Chapter 4
2022 Standards
February 2022

FUEL CELLS AND HYDROGEN OBSERVATORY

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Clean Hydrogen Partnership

Disclaimer

This report is based on data gathered as part of the Fuel Cells and Hydrogen Observatory by February 2022. 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

The Fuel Cells and Hydrogen Observatory (FCHO) is an ambitious project aiming to collect valuable sector information in a single go-to source, making it available to all interested stakeholders. The Standards module within the FCHO gives an overview of developments within existing standards and the addition of new standards, representing the progress of the market.
The development of the international market of fuel cells and hydrogen (FCH) requires refocusing and revision of existing standards, as well as the addition of new standards when existing standards cannot to be applied to new developments. Standardization can be considered a reflection of developments in the FCH market, as expert knowledge determines the content of standards. Moreover, standardization requests for the development of new standards are based on market tendencies and market development, thereby representing the focus of the market.
The Standards module aims to list new and revised standards published in 2021 and beginning of 2022. Furthermore, the subjects of new and revised standards are illuminated, in order to give an insight in subjects that are currently deemed as most important by experts representing the FCH market. Main points of focus appear to be the improvement of FCH infrastructure, adding standardization work on refuelling points, storage and transport and the improvement of safety around usage of fuel cells and hydrogen in society.

Purpose: The standards module of the FCHO (https://www.fchobservatory.eu/observatory/Policy-and-RCS/Standards) presents a large number of standards relevant for the deployment of hydrogen and fuel cells. The standards are categorized per application, enhancing ease of access and findability. The development of sector-relevant standards facilitate and enhance economies of scale, interoperability, comparability, safety, and many other issues.

Scope: This report presents the developments in European and international standards for the year 2021 and the start of 2022. Standards from the following standards developing organizations are included: CEN, CENELEC, ISO, IEC, OIML.

Key Findings: The development of sector relevant standards on an international level continued to grow in 2022; on a European level many standards are still in the process of being drafted. In 2021 & 2022 11 new standards have been published, on the subject of fuel cell technologies and safety and measurement protocols of hydrogen technologies.

The recently established committee 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. In the upcoming years multiple standards will be replaced, such as the ISO 12619 1-12 set of standards affecting 40% of all collected standards.

Previous Reports: The first report was published in September 2020 followed up by a second report in 2021. This report is the 3rd Annual report.

1. Standards

1.1. Introduction

The information in this report covers the period September 2020 – February 2022. 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 government[1] 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. Standardization Developing Organizations: structure

In this report 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)

Members of European and International Standardization Bodies are delegated from their National Committees (NCs). Standards are often initiated by industries and thus reflect economic and social interests of the several sectors present in member countries. Standardization requests can also occur through consumer interest or legislators. Standards thus reflect the general societal/market interest, as they are driven by business. Members of NCs often are experts in the field and have the knowledge necessary to initiate relevant subjects, playing into general market tendencies.

1.3. Recent developments & trends

From 2021- 22 there has been significant progress on international and European standards development. See Appendix 1 for a detailed overview of every newly published or initiated standardization work. In order to give a reflection of market developments in 2021, the committees that have been publishing and initiating new work in 2021 are described under section 2.1. The committees publishing and initiating the largest extent of work are focusing on fuel cell technologies, hydrogen technologies and the usage of hydrogen in road vehicles.

[1] Note: government (all institutions) can still be stakeholders of an issue, and therefore be part of the standardization process.

2. Published standards and relevant initiatives in 2021 & 2022

2.1. Overview of Committees and recent standardization work

CEN/TC 268 - Cryogenic vessels and specific hydrogen technologies applications

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[2].

Recently published standards mainly focus on the preparation of standards for hydrogen refuelling points e.g. incorporating filling procedures and determining connection devices for refuelling of gaseous hydrogen.

CEN/TC 23 - Transportable gas cylinders

Standardization of transportable gas cylinders, their fittings, and requirements relating to their design, testing and operation. The scope does not include LPG cylinder covered by CEN/TC 286 or non-refillable cartridges covered by CEN/TC 157. The scope does not include containers for cryogenic gases covered by CEN/TC 268[3].

