooking appliances	CEN/TC 49 Work Programme	CEN/TC 49 Published Standards
CEN	CEN/TC 62	Independent gas-fired space heaters	CEN/TC 62 Work Programme	CEN/TC 62 Published Standards
CEN	CEN/TC 69	Industrial valves	CEN/TC 69 Work Programme	CEN/TC 69 Published Standards
CEN	CEN/TC 109	Central heating boilers using gaseous fuels	CEN/TC 109 Work Programme	CEN/TC 109 Published Standards
CEN	CEN/TC 185	Fasteners	CEN/TC 185 Work Programme	CEN/TC 185 Published Standards
CEN	CEN/TC 197	Pumps	CEN/TC 197 Work Programme	CEN/TC 197 Published Standards
CEN	CEN/TC 208	Elastomeric seals for joints in pipework and pipelines	CEN/TC 208 Work Programme	CEN/TC 208 Published Standards
CEN	CEN/TC 234	Gas infrastructure	CEN/TC 234 Work Programme	CEN/TC 234 Published Standards

¹ Note: governmental institutions) can still be stakeholders of an issue, and therefore be part of the standardization process.

CEN	CEN/TC 235	Gas pressure regulators and associated safety devices for use in gas transmission and distribution	CEN/TC 235 Work Programme	CEN/TC 235 Published Standards
CEN	CEN/TC 236	Non industrial manually operated shut-off valves for gas and particular combinations valves-other products	CEN/TC 236 Work Programme	CEN/TC 236 Published Standards
CEN	CEN/TC 238	Test gases, test pressures, appliance categories and gas appliance types	CEN/TC 238 Work Programme	CEN/TC 238 Published Standards
CEN	CEN/TC 268	Cryogenic vessels and specific hydrogen technologies applications	CEN/TC 268 Work Programme	CEN/TC 268 Published Standards
CEN	CEN/TC 282	Installation and equipment for LNG	CEN/TC 282 Work Programme	CEN/TC 282 Published Standards
IEC	IEC/TC 21	Secondary cells and batteries	IEC/TC 21 Work Programme	IEC/TC 21 Published Standards
IEC	IEC/TC 31	Equipment for explosive atmospheres	IEC/TC 31 Work Programme	IEC/TC 31 Published Standards
IEC	IEC/TC 105	Fuel cell technologies	IEC/TC 105 Work Programme	IEC/TC 105 Published Standards
ISO	ISO/TC 22	Road vehicles	ISO/TC 22 Work Programme	ISO/TC 22 Published Standards
ISO	ISO/TC 58	Gas cylinders	ISO/TC 58 Work Programme	ISO/TC 58 Published Standards
ISO	ISO/TC 138	Plastics pipes, fittings and valves for the transport of fluids	ISO/TC 138 Work Programme	ISO/TC 138 Published Standards
ISO	ISO/TC 163	Thermal performance and energy use in the built environment	ISO/TC 163 Work Programme	ISO/TC 163 Published Standards
ISO	ISO/TC 192	Gas turbines	ISO/TC 192 Work Programme	ISO/TC 192 Published Standards
ISO	ISO/TC 193	Natural gas	ISO/TC 193 Work Programme	ISO/TC 193 Published Standards
ISO	ISO/TC 197	Hydrogen technologies	ISO/TC 197 Work Programme	ISO/TC 197 Published Standards
OIML	OIML/TC 8	Measurement of quantities of fluids	OIML/TC 8 Work Programme	OIML/TC 8 Published Standards
OIML	OIML/TC 8/SC 6	Measurement of cryogenic liquids	OIML/TC 8/SC 6 Work Programme	OIML/TC 8/SC 6 Published Standards

[CEN-CENELEC Sector Forum Energy Management Working Group Hydrogen](#)

Last year the CEN-CENELEC Sector Forum Energy Management Working Group Hydrogen (SFEM WG Hydrogen) published an updated report. The initial 2015 report aimed to further support Research, Development & Innovation, (RDI); to boost Pre-Normative Research (PNR) and identify standardization work with the objective to address this at the relevant standardization bodies. The 2019 update includes an update of the Executive Summary, the major improvements that have been made and new challenges, projects and relevant initiatives launched since the 2015 report.

