HYDROGEN REFUELLING STATIONS (HRS): RECENT AND CURRENT PERSPECTIVES

HYLAW UK WORKSHOP

CITY HALL 8TH NOVEMBER 2018

NICK HART, ITM POWER PLC

ITM POWER
Energy Storage | Clean Fuel

HRS: RECENT AND CURRENT PERSPECTIVES

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CITY HALL | 8TH NOVEMBER 2018

Presentation Contents:

- Legislation / Guidance
  - Historical
  - Current status
- Actions / Gaps

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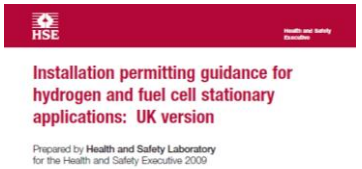
HRS: RELEVANT UK GUIDANCE – 2011

Low pressure stationary applications:
"RR715 - Installation permitting guidance for hydrogen and fuel cell stationary applications: UK version", 2009
(http://www.hyperproject.eu/)

Refuelling stations:
"HyApproval - Handbook for Approval of Hydrogen Refuelling Stations" (European Commission) (http://www.hyapproval.org/), 2008

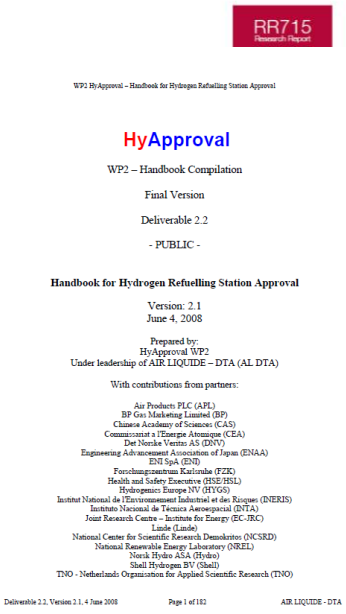
British Compressed Gases Association (BCGA):
Codes of Practice / Industrial guidance

International standards:
ISO TC 197:
Standardization in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen.


HSE

Installation permitting guidance for hydrogen and fuel cell stationary applications: UK version

Prepared by Health and Safety Laboratory for the Health and Safety Executive 2009


RR715
Research Report

WP2 HyApproval – Handbook for Hydrogen Refuelling Station Approval

HyApproval

WP2 – Handbook Compilation

Final Version

Deliverable 2.2

- PUBLIC -

Handbook for Hydrogen Refuelling Station Approval

Version: 2.1
June 4, 2008

Prepared by:
HyApproval WP2
Under leadership of AIR LIQUIDE – DTA (AL DTA)

With contributions from partners:

Air Products PLC (APL)
BP Gas Marketing Limited (BP)
Chinese Academy of Sciences (CAS)
Commissariat a l'Energie Atomique (CEA)
Det Norske Veritas AS (DNV)
Engineering Advancement Association of Japan (ENAA)
ENI SpA (ENI)
Forschungszentrum Karlsruhe (FZK)
Health and Safety Executive (HSE/HSL)
Hydrogenics Europe NV (HYGS)
Institut National de l'Environnement Industriel et des Risques (INERIS)
Instituto Nacional de Técnica Aeroespacial (INTA)
Joint Research Centre – Institute for Energy (EC-JRC)
Linde (Linde)
National Center for Scientific Research Demokritos (NCSRD)
National Renewable Energy Laboratory (NREL)
Norsk Hydro ASA (Hydro)
Shell Hydrogen BV (Shell)
TNO - Netherlands Organisation for Applied Scientific Research (TNO)

Deliverable 2.2, Version 2.1, 4 June 2008 Page 1 of 182 AIR LIQUIDE - DTA

(RECENT) BCGA DEVELOPMENTS

Hydrogen (and alternative gaseous fuels)