Recently published standards focus on the compatibility of cylinder and valve materials with gas contents.

CEN/CLC/JTC 6 - Hydrogen in energy systems

Standardization in the field of systems, devices and connections for the production, storage, transport and distribution, measurement and use of hydrogen from renewable energy sources and other sources, in the context of the European strategy for the development and acceptance of the hydrogen market. The scope includes cross cutting items such as: terminology, Guarantee of Origin, interfaces, operational management, relevant hydrogen safety issues, training, and education[4].

CEN/CLC/JTC 6 are currently still in the stage of drafting standards, focusing on vocabulary and safety regarding hydrogen in energy systems. Below most recent developments in the several Working Groups (WG) of CEN/CLC/JTC6 are illuminated.

WG1: In January 2021 the Technical Board of CEN/CENELEC formally agreed to the New Work Item Proposal “Vocabulary H2 in energy systems”. This project will be developed under Vienna Agreement (CEN lead) according to the decisions taken by CEN-CLC/JTC6 and ISO/TC 197. Thus, the standard will be internationally adopted by the ISO/TC 197. It is expected that the standard will be voted on in 2023.

WG2: focusing on Guarantees of Origin, in extension of the REDII that was published in 2018. In the REDII the standard EN16325 “Guarantees of Origin related to energy – guarantee of Origin for electricity” was adopted.

WG3: focusing on safety. A New Work Item Proposal for the development of a Technical Report: “Safe use of hydrogen in built constructions” has been accepted. Most important subjects within the technical report are the following: prevention of occurrence, considering hydrogen properties, safe

[2] https://standards.iteh.ai/catalog/tc/cen/ab96cfd0-50bb-4a88-9c20-2b2cb7c57a5f/cen-tc-268

[3] https://standards.cen.eu/dyn/www/f?p=204:7:0::::FSP_ORG_ID:6007&cs=13572AFEAD545F99222FA40984860854B

[4] https://www.cenelec.eu/dyn/www/f?p=104:7:1312062867558001::::FSP_ORG_ID,FSP_LANG_ID:2121095,25

design approach, operational aspects; limiting the effect of consequences of fires and explosions; emergency response in case of incidents, considering knowledge transfer, firefighting emergency preparedness and practices and drills. This project is still under drafting and has no foreseeable date of possible implementation.

CEN/CLC/JTC 14/WG 5 – Energy management and energy efficiency in the framework of energy transition

Standardization in the field of energy management within the energy transition framework in close coordination with CEN/CENELEC sectorial strategy including, but not limited to, subjects such as:

- Energy management systems
- Energy audits
- Energy efficiency and energy performance improvement
- Energy and savings calculation methodologies
- Energy efficiency improvement financing (For example: Valuation of Energy Related Investments, Energy Performance Contracting minimum requirements, etc.)
- Energy services providers
- Energy measurement and monitoring
- Role of enabling technologies and RES within the energy management and energy efficiency framework

CEN/TC 234 - Gas infrastructure

I) Standardisation of functional requirements in the field of gas infrastructure* from the input of gas into the on-shore transmission network up to the inlet connection of gas appliances; II) Determination and coordination of the gas infrastructure aspects in the technical work dealt with by other CEN/TCs and any other bodies, whether or not reporting to the Sector Forum Gas Infrastructure; III) To act as a focus for standardisation issues in the field of gas infrastructure[5].

**including transmission, distribution, storage, compression, regulation and metering, installation, injection of non-conventional gases, gas quality issues and others.*

CEN/TC 234 has initiated standardization work regarding hydrogen in the gas infrastructure, specifically regarding the injection of hydrogen into natural gas networks.

IEC/TC 105 - Fuel cell technologies

To prepare international standards regarding fuel cell (FC) technologies for all FC types and various associated applications such as stationary FC power systems for distributed power generators and combined heat and power systems, FCs for transportation such as propulsion systems (see note below), range extenders, auxiliary power units, portable FC power systems, micro FC power systems, reverse operating FC power systems, and general electrochemical flow systems and processes[6].

