Overview of international standards

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International Transport Forum

EXPERT WORKSHOP

Mapping standards for low- and zero-emission electric heavy duty vehicles

17-18 February 2020 – Paris, France

Overview of international standards

ISO/TC 197 "Hydrogen technologies"

ISO/TC 158 "Analysis of gases"

ISO/TC 22 "Road Vehicles"

IEC/TC 105 "Fuel cell technologies"

CEN/CLC/SFEM WG Hydrogen

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

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

ISO/TC 197
Refuelling and charging infrastructure

ISO/TC 197/AHG 1	Permanent editing committee
ISO/TC 197/TAB 1	Technical Advisory Board
ISO/TC 197/WG 5	Gaseous hydrogen land vehicle refuelling connection devices
ISO/TC 197/WG 18	Gaseous hydrogen land vehicle fuel tanks and TPRDs
ISO/TC 197/WG 19	Gaseous hydrogen fueling station dispensers
ISO/TC 197/WG 21	Gaseous hydrogen fueling station compressors
ISO/TC 197/WG 22	Gaseous hydrogen fueling station hoses
ISO/TC 197/WG 23	Gaseous hydrogen fueling station fittings
ISO/TC 197/WG 24	Gaseous hydrogen fueling stations – General requirements
ISO/TC 197/WG 27	Hydrogen fuel quality
ISO/TC 197/WG 28	Hydrogen quality control
ISO/TC 197/WG 29	Basic considerations for the safety of hydrogen systems

SFEM WG Hydrogen

Scope of work

- mapping of
  - hydrogen-energy related issues and challenges
  - existing standardization initiatives
  - needs and gaps in a holistic manner
- objectives
  - analysis of the state of the art of technology and standardization
  - gap analysis on the main barriers including the identification of challenges and needs for PNR and standardization.
  - recommended actions to identified to address these challenges, along with the means of implementation.

