NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Hydrogen Vehicle and Infrastructure Codes and Standards Citations

This document lists codes and standards typically used for U.S. hydrogen vehicle and infrastructure projects. To determine which codes and standards apply to a specific project, identify the codes and standards currently in effect within the jurisdiction where the project will be located. Some jurisdictions also have unique ordinances or regulations that could apply.

Learn about codes and standards basics at www.afdc.energy.gov/afdc/codes_standards_basics.html.

Find hydrogen vehicle and infrastructure codes and standards in these categories:

Annual Inspections and Approvals

Inspection Requirements

CGA G-5.4, Standard for Hydrogen Piping Systems at Consumer Locations (Compressed Gas Association, 2005)

- 7.0 Maintenance and Repair

CGA G-5.5, Hydrogen Vent Systems (Compressed Gas Association, 2004)

- 9 Maintenance

International Fire Code (International Code Council, 2012)

- 406.2 Frequency (of employee training)
- 901.6 Inspection, Testing, and Maintenance
- 901.6.2 Records (of systems inspection and maintenance)
- 2206.2.1.1 Inventory Control for Underground Tanks
- 3204.5.2 Corrosion Protection
- 3205.4 Filling and Dispensing

Personnel Issues and Training

International Fire Code (International Code Council, 2009)

- 406 Employee Training and Response Procedures
- 2209.4 Dispensing into Motor Vehicles at Self-Service Hydrogen Motor Fuel-Dispensing Facilities

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages (National Fire Protection Association, 2003)

- 9.4 Operating Requirements for Attended Self-Service Motor Fuel Dispensing Facilities

NFPA 55, Compressed Gases and Cryogenic Fluids Code (National Fire Protection Association, 2010)

- 4.6 Personnel Training
- 4.7 Fire Department Liaison

Operation Approvals—Dispensing

International Fire Code (International Code Council, 2009)

- 2204.2 Attended Self-Service Motor Fuel-Dispensing Facilities
- 2204.3 Unattended Self-Service Motor Fuel-Dispensing Facilities
- 2209.4 Dispensing into Motor Vehicles at Self-Service Hydrogen Motor Fuel-Dispensing Facilities

NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages (National Fire Protection Association, 2003)

- 6.2 General Requirements
- 6.3 Requirements for Dispensing Devices

Operation Approvals—Fire and Emergency Planning

International Fire Code (International Code Council, 2009)

- 404 Fire Safety and Evacuation Plan
- 406 Employee Training and Response Procedures
- 407 Hazard Communication
- 906 Portable Fire Extinguishers
- 907 Fire Alarm and Detection Systems
- 2209.3.2.6.2 Fire-Extinguishing Systems
- 2209.4 Dispensing into Motor Vehicles at Self-Service Hydrogen Motor Fuel-Dispensing Facilities
- 2209.5.1 Protection from Vehicles
- 2209.5.2 Emergency Shutoff Valves
- 2209.5.3 Emergency Shutdown Controls
- 2209.5.4 Venting of Hydrogen Systems

NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages (National Fire Protection Association, 2003)

- 7.3.5 Fixed Fire Protection

NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages (National Fire Protection Association, 2003)

- 6.3.7 Requirements for Dispensing Devices

General Station Requirements

Site Requirements for Fueling Stations

NFPA 2 Hydrogen Technologies Code (National Fire Protection Association, 2011)

- 6.6.1 Weather Protection- Classification of Weather Protection as an Indoor Versus Outdoor Area
- 6.12 Gaseous Hydrogen Detection Systems
- 6.17.1 Mechanical Exhaust Ventilation

Canopy Tops

International Building Code (International Code Council, 2009)

- 406.5.2.1 Canopies use to support gaseous hydrogen systems

International Fire Code (International Code Council, 2009)

- 2209.3.2.6 Canopy Tops
- 2209.3.3 Canopies

Fuel Delivery

International Fire Code (International Code Council, 2009)