The IEC/TC 105 has both published and initiated several new standards and subjects, reflecting the current focus of industries on the advancing technology of fuel cells. Recently published standards mainly focus on test procedures and safety of fuel cell modules (in reverse mode). As the market recognizes the importance of environmental aspects, a newly published standard focuses on the evaluation methodology for the environmental performance of fuel cell power system, based of life cycle thinking. New initiatives focus on the development of micro fuel cell power systems and their

[5]https://standards.cen.eu/dyn/www/f?p=204:7:0::::FSP_ORG_ID:6215&cs=164D8136B9DA5808851E88A0BB973C593

[6] https://standards.iteh.ai/catalog/tc/iso/d449eb98-4a92-4482-b515-cdfa3d53bd44/iec-tc-105

safety aspects. In total, the IEC/TC 105 has published 2 new standards in 2021, 2 new standards in 2022 and has initiated 15 standardization subjects in several forms.

ISO/TC 197 - Hydrogen technologies
Standardization in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen[7].

At the moment, 17 new standards are under development. New publications and initiatives focus on land vehicle hydrogen refuelling. Standardization work has been initiated on several other parts important to the refuelling of hydrogen land vehicles. Other points of focus are fuel quality control and hydrogen refuelling protocols.

ISO/TC 22 - Road vehicles
All questions of standardization concerning compatibility, interchangeability and safety, with particular reference to terminology and test procedures (including the characteristics of instrumentation) for evaluating the performance of the types of road vehicles and their equipment as defined in the relevant items of Article 1 of the convention on Road Traffic, Vienna in 1968 concluded under the auspices of the United Nations[8].
New initiatives proposed by the ISO/TC 22 are mainly focusing on compressed hydrogen for the use of road vehicles and all parts that should be considered in the usage of compressed hydrogen in road vehicles.
Additional updates on European standardization work: SFEM and AFID

2.2. Background information on the SFEM WG Hydrogen

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 Clean Hydrogen Joint Undertaking 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, there is an important link to EC services (DG JRC, DG RTD, DG ENER and DG GROW). 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 Clean Hydrogen JU.

In 2015, the working group Hydrogen delivered a report with the main objective of performing an analysis of the state of the art of technology and standardization and a gap analysis on the main barriers including challenges and needs in the field of hydrogen. In 2018 an updated report was delivered. During the work of the SFEM/WG hydrogen, a significant amount of information has been collected on past and ongoing research, pre-normative research, and standardization activities as well as on gaps which have to be addressed to enable the technologies to reach the relevant markets.

The main task of the continued SFEM/WG hydrogen (after the publication of the report) is to operate as a permanent platform on Hydrogen to exchange and communicate on hydrogen energy related development, to coordinate the work between different technical committees in this field and boost the development of a holistic approach combining research, pre-normative research and standardization.

[7] https://www.iso.org/committee/54560.html
[8] https://www.iso.org/committee/46706.html

The SFEM/WG Hydrogen meets approximately twice a year in a plenary meeting. Additionally, several workshops and other meetings are organized, based on the set priorities. In February 2022 three workshops were organized on hydrogen in the heavy-duty sector, the maritime sector and the horizontal topic of liquefied hydrogen. Main goal of the workshops was to identify the standardization needs related to the topic and, if relevant, what kind of (pre-normative) research is still needed as input for standardization. The outcomes of the workshops will be translated into a standardisation roadmap and action plan for the future.