- Existing codes for use of gas cylinders (CP4), or bulk hydrogen storage (CP33)
- Relevant to hydrogen refuelling stations
- However, further specific guidance required – ISO 20100 preparation stalled
- TSC9 formed 2011 for hydrogen and alternative gaseous fuels
- Development of code of practice (CP) for refuelling stations:
  - To outline major considerations required in design, construction, operation and maintenance
  - Appropriate EU and UK legislation to be addressed
  - Sign-post to relevant documents (NFPA, ISO, etc)
- Institution of Gas Engineers and Managers (IGEM) – IGEM/UP/20 (to replace IGE/UP/5)
- Gather feedback from other UK stakeholders, including:
  - HSE
  - Association for Petroleum and Explosives Administration (APEA)
  - Energy Institute (EI)
  - London Fire Brigade
  - Society of Motor Manufacturers & Traders (SMMT)

BCGA CODE OF PRACTICE 41

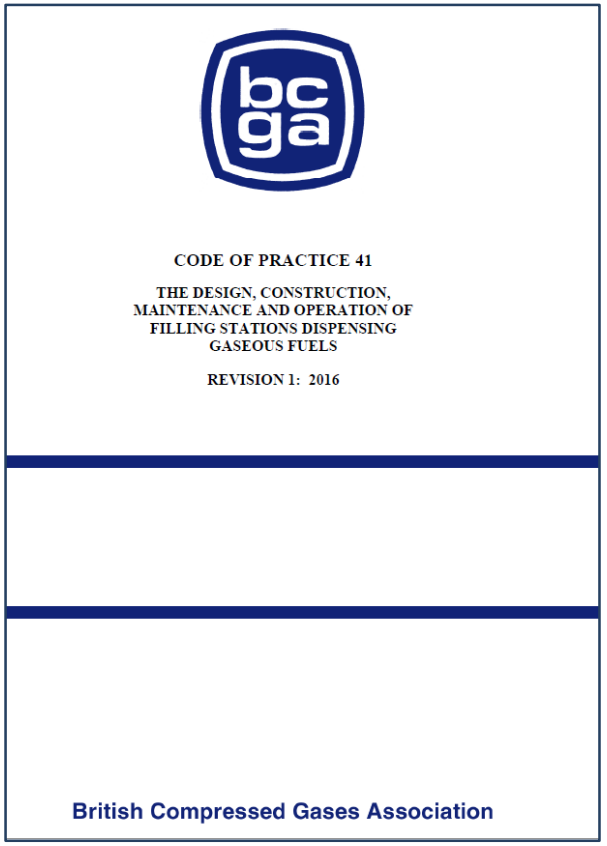
The design, construction, maintenance and operation of filling stations dispensing gaseous fuels

http://www.bcga.co.uk/assets/publications/CP41.pdf

Published 2014 / Revised 2016 & 2018

Including

- Layout & Site Selection Criteria
- Design of Filling Station
- Installation & Commissioning
- Operation
- Periodic Examination & Maintenance
- Fuel Quality
- Training
- Personnel Protective Equipment
- Emergency Situations & Procedures

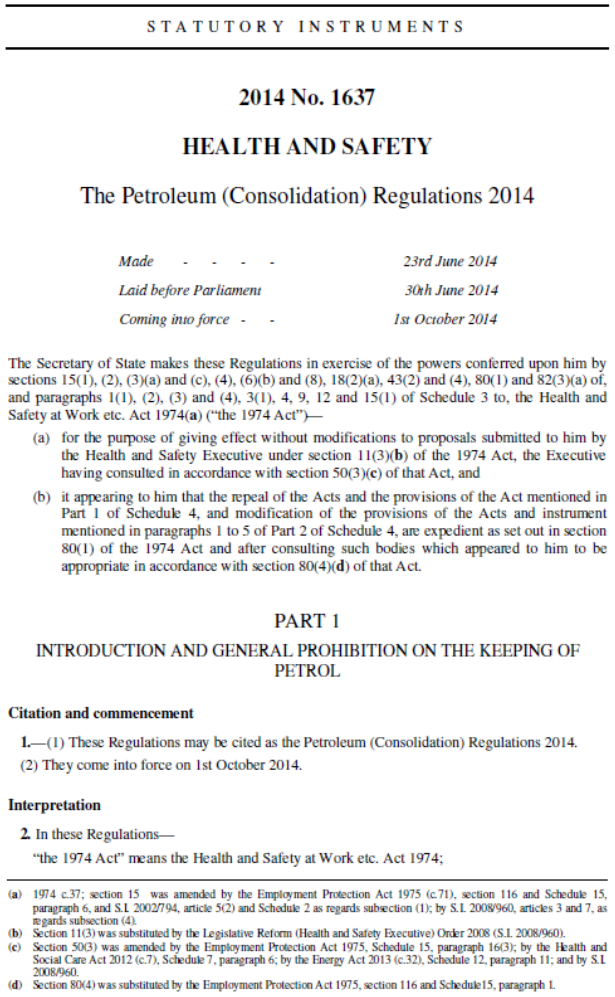


CONVENTIONAL FUELS

In the UK we have a law that is applicable for anywhere that dispenses, or stores, petroleum:

The Petroleum (Consolidation) Regs 2014

- requires that anyone operating a petrol filling station should have a “petroleum storage certificate” issued by their local Petroleum Enforcement Authority (PEA)
- applies both to retail and non-retail filling stations i.e. those that dispense petrol to the general public and those which only dispense petrol into their own vehicles.
- as part of the PEA assessment of a petrol filling station - the PEA will ensure that the arrangements for any other fuels stored and dispensed on the site are also appropriate, and that the risks associated with the fuels are controlled so as not to impact upon each other.



STATUTORY INSTRUMENTS

2014 No. 1637

HEALTH AND SAFETY

The Petroleum (Consolidation) Regulations 2014

Made - - - - *23rd June 2014*
Laid before Parliament *30th June 2014*
Coming into force - - *1st October 2014*

The Secretary of State makes these Regulations in exercise of the powers conferred upon him by sections 15(1), (2), (3)(a) and (c), (4), (6)(b) and (8), 18(2)(a), 43(2) and (4), 80(1) and 82(3)(a) of, and paragraphs 1(1), (2), (3) and (4), 3(1), 4, 9, 12 and 15(1) of Schedule 3 to, the Health and Safety at Work etc. Act 1974(**a**) (“the 1974 Act”)—

(a) for the purpose of giving effect without modifications to proposals submitted to him by the Health and Safety Executive under section 11(3)(**b**) of the 1974 Act, the Executive having consulted in accordance with section 50(3)(**c**) of that Act, and

(b) it appearing to him that the repeal of the Acts and the provisions of the Act mentioned in Part 1 of Schedule 4, and modification of the provisions of the Acts and instrument mentioned in paragraphs 1 to 5 of Part 2 of Schedule 4, are expedient as set out in section 80(1) of the 1974 Act and after consulting such bodies which appeared to him to be appropriate in accordance with section 80(4)(**d**) of that Act.

PART 1

INTRODUCTION AND GENERAL PROHIBITION ON THE KEEPING OF PETROL

Citation and commencement

1.—(1) These Regulations may be cited as the Petroleum (Consolidation) Regulations 2014.

(2) They come into force on 1st October 2014.

Interpretation

2. In these Regulations—

“the 1974 Act” means the Health and Safety at Work etc. Act 1974;

(**a**) 1974 c.37; section 15 was amended by the Employment Protection Act 1975 (c.71), section 116 and Schedule 15, paragraph 6, and S.I. 2002/794, article 5(2) and Schedule 2 as regards subsection (1); by S.I. 2008/960, articles 3 and 7, as regards subsection (4).
(**b**) Section 11(3) was substituted by the Legislative Reform (Health and Safety Executive) Order 2008 (S.I. 2008/960).
(**c**) Section 50(3) was amended by the Employment Protection Act 1975, Schedule 15, paragraph 16(3); by the Health and Social Care Act 2012 (c.7), Schedule 7, paragraph 6; by the Energy Act 2013 (c.32), Schedule 12, paragraph 11; and by S.I. 2008/960.
(**d**) Section 80(4) was substituted by the Employment Protection Act 1975, section 116 and Schedule15, paragraph 1.