- 105.6.8 Compressed Gases
- 105.6.10 Cryogenic Fluids
- 2205.1 Tank Filling Operation for Class I, II, or IIIA Liquids
- 3205.4 Filling and Dispensing

Vehicle Access

International Fire Code (International Code Council, 2009)

- 105.6.8 Compressed Gases

Weather Protection

International Fire Code (International Code Council, 2009)

- 2209.3.2.2 Weather Protection
- 2704.13 Weather Protection

General Safety Requirements

International Fire Code (International Code Council, 2009)

- 2209.5 Safety Precautions
- 2211.7 Repair Garages for Vehicles Fueled by Lighter-than-Air Fuels
- 2211.8 Defueling of Hydrogen from Motor Vehicle Fuel Storage Containers

- 3003 General Requirements
- 3203 General Safety Requirements
- 3503 General Requirements

Repair Facilities

International Fire Code (International Code Council, 2012)

- 2211.7 Repair Garages for Vehicles Fueled by Lighter-than-Air Fuels
- 2211.8 Defueling of Hydrogen from Motor Vehicle Fuel Storage Containers

Gaseous Hydrogen Storage, Compression, and Generation Systems

NFPA 2 Hydrogen Technologies Code (National Fire Protection Association, 2011)

- 7.1.1.3 Building Occupancy Classification for Hydrogen Storage
- 7.1.3 Listed and Approved Hydrogen Equipment
- 7.1.4 Metal Hydride Systems (including systems on industrial trucks)
- 7.1.5 Containers, Cylinders, and Tanks (this section refers to both the ASME BPB Section XIII or Transport Canada, Transportation of Dangerous Goods Regulations)
- 7.1.5.5 Pressure-Relief Devices
- 7.1.6 Labeling Requirements
- 7.1.6.4 Piping Systems
- 7.1.7 Security (including physical protection and securing containers)
- 7.1.8 Valve Protection
- 7.1.9 Separation from Hazardous Conditions
- 7.1.10 Service and Repair
- 7.1.11 Unauthorized Use
- 7.1.12 Containers, Cylinders, and Tanks Exposed Fire
- 7.1.13 Leaks, Damage, or Corrosion
- 7.1.14 Surfaces (on which containers would be placed)
- 7.1.15 Piping (including reference to ASME B31.12, Process Piping)
- 7.1.16 Valves (required accessibility)
- 7.1.17 Vent Pipe Termination
- 7.1.18 Cathodic Protection
- 7.1.19 Transfer (reference to CGA P-1 Safe Handling of Compressed Gases in Containers)

- 7.1.21 Emergency Shut-off Valves
- 7.1.22 Excess Flow Control (requirements for leak detection and emergency shut-off or excess flow control)
- 7.1.23 Ignition Control
- 7.2 Nonbulk GH2
- 7.2.1 Nonbulk GH2 General (separation from incompatible materials)
- 7.2.2 Nonbulk GH2 Storage (includes separation distances for nonbulk GH2 storage systems, systems 5,000 scf or less)
- 7.2.3 Nonbulk GH2 Use
- 7.2.4 Nonbulk GH2 Handling
- 7.3 Bulk GH2 Systems
- 7.3.1 Bulk GH2 Systems General Requirements
- 7.3.2 Bulk GH2 Systems Storage (contains Table 7.3.2.3.1.2 (a), (b), and (c) for above ground system separation distances)
- 7.3.3 Bulk GH2 Systems Use
- 7.3.4 Handling of Bulk GH2 Systems

International Fire Code (International Code Council, 2009)

- 2209.5 Safety Precautions
- 3003 General Requirements
- 3503 General Requirements

Storage Containers

CGA PS-20, Direct Burial of Gaseous Hydrogen Storage Tanks (Compressed Gas Association, 2006)

CGA PS-21, Adjacent Storage of Compressed Hydrogen and Other Flammable Gases (Compressed Gas Association, 2005)