2.3. Links to Technical Committees work

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

Table 1: Overview Technical Committees

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
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

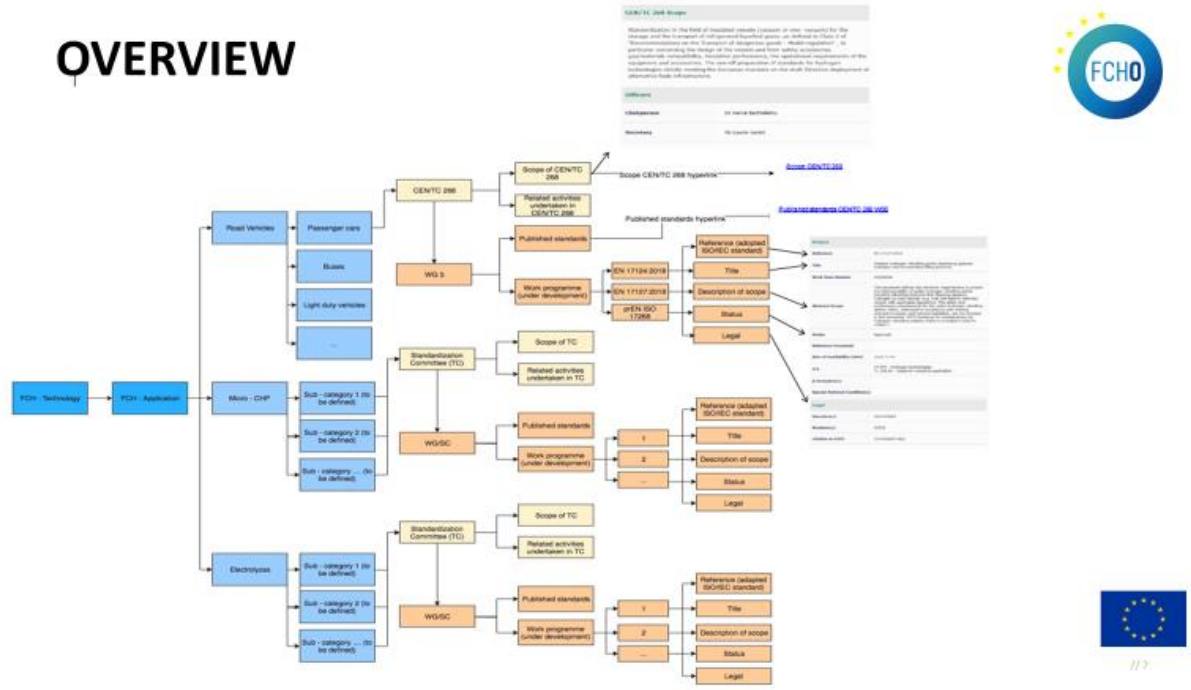
CEN	CEN/TC 236	Non industrial manually operated shut-off valves for gas and particular combinations valves-other products	CEN/TC 236 Work Programme	CEN/TC 236 Published Standards
CEN	CEN/TC 238	Test gases, test pressures, appliance categories and gas appliance types	CEN/TC 238 Work Programme	CEN/TC 238 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

3. FCHO Standards module

3.1. 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 Figure 1 below.

Figure 1: Data stream standards architecture



3.1.1. 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.

3.1.2. 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 to avoid outdated information on the Observatory.

3.2. Scope

The 'standards data stream' used the *Application List* as provided by E4tech 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.

3.3. 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 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.

3.4. Revision and consequences

3.4.1. ISO and IEC

Every International Standard and other deliverable published by ISO or jointly with IEC shall be subject to systematic review in order to determine whether it should be confirmed, revised, amended (for International Standard), converted to another form of deliverable, or withdrawn, according to Table 2. A committee may at any time between systematic reviews pass a resolution initiating a revision of a deliverable.

For minor changes to International Standards, e.g. updating and editorial changes, that do not impact the technical content, a shortened procedure called "minor revision" may be applied. This is comprised

only of the proposal for a minor revision by the committee (through a resolution and completion of ISO form 8B), approval and publication stages. Subsequent to the resolution of the responsible technical committee and consultation of the responsible ISO Technical Programme Manager, a final draft of the revised deliverable shall be circulated for an 8 week FDIS vote, and 12 weeks in the case of Vienna Agreement documents. The Foreword of the next edition of the deliverable shall indicate that it is a minor revision and list the updates and editorial changes made.

