



# Hydrogen Solutions

Conformity Assessment | Risk Mitigation | Quality Auditing  
Supply Chain Qualification | Third Party Inspection



A Munich Re company

## What are Codes and Standards?

Codes and Standards are sets of rules and guidelines to meet safety and performance requirements. The development of Codes and Standards is a collaborative effort that involves input from a wide range of stakeholders, including industry experts, regulators, consumer advocates, and other interested parties. Once developed, Codes and Standards are typically adopted by state and local governments and incorporated into laws and regulations that govern a wide range of activities.

### Benefits of Codes and Standards



#### Safety

Codes and Standards ensure that projects are designed and built to withstand potential hazards, such as gas leaks and fires.



#### Quality Assurance

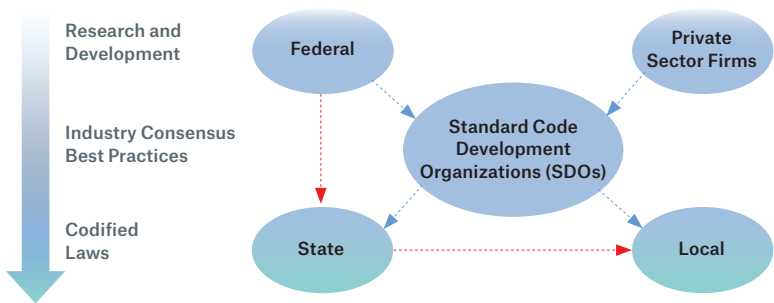
Codes and Standards require quality assurance and control measures, such as inspections and testing. This ensures the equipment and infrastructure are built to meet established standards.



#### Efficiency

Codes and Standards promote efficiency by requiring the use of energy-efficient technologies, such as low-emission dispensers and efficient lighting, which can help reduce energy consumption.

The development of industry products follows market need which can be guided by key industry stakeholders as illustrated below:



## Federal

Federal funding for hydrogen research and development plays a crucial role in the development of Codes and Standards. National labs, such as the National Renewable Energy Laboratory (NREL) and the Pacific Northwest National Laboratory (PNNL), are often involved in the development of Codes and Standards for hydrogen technologies. These national labs work closely with industry experts, academic researchers, and government agencies to develop comprehensive and reliable standards that can be adopted by various stakeholders.

The federal government also plays a crucial role in regulating the use of hydrogen through various agencies such as the Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), and the Department of Transportation (DOT).

## Private Sector

Private sector firms contribute to the development of Codes and Standards for hydrogen technologies by identifying critical attributes for the construction of various components. Private sector firms and special interest groups can help to harmonize standards and promote uniform requirements for the development of hydrogen technologies. This can simplify the permitting process for new hydrogen projects and help to develop more robust and efficient supply chains for hydrogen.

## Codes and Standards Development Organizations

These organizations are composed of volunteers from various backgrounds, including owners, manufacturers, designers, and regulators, who work together to develop standards for the use of specific technologies.

## State and Local Governments

Once a standard is recognized by an authority having jurisdiction, it can be incorporated into codified laws and become a code. Depending on the code, state and local jurisdictions have the authority to evaluate Codes and Standards and decide whether to adopt them, either in whole or in part, or with modifications to meet their specific needs.



## Performance and risk-based alternatives

### 1 Performance-based design

A performance-based approach focuses on meeting specific performance criteria, such as energy efficiency, fire safety, or earthquake resistance. This approach creates more flexibility and innovation in the design process, but requires a higher level of expertise to ensure that the performance criteria are met.

### 2 Risk assessment and mitigation

In some cases, a risk-based approach may be appropriate, which involves assessing the potential risks associated with the construction project and implementing appropriate mitigation measures to reduce those risks to an acceptable level. This approach may be useful for projects that involve unique or complex risks, such as nuclear power plants or chemical processing facilities.

### 3 Third party certification

Some construction projects may choose to obtain certification from independent third party organizations, which evaluate and certify projects based on specific criteria related to risk and safety in conjunction with codes and standards or alternative approaches for further mitigation.