International Fire Code (International Code Council, 2009)

- 2703.2.1 Design and Construction of Containers, Cylinders, and Tanks
- 3003.2 Design and Construction
- 3503.1.2 Storage Containers

Compression Systems and Equipment

International Fire Code (International Code Council, 2009)

- 2209.2 Equipment
- 2209.3 Location on Property
- 2209.5.3.1 System Requirements
- 2209.5.4.2.1 Minimum Rate of Discharge

Design of Gaseous Storage Systems—Barrier Walls

International Fire Code (International Code Council, 2009)

- 2209.3.1.1 Barrier Wall Construction – Gaseous Hydrogen

On-Site Hydrogen Production

International Fire Code (International Code Council, 2009)

- 2209.3.1 Separation from Outdoor Exposure Hazards

International Fuel Gas Code (International Code Council, 2009)

- 703.1 General Requirements

Natural Gas

ASME B31.8, Gas Transmission and Distribution Systems (American Society of Mechanical Engineers, 2003)

Liquefied Hydrogen Storage Systems

NFPA 2 Liquefied Hydrogen Requirements

NFPA 2 Hydrogen Technologies Code (National Fire Protection Association, 2011)

- 8.1.2 Containers – Design, Construction, and Maintenance (refers to ASME BPV, Rules for Unfired Pressure Vessels and Transport Canada *Transportation of Dangerous Goods Regulations*)
- 8.1.3 Design (of systems)
- 8.1.3.1 Piping Systems (refers to ASME B31.3 Process Piping)
- 8.1.4 Pressure Relief Devices (refers to CGA S-1.1 through 1.3)
- 8.1.5 Pressure Relief Vent Piping
- 8.1.6 Marking (refers to NFPA 704 Standard System for the Identification of the Hazards of Materials for Emergency Response)
- 8.1.7 Security
- 8.1.8 Separation from Hazardous Conditions
- 8.1.9 Electrical Wiring and Equipment (general reference to NFPA 70 National Electrical Code)
- 8.1.10 Service and Repair
- 8.1.11 Unauthorized Use
- 8.1.12 Leaks, Damage, and Corrosion
- 8.1.13 Lighting
- 8.1.14 Emergency Shutoff Valves
- 8.1.15 Dispensing Areas

- 8.1.16 Operations (for mobile fueling equipment)
- 8.2 Nonbulk LH2 (storage, handling and use shall be in accordance with Chapter 1–6 and 8 as applicable)
- 8.3 Bulk LH2 Systems (cutoff is = or > 150 liters)
- 8.3.1.2.1.1 Fire Resistance for Steel Supports
- 8.3.1.2.1.2 Container Marking
- 8.3.1.2.2 Vent System Requirements (including reference to CGAG-5.5)
- 8.3.1.2.3 Piping, Tubing, and Fittings (including reference to ASME B31.3 Process Piping)
- 8.3.1.2.4 Equipment Assembly (including location of emergency shutoff valves)
- 8.3.1.2.5 LH2 Vaporizers
- 8.3.1.2.6 Electrical Systems (sets electrically classified areas and refer to NFPA 70)
- 8.3.1.2.7 Bonding and Grounding
- 8.3.1.2.8 Stationary Pumps and Compressors
- 8.3.1.2.9 Emergency Shutdown System
- 8.3.2 Bulk LH2 Systems Storage
- 8.3.1.2.3 Placarding Site
- 8.3.2.1.4.1 Construction of the Inner Vessel
- 8.3.2.1.4.2 Construction of the Vacuum Jacket (Outer Vessel)
- 8.3.2.1.4.3 Nonstandard Containers (can be used with AHJ approval)
- 8.3.2.1.4.4 Concrete Containers
- 8.3.2.1.4.5 Foundations and Supports
- 8.3.2.2 Indoor Storage
- 8.3.2.2.2 Detaching Buildings (including requirements for explosion control)
- 8.3.2.3 Outdoor Storage
- 8.3.2.4 Aboveground Tanks
- 8.3.2.4.2 Physical Protection
- 8.3.2.4.3 Flood Protection
- 8.3.2.4.4 Drainage
- 8.3.2.4.5 Siting Locations (Including Table 8.3.2.4.5.1 Minimum Distance from Liquefied Hydrogen Systems to Exposures)
- 8.3.2.5 Underground Tanks
- 8.3.3 Bulk LH2 Systems Use

