



VALVES FOR HYDROGEN PROCESSES





PERFORMING IN DEMANDING APPLICATIONS

We are leading the emerging Hydrogen-as-a-full process valve market with our unique full range of ball valves and actuators, covering the entire value chain of this new realm.

With Ultra-High-Pressure, High-Cycle Hydrogen valves, designs that support the most advanced standards, and a full set of product type approval and safety certifications, our Hydrogen valve product offer is the natural choice for Hydrogen system designers and manufacturers.

Our experience in successfully supplying hydrogen service valves and automated-valves, stretchers over the last decade and more with a wide install base in hydrogen applications, ranging from Liquid- Hydrogen, Ultra-High-Pressure Hydrogen, to industrial grade Hydrogen and all in between.

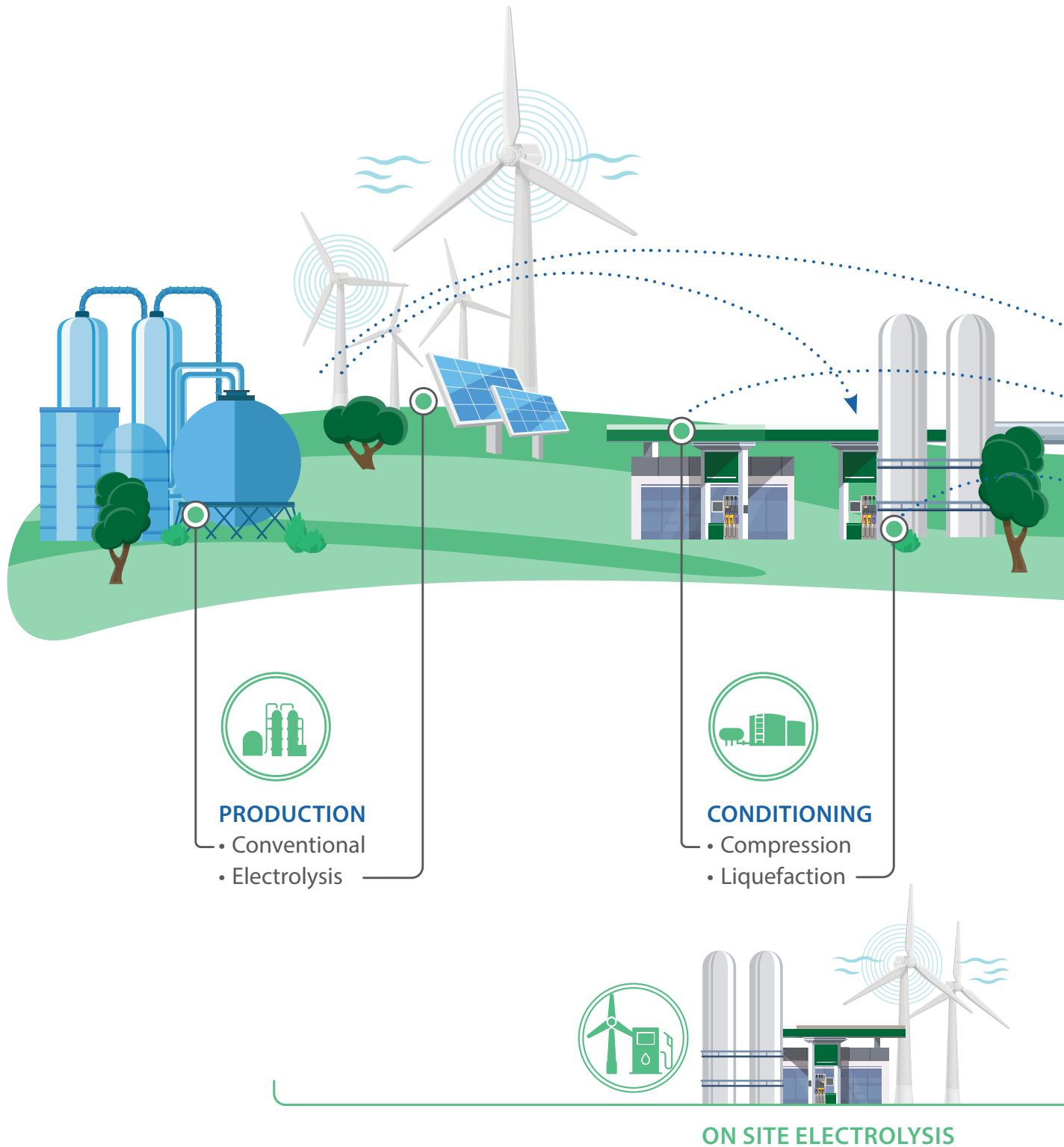
With the understanding of the challenges of modern Hydrogen system designers, we are closely cooperating with our customers to develop optimal solutions within the required safety, quality, and regulations.

