

Global Hydrogen Safety Codes and Standards

Chris LaFleur Sandia National Labs July 21, 2021















International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)

Two active Working Groups

Education & Outreach –

 Aims to share information on hydrogen and fuel cell technologies, including the status, challenges, opportunities, and initiatives (particularly on policies and programs) across countries

Regulations, Codes, Standards, & Safety –

 Aims to share information, lessons learned and best practices with a focus on hydrogen safety, as well as the harmonization of codes and standards developed by relevant industry code and standards development organizations.





Research Priorities







HSE Health and Safety International Association for Hydrogen Safety 'Research Priorities Workshop', September 2018, Buxton, UK Prepared by the International Association for Hydrogen Safety and partners RR1159 Research Report



Standards Affecting H2 Applications are Industry -Specific





North American-Based Codes & Standards



Examples of Standards Impacting Refueling Infrastructure



North American-Based Codes & Standards



Examples of Standards Impacting Vehicles



Other Vehicle-Related
Standards:SAE J2578: Recommended Practice for General Fuel Cell Vehicle
Safety (Revised 2014)SAE J2574: Fuel
SAE J2799: Hydro
Hardware and Sof
SAE J2719: Hydrogen Fuel Quality for Fuel Cell Vehicles (Revised 2020)SAE J2601: Com
Devices (Revised 2020)SAE J2719: Hydrogen Fuel Quality for Fuel Cell Vehicles (Revised 2020)SAE J2600: Com
Devices (Revised 2020)

SAE J2574: Fuel Cell Vehicle Terminology (2011)

SAE J2799: Hydrogen Surface Vehicle to Station Communications Hardware and Software (Revised 2019)

SAE J2600: Compressed Hydrogen Surface Vehicle Fueling Connection Devices (Revised 2015)

North American-Based Standards



- National Fire Protection Association (NFPA) Fire safety topical documents
- American Association of Mechanical Engineers (ASME) –Design requirements for piping, pressure vessels, tanks
- American Society for Testing Materials (ASTM) Standard test methods for materials that come in contact with hydrogen/hydrogen embrittlement
- Canadian National Standards (CAN) Installation , fuel cells (portable and stationary)
- Compressed Gas Association (CGA group) Publication on H2 storage, piping, venting, labeling, etc.
- Canadian Standards Association (CSA)/American National Standards Institute (ANSI/ Underwriters Laboratory (UL)– Product certification and development of safety standards for electrical appliances, medical devices, machinery, equipment, etc.
- Others: Electrical standards and guidance documents (IEEE), Society of Automotive Engineers (SAE)

Incorporated by reference in many countries and across many relevant documents

NFPA 2 – Hydrogen Technologies Code



- Consensus standard Technical Committee Members categorized into classifications based on the roles their funding organization playing in the industry
- Balance Requirement: no more than one-third of the voting members shall represent any one interest category
 - Manufacturer
 - User: A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.
 - Installer/Maintainer
 - Labor
 - Applied Research/Testing Laboratory
 - Enforcing Authority
 - Insurance
 - Consumer
 - Special Expert (SE): A person not representing any other category, and who has special expertise in the scope of the standard.



NFPA 2 – Hydrogen Technologies Code

- Established in 2006 as an all-encompassing document to establish the necessary requirements for the storage, use, and handling of H2
- Scope: This code shall apply to the production, storage, transfer and use of hydrogen.
- Recent Activity
 - Currently in the 2023 version revision cycle
 - First Draft issued March 2021
 - Public Comment closing date July 14, 2021
 - Second Draft meeting will be held in Fall 2021
 - 2023 Version will be issued in Fall 2022





NFPA 2 – Hydrogen Technologies Code

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Parking Garages

Repair Garages



Contents	
 1-3 Admin, References, and Definitions 4 General Fire Safety Requirements 5 Performance-Based Option 6 General Hydrogen Requirements 7 Caseous Hydrogen 	Standards referenced by the Code Other NFPA docs ANSI
 7 Gaseous Hydrogen 8 Liquefied Hydrogen 9 Explosion Protection 10 GH₂ Vehicle Fueling Facilities 11 LH₂ Fueling Facilities 12 H2 Fuel Cell Power Systems 	ASME ASTM CGA CSA Group ICC
 Hydrogen Generation Systems Combustion Application Special Atmosphere Applications Laboratory Operations 	SAE UL