Table 2: Timing of systematic reviews

Deliverable	Max. elapsed time before systematic review	Max. number of times deliverable may be confirmed	Max. life
International Standard	5 years	Not limited	Not limited
Technical Specification	3 years	Once recommended	6 years recommended
Publicly Available Specification	3 years	Once	6 years (If not converted after this period, the deliverable is proposed for withdrawal)
Technical Report	Not specified	Not specified	Not limited

A systematic review will typically be initiated in the following circumstances:

- (all deliverables) on the initiative and as a responsibility of the secretariat of the responsible committee, typically as the result of the elapse of the specified period since publication or the last confirmation of the document, or
- (for International Standards and Technical Specifications) a default action by ISO Central Secretariat if a systematic review of the International Standard or Technical Specification concerned has not been initiated by the secretariat of the responsible committee, or
- (all deliverables) at the request of one or more National Body, or
- (all deliverables) at the request of the CEO.

The timing of a systematic review is normally based either on the year of publication or, where a document has already been confirmed, on the year in which it was last confirmed. However, it is not necessary to wait for the maximum period to elapse before a document is reviewed.

3.4.2. CEN and CENELEC

The responsible technical body shall ensure that European Standards (ENs) are periodically reviewed. The periodical review shall occur at intervals not exceeding five years. The review may be initiated earlier at the request of the responsible technical body. In CENELEC, such request shall be approved by the Technical Board. If there is no technical body, the responsibility for review shall rest with the Technical Board.
As a result of the review the EN shall be

a. confirmed, or
b. amended, or
c. revised as a new edition with a new date, or

d. withdrawn.

Every effort shall be made to reach a unanimous agreement of the CEN/CENELEC national members and partner organizations participating in the Technical Committee or Technical Board on the choice between these four possibilities. If unanimity is not possible, the chair shall seek consensus. If consensus cannot be achieved despite all efforts, a decision can be made by majority of the CEN/CENELEC national members, while duly recording any possible sustained opposition from CEN/CENELEC national members and/or participating partner organizations.

The resulting decision shall be communicated to all CEN/CENELEC national members for action to be taken with respect to their national implementations.

For European Standards adopting ISO or IEC publications (including common modifications), no review process is initiated at European level. These standards will be subject to the review carried out by ISO or IEC, respectively.

Technical Specifications are not amended but replaced by a new edition with a new date of edition. Corrigenda published by the CEN-CENELEC Management Centre (CCMC) are, however, possible. The responsible CEN/CENELEC technical body shall ensure that Technical Specification are reviewed at intervals of not more than three years, starting from their date of availability. The aim of such review shall be to re-examine the situation which resulted in the publication of a Technical Specification and if possible, to achieve the agreement necessary for the publication of an EN to replace the Technical Specification, the other options being an extension for another three years or the withdrawal of the Technical Specification. Any decision to confirm the Technical Specification for another three years shall be accompanied with a valid justification of the responsible technical body.

3.4.3. OIML

All OIML publications are subject to periodic review. Five years after publication, the International Bureau of Legal Metrology (BIML) shall organize an enquiry amongst members of the appropriate TC or SC, with a three-month voting deadline, to decide if a publication should be

a. re-confirmed in its existing form,
b. revised, or
c. withdrawn.

The decision shall be valid when two-thirds of the votes cast by the TC's, SC's or Project Group's P-members[9] are in favor of option a), b), or c). Abstentions and failures to reply are not considered as votes cast.
The BIML shall report on the outcome of the review to the International Committee of Legal Metrology (CIML), which shall make a decision, based on the result of the TC/SC vote, whether the publication should be

a. reconfirmed, in which case the BIML shall amend the cover page of the publication and references to it on the OIML web site to indicate both the original date of publication and the latest date of reconfirmation, and notify all CIML Members, or
b. revised, in which case the BIML shall develop a project proposal with the appropriate TC or SC secretariat for CIML approval, or
c. withdrawn.