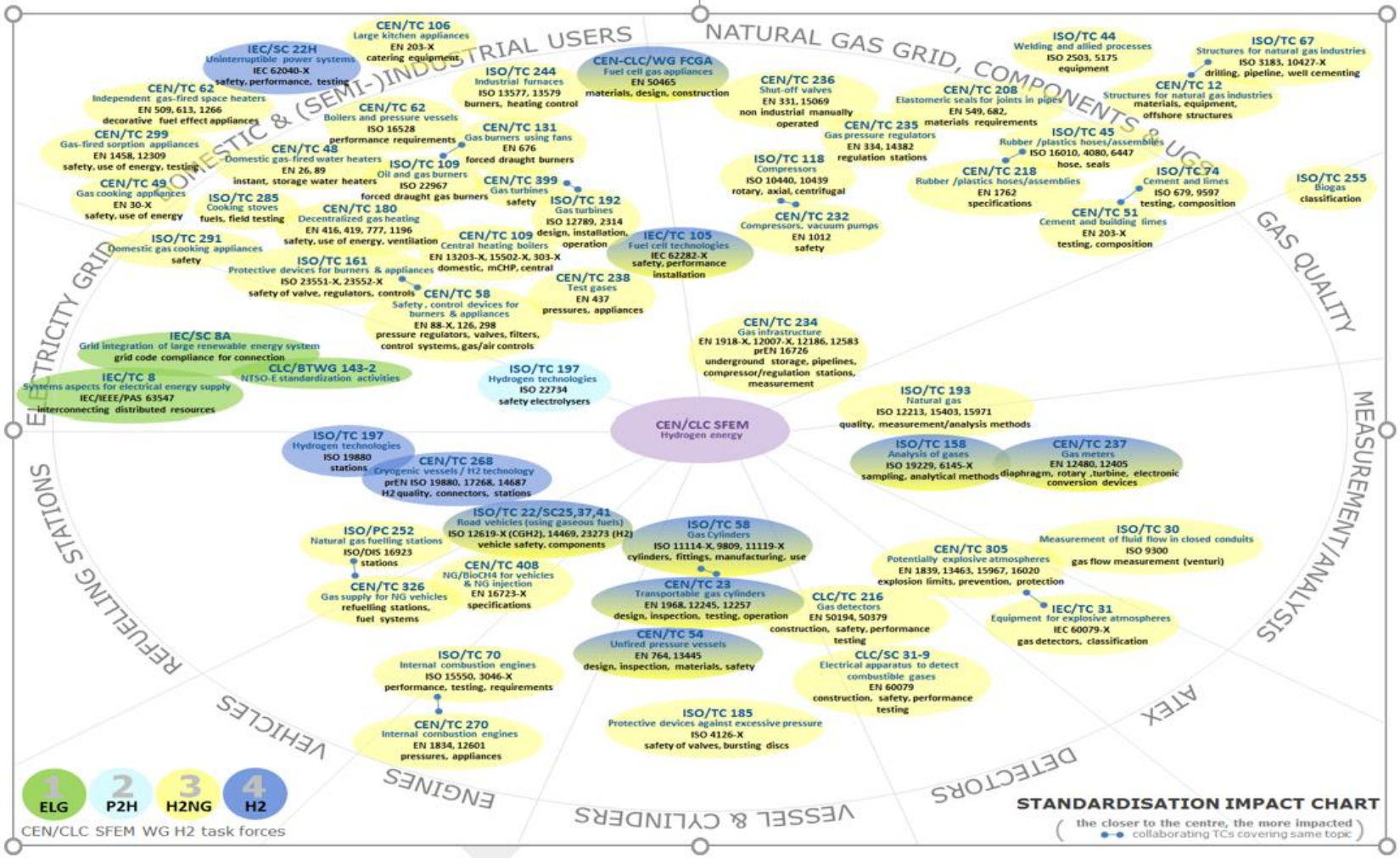


Figure 2 Mapping of international and European standardization activities in the area of hydrogen and H2NG.

Source CEN/CLC/SFEM/WG Hydrogen report 2015

European legislation related to standardizaton

DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 22 October 2014 on the deployment of alternative fuels infrastructure

> Alternative Fuel Infrastructure Directive (AFID)

Alternative Fuel Infrastructure Directive

Based on the consultation of stakeholders and national experts, as well as the expertise reflected in the Communication from the Commission of 24 January 2013 entitled 'Clean Power for Transport: **A European alternative fuels strategy**', electricity, hydrogen, biofuels, natural gas, and liquefied petroleum gas (LPG) **were identified as currently the principal alternative fuels with a potential for long-term oil substitution**, also in light of their possible simultaneous and combined use by means of, for instance, dual-fuel technology systems. Power sources means all alternative sources of energy for transport, **such as electricity and hydrogen,** that do not have to be released through combustion or non-combustion oxidation.

The lack of harmonised development of alternative fuels infrastructure across the Union prevents the development of economies of scale on the supply side and Union-wide mobility on the demand side. New infrastructure networks need to be built up, such as for **electricity**, natural gas (liquefied natural gas (LNG) and compressed natural gas (CNG)) and, **where appropriate, hydrogen.**

Alternative Fuel Infrastructure Directive

2. **Technical specifications for hydrogen refuelling points for motor vehicles**

2.1. Outdoor hydrogen refuelling points dispensing gaseous hydrogen used as fuel on board motor vehicles shall comply with the technical specifications of the **ISO/TS 20100 Gaseous Hydrogen Fuelling specification.**

2.2. The hydrogen purity dispensed by hydrogen refuelling points shall comply with the technical specifications included in the **ISO 14687-2 standard.**

2.3. Hydrogen refuelling points shall employ fuelling algorithms and equipment complying with the **ISO/TS 20100 Gaseous Hydrogen Fuelling specification.**

2.4. Connectors for motor vehicles for the refuelling of gaseous hydrogen shall comply with the **ISO 17268 gaseous hydrogen motor vehicle refuelling connection devices standard.**

COMMISSION IMPLEMENTING DECISION M/533

>>on a standardisation request addressed to the European standardisation organisations, in accordance with Regulation (EU) No 1025/2012 of the European Parliament and of the Council, to draft European standards for alternative fuels infrastructure<<

Commission Delegated Regulation (13.8.2019)

1. EN 17127 'Outdoor hydrogen refuelling points dispensing gaseous hydrogen and incorporating filling protocols'

   Covers: interoperability of design, construction, operation, inspection and maintenance of stations for fuelling gaseous hydrogen to vehicles.
2. The interoperability requirements described in standard EN 17127 should apply for hydrogen refuelling points as well as the same European standard should apply for the relevant filling protocols.