CONVENTIONAL FUELS

Forecourt design criteria against which a petrol filling station is assessed can be obtained from the Petroleum Enforcement Liaison Group (PELG):

PELG "The Red Guide"

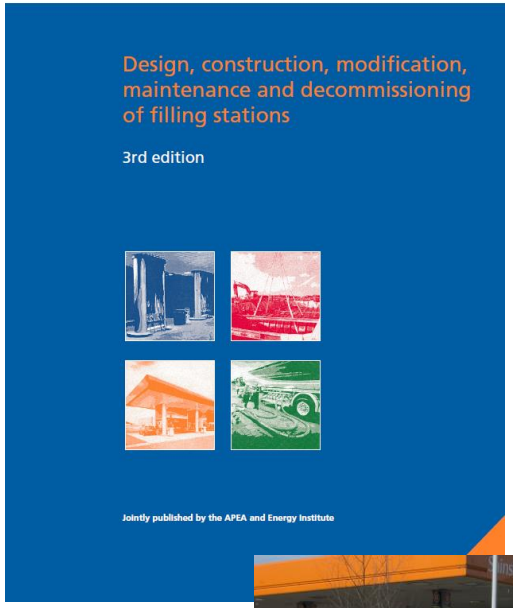
Petrol filling stations guidance on managing the risks of fire and explosion

EI & APEA "The Blue Book":

Design, construction, modification, maintenance and decommissioning of filling stations.

(APEA = Association for Petroleum and Explosives Administration

EI = Energy Institute)



Compliance with CP41 alone was inadequate to get permit from PEA (ref Air Products experience at Hendon) as, at the time, there was no provision for the use of hydrogen specifically as a vehicle fuel on a petrol filling station in the documents above

HYDROGEN ON UK PETROL STATION FORECOURTS

Guidance on hydrogen delivery systems for refuelling of motor vehicles, co-located with petrol fuelling stations (Supplement to the Blue Book)

http://publishing.energyinst.org/topics/petroleum-product-storage-and-distribution/filling-stations/guidance-on-hydrogen-delivery-systems-for-refuelling-of-motor-vehicles

Developed by:

- Energy Institute (EI)
- Association for Petroleum and Explosives Administration (APEA)
- BCGA
- London Fire Brigade
- HSE

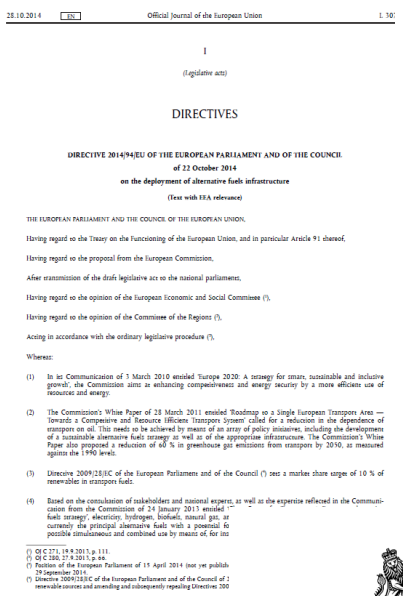
SPECIFIC LEGISLATION RELEVANT TO HRS

European legislation:

- Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure
- Requirements for electric vehicle charging, hydrogen, CNG and LNG vehicle fuelling;
- Both safety (interoperability) and availability;
- For hydrogen, current Directive includes reference to ISO standards (see Annex II) – changing to EN standards by Delegated Regulation 2017 and 2018 (to come).

UK legislation:

- SI. 2017 No. 897: The Alternative Fuels Infrastructure Regulations 2017
- (Transposes Directive 2014/94/EU in UK law)
- Automated and Electric Vehicles Act 2018
- Primary legislation, to enable new regulations that could require introduction of hydrogen refuelling points (and electric charging points), and other availability related requirements



28.10.2014 EN Official Journal of the European Union L 307

I

(Legislative acts)

DIRECTIVES

DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 22 October 2014
on the deployment of alternative fuels infrastructure
(Text with EEA relevance)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 91 thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national parliaments,

Having regard to the opinion of the European Economic and Social Committee (1),

Having regard to the opinion of the Committee of the Regions (2),

Acting in accordance with the ordinary legislative procedure (3),

Whereas:

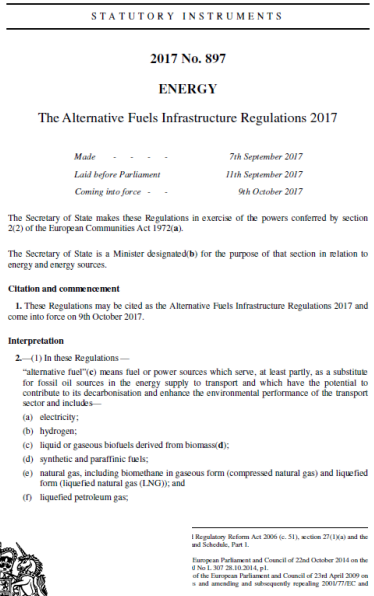
(1) In its Communication of 3 March 2010 entitled 'Europe 2020: A strategy for smart, sustainable and inclusive growth', the Commission aims at enhancing competitiveness and energy security by a more efficient use of resources and energy.