[9] Participating members are called "P" members

4. Conclusion

Since the initiation of these reports for the Fuel Cell and Hydrogen Observatory in 2020, there have been significant developments of sector relevant international standards. On a European level, there has been considerable progress, with 11 new standards published in 2021 and 2022 on fuel cell technologies and safety and measurement protocols of hydrogen technologies. Many standards are still in the process of being drafted, such as those being worked on by the committee CEN-CLC JTC 6 (Hydrogen in energy systems). These standards will be key to enabling the growth and development of the hydrogen sector.

Appendix 1 - Detailed list of newly published and initiated standards

This appendix gives a description of the International and European committees that have recently published or initiated new standards. Annex 1 gives a detailed list of all relevant standards that have been published or initiated in 2021 or 2022. an international level, and new and relevant initiatives on standards development. Publications are standards that are officially published and effective. Initiatives are "topics of interest" as expressed by Standardization committees, but that are still under construction (drafting stage).

CEN/TC 268 - Cryogenic vessels and specific hydrogen technologies applications

New publications

- no relevant publications after 2020

New initiatives

- EN 17124:2022 - Hydrogen fuel - Product specification and quality assurance - Proton exchange membrane (PEM) fuel cell applications for road vehicles output
- EN ISO 17268 rev - Gaseous hydrogen land vehicle refuelling connection devices

CEN/TC 23 - Transportable gas cylinders

New publications

- EN 17339:2020 - Transportable gas cylinders - Fully wrapped carbon composite cylinders and tubes for hydrogen
- EN 17533:2020 - Gaseous hydrogen - Cylinders and tubes for stationary storage

CEN/CLC/JTC 6 - Hydrogen in energy systems

New publications

- no relevant publications after 2020

New initiatives

- prEN ISO 24078 - Hydrogen in energy systems – vocabulary
- PrTR xxxx – Safe use of hydrogen in built constructions

CEN/CLC/JTC 14/WG 5

New publications

- No relevant publications after 2020

New initiatives

- no relevant new initiatives

CEN/TC 234 - Gas infrastructure

New initiatives

- prCEN/TR XXX - Gas infrastructure - Consequences of hydrogen in the gas infrastructure and identification of related standardisation need in the scope of CEN/TC 234
- Gas infrastructure - Plants for the injection of renewable gases into natural gas networks - Part 3: Specific requirements regarding hydrogen

IEC/TC 105 - Fuel cell technologies

New publications

- IEC TS 62282-9-102:2021 - Part 9-102: Evaluation methodology for the environmental performance of fuel cell power systems based on life cycle thinking - Product category rules for

environmental product declarations of stationary fuel cell power systems and alternative systems for residential applications
- IEC 62282-3-201:2017/AMD1:2022 Amendment 1 - Fuel cell technologies - Part 3-201: Stationary fuel cell power systems - Performance test methods for small fuel cell power systems

New initiatives
- IEC 62282-3-202 ED1 - Fuel cell technologies - Part 3-202: Stationary fuel cell power systems - Performance test methods for small fuel cell power systems that can be complemented with a supplementary heat generator for multiple units operation by an energy management system
- PWI 105-1 - General safety standard
- PNW 105-893 ED1 - Fuel cell technologies - Part 2-200: Calculation of rated power and power density of a stack/module

ISO/TC 197 - Hydrogen technologies

New publications
- ISO 19880-8:2019/AMD 1:2021 - Gaseous hydrogen — Fuelling stations — Part 8: Fuel quality control — Amendment 1