Commission Delegated Regulation (13.8.2019)

EN 17124 'Hydrogen fuel - Product specification and quality assurance - Proton exchange membrane (PEM) fuel cell applications for road vehicles'

covers the quality characteristics of hydrogen fuel and the corresponding quality assurance in order to ensure uniformity of the hydrogen product as dispensed for utilization in proton exchange membrane (PEM) fuel cell road vehicle systems.

Commission Delegated Regulation (13.8.2019)

EN ISO 17268 'Gaseous hydrogen land vehicle refuelling connection devices'

- to be applied to connectors for motor vehicles for the refuelling of gaseous hydrogen.
- important to conclude the process of the certification of connectors for the refuelling of motor vehicles with gaseous hydrogen according to standard EN ISO 17268.
- When this process is concluded, connectors for motor vehicles for the refuelling of gaseous hydrogen should comply with EN ISO 17268.

Current situation European standards

EN 17127: published in 2018; under revision – norm. reference to ISO 17268

based on ISO 19880-1 "Gaseous hydrogen — Fuelling stations — Part 1: General requirements" – under publication;

Normative reference to ISO 17268 and/or SAE J2600 and reference to e.g. SAE J2601 and J2799; (ISO/TR 20100 withdrawn)

EN 17124: published 2018; under revision

Based on ISO 14687 – published 2019 (minimum quality characteristics of hydrogen fuel) -bibl. reference to SAE J2799

ISO 19880-8 – published 2019 (the protocol for ensuring the quality of the gaseous hydrogen)

EN ISO 17268: Published in 2016; revison to be published soon. ISO 17268 published 2019 - bibl. reference to SAE J2799

Vienna Agreement ISO -CEN

- The agreement recognises the primacy of international standards
- Also recognises that particular needs (of the Single European Market for example) might require the development of standards for which a need has not been recognized at the international level.
- In some instances CEN needs to undertake work which is urgent in the European context, but less so in the international one.

Benefit VA:

- increasing transparency of work ongoing in CEN to ISO members, and their possibility to influence the content of CEN standards
- avoidance of duplication of work and structures, thus allowing expertise to be focused and used in an efficient way to the benefit of international standardization
- increasing the speed of elaboration, availability and maintenance of standards through a need to establish consensus only once

Status EN standard

A published European Standard **must** be given the status of national standard in all member countries

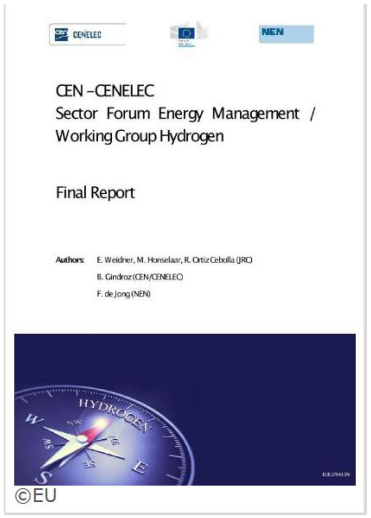
- obligation to withdraw any national standards that conflict with it.

This guarantees that a manufacturer has easier access to the market of all the member countries when applying European Standards and this also applies whether the manufacturer is based in a member's territory or not.

SFEM/WG Hydrogen - 2019 Recommendation Heavy Duty

KEY OUTCOMES of SFEM/WG Hydrogen activities 2015-2018

- develop refuelling protocols for medium/heavy duty vehicles.
- medium and heavy duty transport applications will need further PNR and standardisation work.