- 8.3.3.1.5 Inspection (requirements for annual inspection and recordkeeping)
- 8.3.4 Bulk LH2 Systems Handling
- 8.3.4.2 Carts and Trucks
- 8.3.4.4 Closed Containers
- 8.3.4.5 Cargo Transport Unloading
- 8.3.4.6 Overfilling

Liquid Hydrogen Storage—Equipment Location

International Fire Code (International Code Council, 2009)

- 2209.3 Location on Property
- 3203.5.4 Physical Protection
- 3203.6 Separation from Hazardous Conditions
- 3204.3.1.1 Location
- 3204.4.2 Location
- 3504 Storage

Liquid Hydrogen Storage—Storage Containers

International Fire Code (International Code Council, 2009)

- 2703.2 Systems, Equipment, and Processes
- 3203.1 Containers
- 3203.5 Security
- 3203.6 Separation from Hazardous Conditions
- 3204.3.1 Stationary Containers
- 3204.4 Underground Tanks

Dispensing Systems

NFPA 2 Hydrogen Technologies Code (National Fire Protection Association, 2011)

- 10.2.1 System Approvals
- 10.3.1.1 System Component Qualifications
- 10.3.1.4 Pressure Relief Devices
- 10.3.1.5 Pressure Guages
- 10.3.1.6 Pressure Regulators
- 10.3.1.7 Fuel Lines and Piping Systems
- 10.3.1.8 Hose and Hose Connections

- 10.3.1.9 Valves
- 10.3.1.10 System Testing
- 10.3.1.11 System Maintenance
- 10.3.1.12 Equipment Security and Vehicle Protection
- 10.3.1.13 Compressed and Gas Processing Systems
- 10.3.1.14 Vehicle Fueling Dispenser System Operation
- 10.3.1.15 Vehicle Fueling Connection
- 10.3.1.16 Installation of Electrical Equipment
- 10.3.1.17 Stray or Impressed Currents and Bonding
- 10.3.1 18 Installation of Emergency Shutdown Equipment
- 10.3.1.19 Fire Protection
- 10.3.2.2.3.1.3 Separation Distances for Outdoor Gaseous Hydrogen Dispensing Systems

Vaporizers

International Fire Code (International Code Council, 2009)

- 2209.2 Equipment
- 2209.3 Location on Property
- 3203.1.3 Foundations and Supports
- 3203.2.2 Vessels or Equipment Other than Containers
- 3203.5.3 Securing of Vaporizers

International Fuel Gas Code (International Code Council, 2009)

- 708 Design of Liquefied Hydrogen Systems Associated with Hydrogen Vaporization Operations

Dispensing, Operations, and Maintenance Safety—Gaseous Hydrogen

CGA G-5.5, Hydrogen Vent Systems (Compressed Gas Association, 2004)

- 9 Maintenance

International Fire Code (International Code Council, 2009)

- 2204 Dispensing Operations
- 2209.4 Dispensing into Motor Vehicles at Self-Service Hydrogen Motor Fuel-Dispensing Facilities

NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages (National Fire Protection Association, 2003)

- 9.2.2 Tank Filling and Bulk Delivery
- 9.4 Operating Requirements for Attended Self-Service Motor Fuel Dispensing Facilities

- 9.5 Operating Requirements for Unattended Self-Service Motor Fuel Dispensing Facilities