(2) The Commission's White Paper of 28 March 2011 entitled 'Roadmap to a Single European Transport Area — Towards a Competitive and Resource Efficient Transport System' called for a reduction in the dependence of transport on oil. This needs to be achieved by means of an array of policy initiatives, including the development of a sustainable alternative fuels strategy as well as of the appropriate infrastructure. The Commission's White Paper also proposed a reduction of 60 % in greenhouse gas emissions from transport by 2050, as measured against the 1990 levels.

(3) Directive 2009/28/EC of the European Parliament and of the Council (4) sets a market share target of 10 % of renewables in transport fuels.

(4) 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 '... fuels strategy', electricity, hydrogen, biofuels, natural gas, at currently the principal alternative fuels with a potential fo possible simultaneous and combined use by means of, for ins

(1) OJ C 271, 19.9.2013, p. 111.
(2) OJ C 280, 27.9.2013, p. 66.
(3) Position of the European Parliament of 15 April 2014 (not yet publish 29 September 2014.
(4) Directive 2009/28/EC of the European Parliament and of the Council of renewable sources and amending and subsequently repealing Directives 200



STATUTORY INSTRUMENTS

2017 No. 897

ENERGY

The Alternative Fuels Infrastructure Regulations 2017

Made - - - - 7th September 2017
Laid before Parliament 11th September 2017
Coming into force - - 9th October 2017

The Secretary of State makes these Regulations in exercise of the powers conferred by section 2(2) of the European Communities Act 1972(a).

The Secretary of State is a Minister designated(b) for the purpose of that section in relation to energy and energy sources.

Citation and commencement

1. These Regulations may be cited as the Alternative Fuels Infrastructure Regulations 2017 and come into force on 9th October 2017.

Interpretation

2.—(1) In these Regulations —

"alternative fuel"(c) means fuel or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector and includes—

(a) electricity;
(b) hydrogen;
(c) liquid or gaseous biofuels derived from biomass(d);
(d) synthetic and paraffinic fuels;
(e) natural gas, including biomethane in gaseous form (compressed natural gas) and liquefied form (liquefied natural gas (LNG)); and
(f) liquefied petroleum gas;

1 Regulatory Reform Act 2006 (c. 51), section 27(1)(a) and the and Schedule, Part 1.

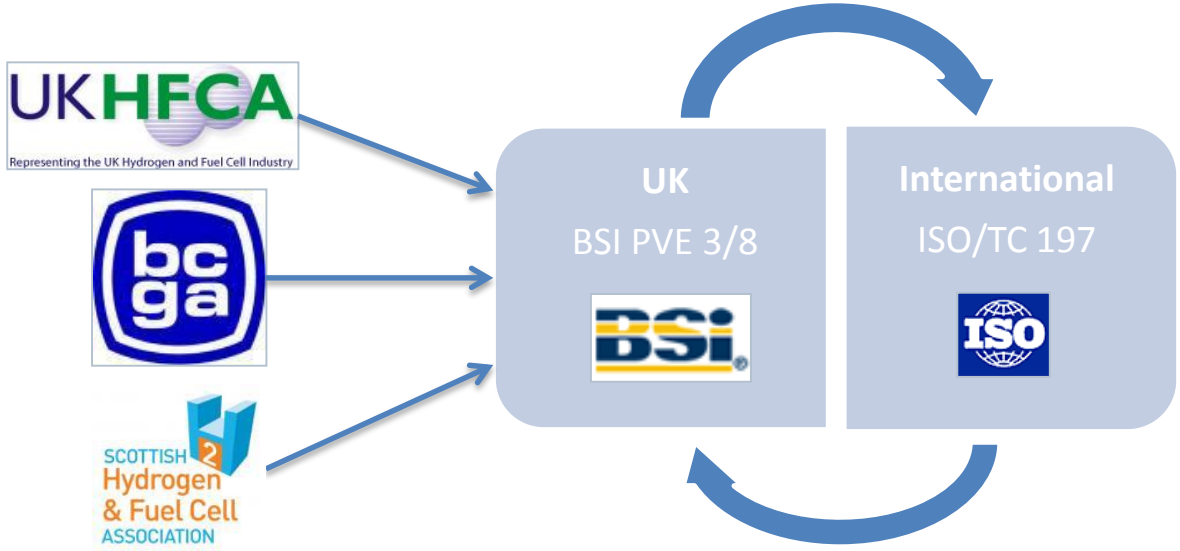
European Parliament and Council of 22nd October 2014 on the f No L 307 28.10.2014, p1.
of the European Parliament and Council of 23rd April 2009 on s and amending and subsequently repealing 2003/77/EC and