Hydrogen Systems in Canada



- Canadian Hydrogen Installation Code: CAN/BNQ 1784-0000
- Sets the installation requirements for hydrogen generating equipment, hydrogenpowered equipment, hydrogen dispensing equipment, hydrogen storage containers, hydrogen piping systems and their related accessories.
- Applies to gaseous and liquid hydrogen
- Exceptions
 - Petroleum refineries and chemical plants as feedstock
 - Industrial facilities with mass flow greater than 21 kg/hr
 - New edition expected December 2021
- <u>https://www.bnq.qc.ca/en/standardization/hydrogen/canadian-hydrogen-installationcode.html</u>



Maritime (IMO) Hazardous Goods



- Sub-Committee on Carriage of Cargoes and Containers (CCC), under the Maritime Safety and Marine Environment Protection Committees, covers:
 - Effective implementation of codes and standards dealing with cargo operations, including packaged dangerous goods, solid bulk cargoes, bulk gas cargoes, and containers;
 - Evaluation of safety and pollution hazards of packaged dangerous goods, solid bulk cargoes and gas cargoes;
 - Survey and certification of ships carrying hazardous cargoes;
 - Enhancement of the safety, security culture and environmental consciousness in all cargo and container operations; and
 - Cooperation with other relevant UN bodies, IGOs and NGOs
- Relevant sections
 - Fuel IGF Code International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (Mandatory under SOLAS)
 - Cargo IGC Code International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk



Codes and Standards Database



Codes and standards provide the information needed to safely build, maintain, and operate equipment, systems, and facilities. They help ensure uniformity of safety requirements and give local inspectors and safety officials the information they need to approve systems and installations.

Who is keeping track of all this??

This resource tracks the world-wide development of about 400 hydrogen and fuel cell standards.

Hydrogen To	ols	RESOURCES HYARC ABOUT	۹	2	
HOME / FUEL CELL STAND	ARDS				
442 results found		the state of the Advertised and a second			
Application type		About the Codes & Standards resource.		-	
H2 AND FUEL CELL ROAD VEHICLES	(1)		Q	1	
HYDROGEN & FUEL CELL VEHICLE APPLICATIONS	(57)	American Institute of Aeronautics and Astronautics			
HYDROGEN	(165)	AIAA G-095 Guide to Safety of Hydrogen and Hydrogen Systems			
MISC	(34)	American Society of Mechanical Engineers			
PORTABLE & MICRO FUEL CELLS	(51)	ASME B31.1 Power Piping			
Show more				_	
Organization		ASME B31.3 Process Piping			
AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS	(1)	ASME B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids			
AMERICAN SOCIETY FOR TESTING AND MATERIALS	(22)	ASME B31.8 Gas Transmission and Distribution Piping Systems			
AMERICAN SOCIETY OF MECHANICAL ENGINEERS	(14)	ASME B31.8S Managing System Integrity of Gas Pipelines		-	
ASSOCIACAO BRASILEIRA DE NORMAS TECNICAS (ABNT) (BRAZILIAN NATIONAL STANDARDS)	(2)	ASME B31.12 Hydrogen Piping and Pipelines		-	
BRITAIN'S HEALTH AND SAFETY EXECUTIVE (WITH UK INDUSTRY STAKEHOLDERS)	(1)	ASME STP-PT-006 Design Guidelines for Hydrogen Piping and Pipelines			
Show more		ASME BPVC Section VIII, Division 1 Rules for Construction of Pressure Vessels Division 1			
Region		ASME BPVC Section VIII, Division 2 Rules for Construction of Pressure Vessels Division 2,			
EUROPE	(46)	Alternate Rules			
INTERNATIONAL	(83)				
NORTH AMERICA	(149)	ASME BPVC Section VIII, Division 3 Rules for Construction of Pressure Vessels Division 3, Alternate Rules High Pressure Vessels Article KD-10 Special Requirements for Vessels in High			
PACIFIC RIM	(141)	Pressure Gaseous Hydrogen Transport and Storage			

Screenshot of the codes and standards database

Thanks for Your Attention!



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http://energy.sandia.gov/programs/sustainable-transportation/hydrogen/hydrogen-safetycodes-and-standards/

CHS... Bringing together individuals and organizations to develop and share best safety practices and learnings