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SFEM/WG Hydrogen - 2019 Recommendation Heavy Duty

* 2015 PNR action: Secure continuation of PNR work in EU projects on hydrogen refuelling station concepts and protocols, and facilitate information exchange with relevant activities undertaken by EU Member States. ⇒ 2018 status PNR action: No PNR activity for the calibration and validation of simulation models for **refuelling of vehicles with CHSS > 10kg for 700 bar and > 6 kg for 350 bar**	No PNR activities ongoing	**PNR gap changes. In order to define acceptable maximum gas temperature at end of fill, there is a need for calibration and validation of simulation models for predicting local material temperatures in the CHSS**	*** 2015 STD action: Development of performance based standards for refuelling protocols outside the SAE standardization platform.** ⇒ 2018 status STD action: Refuelling protocols are needed for medium & heavy duty vehicles (e.g. vehicles with CHSS > 10 kg for 700 bar and > 6 kg for 350 bar). The development of performance based standards are considered not within the scope of ISO TC 197.	Revision of J2601 on-going, regarding fuelling protocol standards for medium duty vehicles, but this will still be based on the existing assumptions.. Development of standards for refuelling of medium & heavy duty vehicles (e.g. buses, trains, trucks…) is required (e.g. taking into consideration the results of HyTransfer) FCH JU has put out a call (2019) for Refueling Protocols for Medium and Heavy-Duty Vehicles	PNR: call FCH JU 2019 Standardisation: to be started in relation to the PNR	***PNR:*** *Impact:* **High** *Urgency:* ***Start immediately*** *Time for finalisation:* ***Less than 5 years*** *Timing:* ***current-2023*** ***Standardisation:*** *Impact:* ***Medium*** *Urgency:* ***Start within 5 years*** *Time for finalisation:* ***Within 10 years*** *Timing:* ***2020-2025***	Standardization bodies, industrial and research organisations

⇒ 2018 status STD action: Refuelling protocols are needed for medium & heavy duty vehicles (e.g. vehicles with CHSS > 10 kg for 700 bar and > 6 kg for 350 bar). The development of performance based standards are considered not within the scope of ISO TC 197.

Revision of J2601 on-going, regarding fuelling protocol standards for medium duty vehicles, but this will still be based on the existing assumptions..
Development of standards for refuelling of medium & heavy duty vehicles (e.g. buses, trains, trucks…) is required (e.g. taking into consideration the results of HyTransfer)

FCH JU has put out a call (2019) for Refueling Protocols for Medium and Heavy-Duty Vehicles

Standardisation: to be started in relation to the PNR

SFEM/WG Hydrogen - 2019 Recommendation Heavy Duty

*** 2015 PNR action: Continue PNR activities to further understand the <u>impact of impurities</u> on fuel cell system performance under automotive conditions.** ⇒ 2018 status PNR action: FCHJU HyCora concluded that formic acid and formaldehyde impurities have a very small effect on performance and that the	* FCHJU HyCORA project: finalised * FCHJU HYDRAITE (2018-2020) (follow-up FCHJU HyCORA) * EMPIR Hydrogen project (2016-2019)	PNR gap is being addressed and efforts to fill the gap are intensified. Investigate the possibility to add an odorisant with no detrimental effect.	*** 2015 STD action: Reassess PNR results to feed into <u>revision</u> work of hydrogen quality standards.** ⇒ 2018 status STD action: prEN 17124 and ISO DIS 14687 have a relaxed threshold for formaldehyde impurities. Also the remark for total halogenated compounds has changed. Successful translation of PNR results to standards. Results from ongoing PNR work may be used in standards' revision cycles	Update standards with PNR results from ongoing PNR project if necessary and relevant. Once the ISO 14687 is finalised, a revision will start on the thresholds. Extend the standards to heavy duty applications (trucks, trains, ships)	PNR: 2-3 years Standardisation: 1-2 years	***PNR:*** ***TBC on completion of projects*** ***Standardisation:*** ***TBC on completion of existing activities***	Standardization bodies, industrial and research organisations

Update standards with PNR results from ongoing PNR project if necessary and relevant. Once the ISO 14687 is finalised, a revision will start on the thresholds. Extend the standards to heavy duty applications (trucks, trains, ships)