Automated and Electric Vehicles Act 2018

CHAPTER 18

Explanatory Notes have been produced to assist in the understanding of this Act and are available separately

EXAMPLE: INPUT TO ISO HYDROGEN STANDARDS



ISO/TC 197 Group	Standard	Title
WG 5:	ISO 17268	Gaseous hydrogen - land vehicle refuelling connection devices
WG 24:	ISO 19880-1	Gaseous hydrogen - Fuelling stations: General requirements
WG 26:	ISO 22734	Hydrogen generators using water electrolysis
WG 27:	ISO 14687	Hydrogen fuel quality - Product specification

ISO: HYDROGEN FUELLING STATIONS

ISO TC 197:

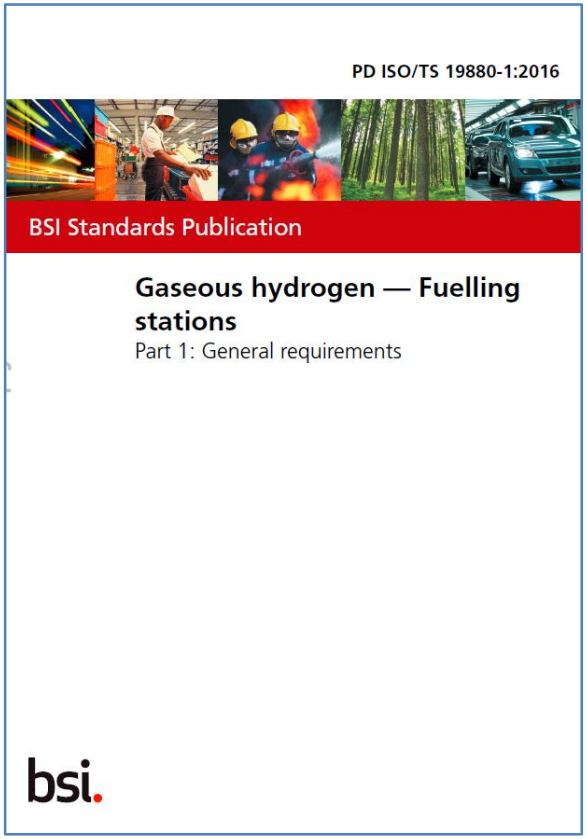
2016: ISO TS 19880-1 (informative)

2019: ISO 19880-1

- Outdoor, public stand-alone and integrated fuelling stations;
- Risk assessment requirements;
- Fuelling protocol requirements (e.g. as met by SAE J2601);
- Component requirements;
- Location of equipment in enclosures;
- Station validation requirements (FAT / SAT);
- Additional guidance, including separation distance methodologies (e.g. HyRAM) and other considerations

CEN TC 268 WG5:

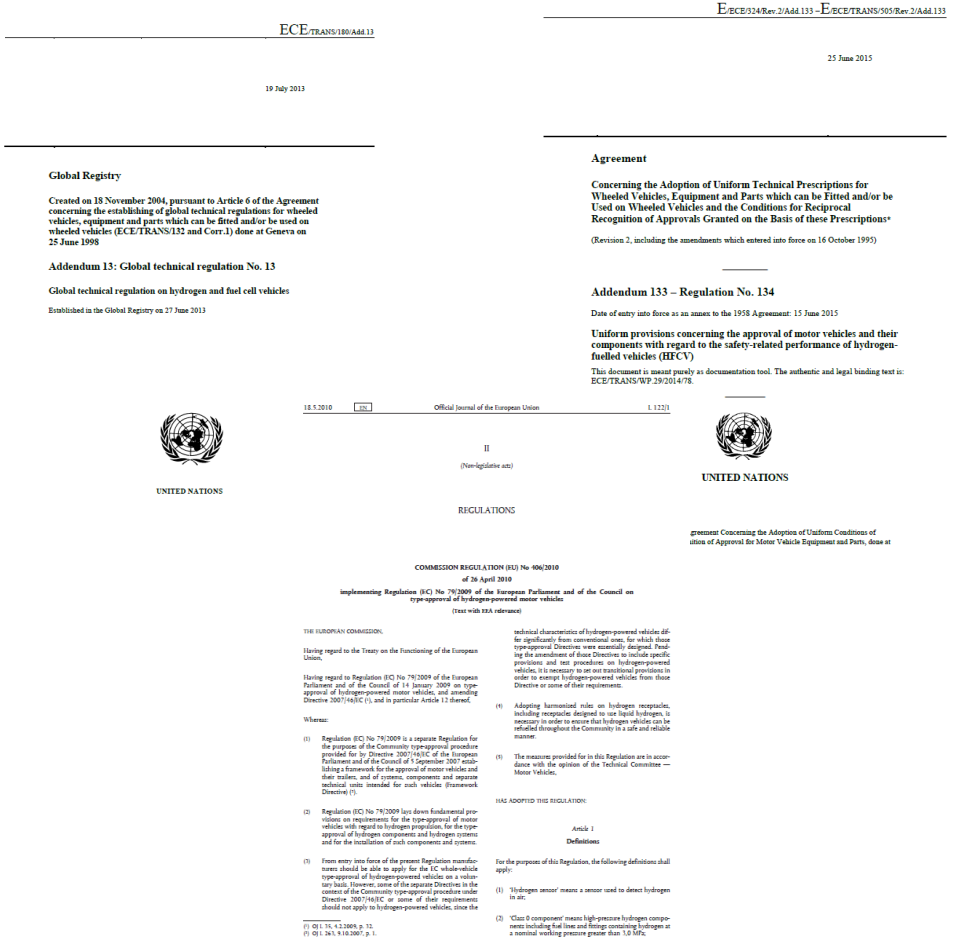
EN 17127 – includes interoperability requirements of ISO 19880-1



LEGISLATION RELEVANT TO HYDROGEN VEHICLES

International:

- Regulation (EC) No 79/2009 of the European Parliament and of the Council of 14 January 2009 on type-approval of hydrogen-powered motor vehicles,
- Commission Regulation (EU) No 406/2010 of 26 April 2010 implementing Regulation (EC) No 79/2009 of the European Parliament and of the Council on type-approval of hydrogen-powered motor vehicles
- Global Technical Regulation No. 13: Global technical regulation on hydrogen and fuel cell vehicles
- UNECE Regulation No. 134: Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety-related performance of hydrogen fuelled vehicles (HFCV)



ECE/TRANS/180/Add.13

19 July 2013

Global Registry

Created on 18 November 2004, pursuant to Article 6 of the Agreement concerning the establishing of global technical regulations for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles (ECE/TRANS/132 and Corr.1) done at Geneva on 25 June 1998

Addendum 13: Global technical regulation No. 13

Global technical regulation on hydrogen and fuel cell vehicles

Established in the Global Registry on 27 June 2013

UNITED NATIONS

E/ECE/324/Rev.2/Add.133 – E/ECE/TRANS/505/Rev.2/Add.133

25 June 2015

Agreement

Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions*

(Revision 2, including the amendments which entered into force on 16 October 1995)

Addendum 133 – Regulation No. 134

Date of entry into force as an annex to the 1958 Agreement: 15 June 2015

Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety-related performance of hydrogen-fuelled vehicles (HFCV)

This document is meant purely as documentation tool. The authentic and legal binding text is: ECE/TRANS/WP.29/2014/78.