Lawmakers and hydrogen industry stakeholder groups should use codes and regulations or alternatives when making decisions related to the development and operation of hydrogen projects. Ultimately, the choice of approach will depend on a variety of factors, including the specific project objectives, regulatory requirements, and available resources.

It is important to carefully consider the risks and benefits of each approach and work with qualified experts to ensure that the chosen approach meets the desired objectives and promotes safety and reliability.

## **Key Considerations**

**Location:** The location of a hydrogen project should be chosen carefully, considering the distance from other hazardous activities, residential areas, and environmental factors such as flooding and seismic activity. The National Fire Protection Association (NFPA) provides guidelines for selecting suitable locations.

**Ventilation:** Adequate ventilation is crucial to ensure safe hydrogen storage. The International Code Council (ICC) requires that hydrogen storage areas have proper ventilation.

**Structural Integrity:** Hydrogen storage tanks require specialized construction and materials to withstand high pressures and potential impact from external forces. The American Society of Mechanical Engineers (ASME) provides codes for the design and construction of hydrogen storage tanks.

**Electrical and Piping:** Proper electrical and piping systems are necessary for hydrogen projects to operate safely and efficiently. The National Electrical Code (NEC) provides guidelines for electrical systems, while the ASME provides guidelines for piping and pressure systems.

**Compliance:** By adhering to construction codes, hydrogen projects can meet the requirements of regulatory bodies, such as the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA), and avoid potential fines and penalties.

## Major Components of a Hydrogen Production Plant and Applicable Standards

Component	Code, Standard, Regulation	Function
Electrolyzer generates Hydrogen from green renewables via system of pressure equipment components	ASME Section VIII, Division 1 or 3	This code provides guidelines for the design, fabrication, and inspection of pressure vessels, which may be used in hydrogen storage or transportation.
	CGA G-5.5: Hydrogen Generation Equipment	This standard provides guidelines for the design, construction and maintenance of hydrogen generation equipment, including inspection and testing procedures.
Fueling Station	National Fire Protection Association (NFPA) 2: Hydrogen Technologies Code	This code provides guidance on the safe design, installation, operation and maintenance of hydrogen technologies, including hydrogen production, storage, and use.
	Compressed Gas Association (CGA) G-5.4: Hydrogen Fueling Station General Requirements	This standard provides guidelines for the design, installation and operation of hydrogen fueling stations, including requirements for inspection and maintenance.
Hydrogen Generator using Water electrolysis	ISO 22734-2:2018 - Hydrogen generators using water electrolysis process Part 2	Test methods for performance of electrolyzers - This standard provides testing and inspection procedures for the performance of hydrogen generators that use water electrolysis process.
Hydrogen Piping and Pipelines	ASME B31.12	This code provides guidelines for the design, fabrication, installation, inspection, and testing of piping systems for the transportation of hydrogen gas.
Compressors and Expanders for storage and transportation	API 617: Axial and Centrifugal Compressors and Expander-compressors	This code provides guidelines for the design, manufacture, inspection, and testing of centrifugal compressors and expander-compressors used for hydrogen.
Storage Tanks	ASME Section VIII, Division 1	This code provides guidelines for the design, fabrication, and inspection hydrogen storage tanks.

Hydrogen is a climate friendly alternative energy source that utilizes developed equipment with a mix of established and new requirements for safe and reliable operation. For more detail regarding Hydrogen equipment Codes and Standards or to discuss specific applications, please contact HSB at [GetInfo@hsb.com](mailto:GetInfo@hsb.com).

The use of hydrogen is expanding as a climate friendly energy source with significant interest in the development of infrastructure for generation, transport, storage, and utilization. Building these projects requires adherence to specific construction codes, standards, and regulations to ensure safety, reliability, and performance. The information contained herein provides an overview of the construction codes and regulations commonly used by lawmakers and hydrogen industry stakeholder groups for hydrogen projects.

### For more information



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