SFEM/WG Hydrogen – 2019 Recommendation Heavy Duty

HEAVY DUTY ROAD VEHICLE APPLICATIONS							
PNR 2018: Bus roll-over testing GTR phase 2 is considering to include a bus roll-over test. This testing might need to be conducted in Europe, and the appropriate protocols implemented.			*** 2018 STD action (new): Review and possibly update/expand existing standards on fuel cell road vehicles** ⇒ 2018 status STD action: The standards developed for fuel cell vehicles in ISO TC 22 SC 37 were published in 2013 (ISO 23828:2013 (energy consumption measurement) and ISO 23273:2013 (safety)). GTR 13 phase 2 to look at including trucks, lorries and buses.	Review the necessity to update standards in ISO TC 22 SC37 regarding fuel cells. Vehicle requirements for interoperability need to be included in a standard.	*Timing Standardisation:* ***2019-2020***	***PNR:*** *Impact:* ***Medium*** *Urgency:* ***Start now*** *Time for finalisation:* ***Less than 3 years*** ***Standardisation:*** *Impact:* **High** *Urgency:* ***Start now***	Standardization bodies, industrial and research organisations

*** 2018 STD action (new): Review and possibly update/expand existing standards on fuel cell road vehicles** ⇒ 2018 status STD action: The standards developed for fuel cell vehicles in ISO TC 22 SC 37 were published in 2013 (ISO 23828:2013 (energy consumption measurement) and ISO 23273:2013 (safety)). GTR 13 phase 2 to look at including trucks, lorries and buses.	Review the necessity to update standards in ISO TC 22 SC37 regarding fuel cells. Vehicle requirements for interoperability need to be included in a standard.

SFEM/WG Hydrogen – 2019 Recommendation Heavy Duty

Additional hydrogen system and usage PNR and standardisation actions since the 2015 report

3. Truck applications: With the increasing interest in using hydrogen and fuel cells in medium and heavy duty applications (e.g. Nikola, Hyundai, Toyota), the need for dedicated standards for these applications increases. Currently, ISO standards and UNECE GTR13 (R134) exist for fuel cell vehicles regarding safety, refuelling protocols, and energy consumption measurements. Relevant stakeholders should review whether these standards are sufficient, up-to-date and whether new standards should be developed.

4.4.5.1 Changes in terms of prioritisation for hydrogen system and usage

However, hydrogen refuelling infrastructure topics like the risk assessment, refuelling conditions and the development of protocols for medium and heavy duty applications are still considered as very high priority as some of these actions have not yet delivered sufficient results (risk assessment) or are yet to be started (refuelling conditions and protocols).

SFEM/WG Hydrogen – 2019 Recommendation Heavy Duty

5.1 Near term actions roadmap

For pure **hydrogen technologies**, the priority actions for PNR and standardization are targeted to facilitate the uptake of hydrogen in the transport market. The AFID provides a clear timeline regarding standardization, aimed at ensuring interoperability of connectors, filling protocols and hydrogen quality. Although many of the gaps identified in 2015 have been filled, or are receiving a sufficient level of attention, some issues on HRS remain. One of these topics is the research needed to develop refuelling protocols for medium/heavy duty vehicles. For the HRS there is still the issue of developing risk assessment methodologies. There are knowledge gaps regarding failure modes of hydrogen refuelling stations and understanding the consequences for onboard hydrogen storage systems. For fuel cell development, the medium and heavy duty transport applications will need further PNR and standardisation work. For the use of hydrogen and fuel cells for maritime and railway applications, both PNR and standards are needed. Projects are facing barriers due to a lack of standards. The recent EMSA study mentions a large number of gaps such as bunkering of liquid and gaseous hydrogen fuel, onboard storage systems and fuel cell systems.

Developments

ISO/TC 197 plenary meeting December 2019

- Request for resubmission New Work Item Proposal on a 3-part standard to be developed (independently) from a single WG within the next three months, based on the need for standards for hydrogen fueling protocols for heavy-duty, high-flow applications.

Developments

PRHYDE
Protocol for heavy-duty Hydrogen refuelling

FCH | FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Project: Protocol for heavy duty hydrogen refuelling (PRHYDE)

What is PRHYDE?

PRHYDE is a European based project, funded by the FCH2 JU under the Horizon 2020 programme, looking at the current and future developments needed for refuelling medium and heavy duty hydrogen vehicles, predominantly road vehicles, but also other applications such as rail and maritime.

The project aims to investigate refuelling protocol requirements, and provide data for compressed (gaseous) hydrogen refuelling protocols developed for the 35, 50 and 70 MPa nominal working pressures, that is anticipated to help facilitate the future standardisation of fuelling protocols for medium and heavy duty vehicles.

CEN CENELEC

Questions

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