The updated report can be found on the EC Search EU SCIENCE HUB 'The European Commission's science and knowledge service', through this link: <https://ec.europa.eu/jrc/en/publication/cen-cenelec-sector-forum-energy-management-working-group-hydrogen-2018-update-report>

The main objective of the CEN-CENELEC SFEM WG Hydrogen is to perform an analysis on the state-of-the-art technology and standardization, and a gap analysis on the main barriers including challenges and needs. A second objective is to establish contact with key stakeholders from the gas sector, electricity supply, mobility and the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) in order to perform the work in the most effective way and to have broad support from the stakeholders to identify the key challenges. Furthermore, the link to EC services (DG JRC, DG RTD, DG ENER and DG GROW) was seen as important. The final objective is to set a long term collaborative framework (liaison) with major bodies for strengthening cooperation between regulatory work, standardization work and RDI programs (e.g. European Commission, JRC, FCH 2 JU, IEA Task 38, ISO, IEC). There is a regular exchange of information with the RCS strategy coordination group of the FCH JU.

In the report you will be able to find a broad overview of the RDI, PNR and standardization developments. The information has been structured through tables and update of roadmaps for the Taskforces:

- Task Force 1/2: Electricity grid connection and electrolysers
- Task Force 3: Natural gas system and usage
- Task Force 4: Hydrogen system and usage

For Task Force 5 Cross-cutting issues (safety, training, policy, etc.) a roadmap is developed

- Task Force 5: Cross-cutting issues

Also included are the key near term actions including an overview of key near term standardization priorities, key near term action items including a near term actions roadmap and near-term standardization actions. Also, recommendations for next steps and future work of the platform are included.

CEN / CLC / JTC 6 "Hydrogen in energy systems"

At the CEN – CENELEC Joint Technical Committee for Hydrogen in energy systems (JTC 6), a number of working groups have been defined to explore and develop European level standards. The topics include, "Terms and definitions"; "Guarantee of Origin"; and, "Safety". The working group on Guarantee of Origin is a joint effort with CEN / CLC / JTC 14 "Energy management and energy efficiency in the framework of the energy transition" for the revision of the standard EN 16325 "Guarantees of Origin for Electricity". Hydrogen will be included in the overhaul. Experts from CEN / CLC / JTC 6 will participate in the contribution of hydrogen to this standard. This standard is included in the RED II in Article 19 (6) with the important mention that "Member States and designated competent bodies shall ensure that the requirements they impose comply with the standard CEN - EN 16325". In the Safety working group, New Work Item is drafted on "Safe use of hydrogen in built constructions".

Next step (1): Standardization Request from the European Commission to CEN / CENELEC Management Center for hydrogen

The Standardization Request (SR)² for hydrogen is a topic that was already included in the European Commission's Annual Work Program for Standardization in 2017. DG ENER has indicated that the reason

² Standardisation results from voluntary cooperation between industry, businesses, public authorities, and other stakeholders. About a fifth of all European standards are developed following a standardisation request (mandate) from the European Commission to the European Standardisation Organisations (ESOs). This is a request to draw up and adopt European standards or European standardisation deliverables in

this SR has not been further developed in the last years is due to the development of the Clean Energy Package and REDII, among other things. The current status is that a list has been drawn up by the SFEM WG Hydrogen in consultation with the secretary of CEN / TC 234 “gas infrastructure” on the basis of the SFEM / WG report 2015 and 2019 and input from CEN / TC 234. This list is the basis for further discussions to be included in the SR. An important extension of the scope is that in addition to hydrogen as a blend with natural gas transported and distributed through the natural gas networks, pure hydrogen through the natural gas infrastructure and pure hydrogen via a dedicated hydrogen infrastructure are now included in the scope.