UNITED NATIONS

greement Concerning the Adoption of Uniform Conditions of ution of Approval for Motor Vehicle Equipment and Parts, done at

18.5.2010 EN Official Journal of the European Union L 122/1

II

(Non-legislative acts)

REGULATIONS

COMMISSION REGULATION (EU) No 406/2010

of 26 April 2010

implementing Regulation (EC) No 79/2009 of the European Parliament and of the Council on type-approval of hydrogen-powered motor vehicles

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EC) No 79/2009 of the European Parliament and of the Council of 14 January 2009 on type-approval of hydrogen-powered motor vehicles, and amending Directive 2007/46/EC (1), and in particular Article 12 thereof,

Whereas:

(1) Regulation (EC) No 79/2009 is a separate Regulation for the purposes of the Community type-approval procedure provided for by Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (Framework Directive) (2).

(2) Regulation (EC) No 79/2009 lays down fundamental provisions on requirements for the type-approval of motor vehicles with regard to hydrogen propulsion, for the type-approval of hydrogen components and hydrogen systems and for the installation of such components and systems.

(3) From entry into force of the present Regulation manufacturers should be able to apply for the EC whole-vehicle type-approval of hydrogen-powered vehicles on a voluntary basis. However, some of the separate Directives in the context of the Community type-approval procedure under Directive 2007/46/EC or some of their requirements should not apply to hydrogen-powered vehicles, since the technical characteristics of hydrogen-powered vehicles differ significantly from conventional ones, for which those type-approval Directives were essentially designed. Pending the amendment of those Directives to include specific provisions and test procedures on hydrogen-powered vehicles, it is necessary to set out transitional provisions in order to exempt hydrogen-powered vehicles from those Directive or some of their requirements.

(4) Adopting harmonised rules on hydrogen receptacles, including receptacles designed to use liquid hydrogen, is necessary in order to ensure that hydrogen vehicles can be refuelled throughout the Community in a safe and reliable manner.

(5) The measures provided for in this Regulation are in accordance with the opinion of the Technical Committee — Motor Vehicles,

HAS ADOPTED THIS REGULATION:

Article 1

Definitions

For the purposes of this Regulation, the following definitions shall apply:

(1) 'Hydrogen sensor' means a sensor used to detect hydrogen in air;

(2) 'Class 0 component' means high-pressure hydrogen components including fuel lines and fittings containing hydrogen at a nominal working pressure greater than 3,0 MPa;

(1) OJ L 35, 4.2.2009, p. 32.
(2) OJ L 263, 9.10.2007, p. 1.

ACTIONS / GAPS TO ADDRESS RELEVANT TO HRS (1)

Near term actions:

- Completion of ISO 19880-1, ISO 19880-8, ISO 14687
- Revision of EN 17127 (& EN 17124)
- Revision of BCGA CP41

Remaining gaps:

- Hydrogen nozzles:
  - Legal requirement for operators for nozzles to meet ISO 17268, however, none exist on market currently
- Hydrogen dispenser testing:
  - Soon to be legal requirement(?) for operators to test against EN 17127, however, no test apparatus exists in UK currently
- Hydrogen quality testing:
  - Soon to be legal requirement(?) for operators to test against EN 17124, however, capability for full testing does not exist in UK currently
- Hydrogen dispenser meter testing:
  - Probable future legal requirement for operators(?) to test against OIML R139, however, no test apparatus exists in UK currently

ACTIONS / GAPS TO ADDRESS RELEVANT TO HRS (2)

Remaining gaps (contd):

- Interoperability:
  - Mostly addressed where type-approved hydrogen light duty vehicle
  - What if proto-type / small series / one-off / heavy duty? – no clear requirements
  - How to make sure that the vehicle is safe to fill at a dispenser?

- Vehicle maintenance
  - MOT currently does not appear to cover hydrogen system
  - Is there an intention to implement the hydrogen vehicle relevant sections of Directive 2014/45/EU of the European Parliament and of the Council of 3 April 2014 on periodic roadworthiness tests for motor vehicles and their trailers

HRS: RECENT AND CURRENT PERSPECTIVES

HYLAW UK WORKSHOP

CITY HALL | 8TH NOVEMBER 2018

ITM POWER
Energy Storage | Clean Fuel