New initiatives
- ISO/AWI 14687 - Hydrogen fuel quality — Product specification
- ISO/AWI TR 15916 - Basic considerations for the safety of hydrogen systems
- ISO/AWI 17268 - Gaseous hydrogen land vehicle refuelling connection devices
- ISO/AWI 19880-5 - Gaseous hydrogen — Fuelling stations — Part 5: Dispenser hoses and hose assemblies
- ISO/CD 19880-6 - Gaseous hydrogen — Fuelling stations — Part 6: Fittings
- ISO/AWI 19880-9 - Gaseous hydrogen — Fuelling stations — Part 9: Sampling for fuel quality analysis
- ISO/AWI 19881 -Gaseous hydrogen — Land vehicle fuel containers
- ISO/AWI 19882 -Gaseous hydrogen — Thermally activated pressure relief devices for compressed hydrogen vehicle fuel containers
- ISO/AWI 19884 - Gaseous hydrogen — Cylinders and tubes for stationary storage
- ISO/AWI 19885-1 - Gaseous hydrogen — Fuelling protocols for hydrogen-fuelled vehicles — Part 1: Design and development process for fuelling protocols
- ISO/AWI 19885-2 - Gaseous hydrogen — Fuelling protocols for hydrogen-fuelled vehicles — Part 2: Definition of communications between the vehicle and dispenser control systems
- ISO/AWI 19885-3 - Gaseous hydrogen — Fuelling protocols for hydrogen-fuelled vehicles — Part 3: High flow hydrogen fuelling protocols for heavy duty road vehicles
- ISO/AWI 19887 - Gaseous Hydrogen — Fuel system components for hydrogen fuelled vehicles
- ISO/AWI TR 22734-2 - Hydrogen generators using water electrolysis — Part 2: Testing guidance for performing electricity grid service

ISO/TC 22 - Road vehicles

New publications
- no relevant publications after 2020

New publications

- ISO 12614-16:2021 - Liquefied natural gas (LNG) fuel system components — Part 16: Heat exchanger-vaporizer
- ISO 12614-17:2021 - Liquefied natural gas (LNG) fuel system components — Part 17: Natural gas detector
- ISO 12614-18:2021 - Liquefied natural gas (LNG) fuel system components — Part 18: Gas temperature sensor
- ISO 12614-19:2021 - Liquefied natural gas (LNG) fuel system components — Part 19: Automatic valve
- ISO 15500-17:2021 Road vehicles — Compressed natural gas (CNG) fuel system components — Part 17: Flexible fuel line
- ISO 20766-13:2022 Road vehicles — Liquefied petroleum gas (LPG) fuel system components — Part 13: Multivalve
- ISO 20766-14:2022 Road vehicles — Liquefied petroleum gas (LPG) fuel system components — Part 14: Vaporizer/pressure regulator
- ISO 20766-16:2022
  - Road vehicles — Liquefied petroleum gas (LPG) fuel system components — Part 16: Injectors and gas mixing device/fuel rail
- ISO 20766-24:2022 Road vehicles — Liquefied petroleum gas (LPG) fuel system components — Part 24: Gas tubes
- ISO 20766-25:2022 Road vehicles — Liquefied petroleum gas (LPG) fuel system components — Part 25: Gas connections

New initiatives

- ISO/CD 23828.2 - Fuel cell road vehicles — Energy consumption measurement — Vehicles fuelled with compressed hydrogen
- ISO/WD 12619-1 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 1: General requirements and definitions
- ISO/WD 12619-2 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 2: Performance and general test methods
- ISO/WD 12619-3 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 3: Pressure regulator
- ISO/WD 12619-4 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 4: Check valve
- ISO/WD 12619-5 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 5: Manual cylinder valve
- ISO/WD 12619-6 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 6: Automatic valve
- ISO/WD 12619-7 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 7: Gas injector
- ISO/WD 12619-8 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 8: Pressure indicator
- ISO/WD 12619-9 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 9: Pressure relief valve (PRV)

- ISO/WD 12619-10 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 10: Pressure relief device (PRD)
- ISO/WD 12619-11 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 11: Excess flow valve
- ISO/WD 12619-12 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 12: Gas-tight housing and ventilation hoses
- ISO/WD 12619-13 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 13: Rigid fuel line in stainless steel
- ISO/WD 12619-14 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 14: Flexible fuel line
- ISO/WD 12619-15 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 15: Filter
  ISO/WD 12619-16 - Road vehicles — Compressed gaseous hydrogen (CGH2) and hydrogen/natural gas blends fuel system components — Part 16: Fittings