Next step (2): CEN Project “Pre normative research on hydrogen in natural gas and natural gas infrastructure”

The CEN Project “Pre normative research on hydrogen in natural gas and natural gas infrastructure” is an EC funded project in preparation, which includes the following eight topics:

1. **Safety** (e.g. classification of leakages, sensors, tightness...)
2. **Gas quality** (e.g. relative density, H₂-quality, Odourisation, energy density...)
3. **Underground storage** (> 2% porous storage, aquifers, subsurfaces)
4. **Centralised and de-centralised energy production** (>5%, turbines, CHP Gas engines)
5. **H₂/H₂NG in industry** (> 5% upto/incl. conversion to H₂, variations due to uncontinuous H₂ injection)
6. **Steel pipes** (> 10%, corrosion, integrity, welding, embrittlement)
7. **Equipment and materials in the gas grid** (incl. variations due to uncontinuous H₂ injection)
8. **End-use applications** (>20%)

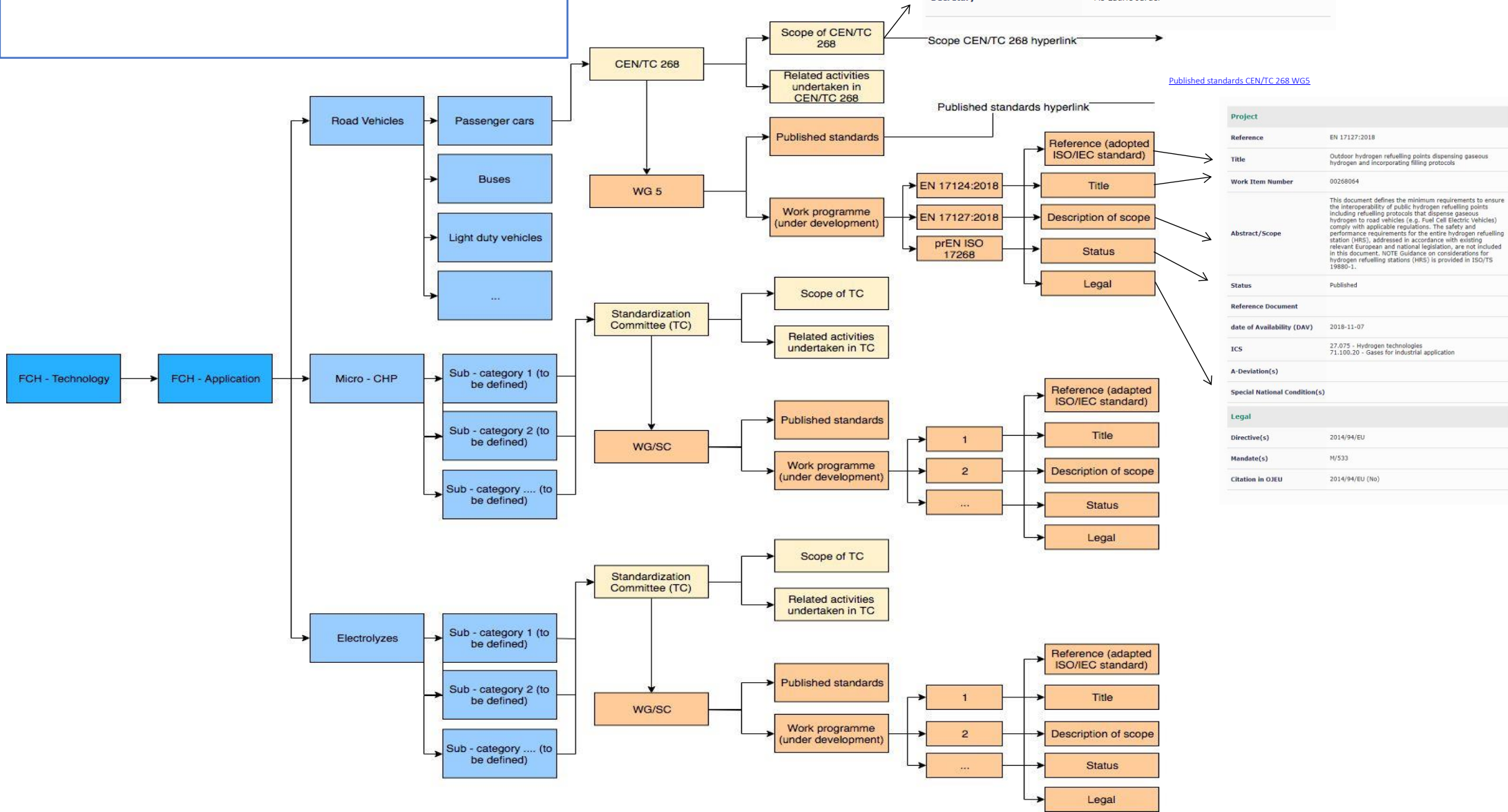
1.3. Used data and data-architecture

For the Standards data stream NEN set up an architecture to demonstrate the amount of data available from public sources, see below:

support of European policies and legislation. European standards and European standardisation deliverables, even though developed under a Commission request and for European legislation, usually remain voluntary. However, when European standards are adopted, National Standardisation Bodies (NSBs) should transpose them into identical national standards and withdraw any conflicting national standards. Source: https://ec.europa.eu/growth/single-market/european-standards/requests_en

This online portal for standards offers two entry paths for finding the correct and relevant standards. The first entry path is through a free search, where users are able to search on standard codes, titles, or any terms used in the description of that standard. The second entry path is through an interactive menu, where users are able to select categories and go into further detail per click; from category to sub-category, and from sub-category to class. Having found the correct standard, users are able to click and open a pop-up with further details on that specific standard.

This image visualizes the structure of the database, and shows how standards are structured through various categories and subcategories.



CEN/TC 268 Scope

Standardization in the field of insulated vessels (vacuum or non- vacuum) for the storage and the transport of refrigerated liquefied gases, as defined in Class 2 of "Recommendations on the Transport of dangerous goods - Model regulation", in particular concerning the design of the vessels and their safety accessories, gas/materials compatibility, insulation performance, the operational requirements of the equipment and accessories. The preparation of standards for hydrogen refuelling points

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Scope CEN/TC 268 hyperlink

Published standards hyperlink

[Published standards CEN/TC 268 WGS](#)

1.3.1. Standardization Developing Bodies

For the purpose of this Observatory standards from the following Standardization Developing Organizations (SDO) have been included:

- International Organization for Standardization (ISO)
- International Electrotechnical Commission (IEC)
- European Committee for Standardization (CEN)
- European Committee for Electrotechnical Standardization (CENELEC)
- International Organization of Legal Metrology (OIML)

National standards were initially included but later removed due to language barriers and doubling of standards. Relevant national standards are often introduced into regional (European) and/or international standards drafting process. As the standard data stream also includes standards under development (being drafted), it ensures that no relevant developments are left out of the Observatory.

1.3.2. Data per standard

Publicly available data from the SDO portals included:

- Code or reference of the standard
- Title of the standard
- Description of the standard
- Status of the standard (published or being drafted)
- Hyperlink to specific standard
- Hyperlink to the SDO Technical Committee responsible for drafting the Standard
- Hyperlink to the SDO Technical Committee scope
- In some cases: related Legal EU Directive
- In some cases: related legal Mandate
- In some cases: Citation in the Official Journal of the European Union

Where possible hyperlinks were used in order to refer to the owner of the original data (i.e. the online portals of ISO, IEC, CEN, CENELEC, and OIML). This is a measure in order to avoid outdated information on the Observatory.

1.4. Scope

The 'standards data stream' used the Application List as provided by E4tech in order to determine the scope for the database. This Application List contained categories, sub-categories, classes, and in some cases sub-classes. An example; category: Transport (motive power); sub-category: Road vehicles; class: Heavy good vehicles; sub-class: 3.5-7.5t.

For the purpose of accessibility, the consideration for inclusion of standards in the Observatory is determined by their relevance to hydrogen-specific applications. When identifying relevant standards for passenger cars, for example, standards such as ISO 18164:2005 - Passenger car, truck, bus and motorcycle tyres — Methods of measuring rolling resistance were excluded.

Any given standard can apply to various categories, sub-categories, classes and even sub-classes. For the purpose of findability and user friendliness, standards have been tagged with all relevant categories to sub-classes.

1.5. Online presentation of data

On the online portal of the Observatory there are two entry paths for users for finding the correct and relevant standards. The first entry path is through a free search, where users are able to search on standard codes, titles, or any terms used in the description of that standard. The second entry path is through a interactive menu, where users are able to select categories and go into further detail per click; from category to sub-category, and from sub-category to class. Having found the correct standard, users are able to click and open a pop-up with further details on that specific standard (see 1.3.2. Data per standard).