Dispensing, Operations, and Maintenance Safety—Liquid Hydrogen

CGA G-5.5, Hydrogen Vent Systems (Compressed Gas Association, 2004)

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- 9.5 Operating Requirements for Unattended Self-Service Motor Fuel Dispensing Facilities

Piping and Tubing for All Systems

ASME B31.12, Hydrogen Piping and Pipelines (American Society of Mechanical Engineers, 2012)

ASME B31.3, Process Piping (American Society of Mechanical Engineers, 2006)

- F323.4(5) Specific Material Considerations—Metals
- IX K305 Pipe

CGA G-5.4, Standard for Hydrogen Piping Systems at Consumer Locations (Compressed Gas Association, 2005)

- 3.1 General
- 3.2 Piping Materials
- 5.0 Installation
- 5.1 Piping Installation General
- 5.2 Piping Installation Above Ground Installation
- 5.3 Piping Installation Underground Installation

International Fuel Gas Code (International Code Council, 2012)

- 101.2.1 Gaseous Hydrogen Systems
- 704 Piping, Use, and Handling

705 Testing of Hydrogen Piping Systems CGA H-3 Cryogenic Hydrogen Storage (Compressed Gas Association, 2006)

- 10.0 External Piping

Valving and Fittings for All Systems

ASME B31.3, Process Piping (American Society of Mechanical Engineers, 2006)

- IX K306 Fittings, Bends, and Branch Connections
- IX K307 Valves and Specialty Components

CGA G-5.4, Standard for Hydrogen Piping Systems at Consumer Locations (Compressed Gas Association, 2005)

- 3.3.2 Isolation Valves
- 3.3.3 Emergency Isolation Valves
- 3.3.4 Excess Flow Valves
- 3.3.5 Check Valves
- 3.3.7 Gasket and Sealing Materials
- 3.3.8 Additional Requirements
- 5.0 Installation
- 5.1 Installation General

Venting and Other Equipment

CGA G-5.5, Hydrogen Vent Systems (Compressed Gas Association, 2004)

- 6.0 Vent System
- 6.2 Sizing
- 6.3 Design
- 6.4 Materials
- 6.5 Components
- 7 Installation

International Fire Code (International Code Council, 2009)

- 2209.5.4 Venting of Hydrogen Systems
- 2211.8.1.2 Atmospheric Venting of Hydrogen from Motor Vehicle Fuel Storage Containers
- 3003.16.8 Connections
- 3005.5 Venting
- 3203.3 Pressure Relief Vent Piping
- 3204.4.5 Venting of Underground Tanks

Fire Safety

Construction

International Fire Code (International Code Council, 2009)

- 911 Explosion Control
- 2209.5 Safety Precautions

International Fuel Gas Code (International Code Council, 2009)

- 706.3 Outdoor Gaseous Hydrogen Systems

NFPA 52, Vehicular Gaseous Fuel Systems Code (National Fire Protection Association, 2010)

- 9.12 Stray or Impressed Currents and Bonding

NFPA 55, Compressed Gases and Cryogenic Fluids Code (National Fire Protection Association, 2010)

- 7.1.6 Separation from Hazardous Conditions

Equipment

International Fire Code (International Code Council, 2009)

- 404 Fire Safety and Evacuation Plan
- 406 Employee Training and Response Procedures
- 407 Hazard Communication
- 906 Portable Fire Extinguishers
- 907 Fire Alarm and Detection Systems
- 2209.4 Dispensing into Motor Vehicles at Self-Service Hydrogen Motor Fuel-Dispensing Facilities
- 2209.5 Safety Precautions

Signage

International Fire Code (International Code Council, 2009)

- 2204.3.5 Emergency Procedures
- 2209.5.2.1 Identification

CGA H-3 Cryogenic Hydrogen Storage (Compressed Gas Association, 2006)

- 6.0 Tank Design and Manufacturing Criteria
- 7.0 Inner Vessel
- 8.0 Outer Jacket

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