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THE HYDROGEN SUPPLY CHAIN





Green H₂



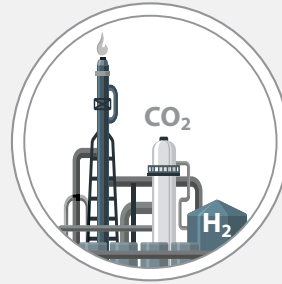
Green/Renueable energy.
Electroliz process.
Zero carbon footprint.

Blue H₂

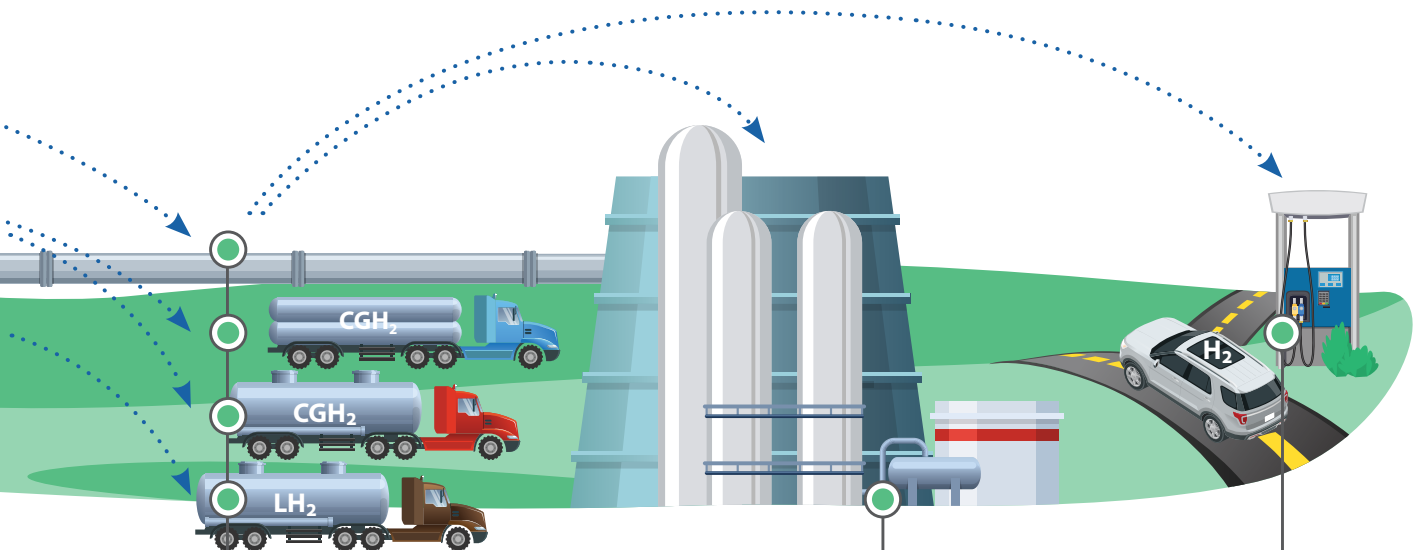


Carbon based energy with
carbon capturing, utilization
or underground storage.

Grey H₂



Carbon based energy.
Legacy process.



DELIVERY / SUPPLY

- CGH₂ Cylinders distribution/storage
- CGH₂ Road Transport distribution
- LH₂ distribution/storage
- Pipeline distribution



INDUSTRIAL USE

- Process
- Energy



REFUELING/ MOBILITY

- Dispensing
- Ionic Compressor
- Cryo pump



HYDROGEN SERVICE PROCESS VALVES

Habonim's Hydrogen Service process valves are designed, tested, and certified to provide the compatibility required in the hydrogen supply chain, end-to-end. The valves design, materials selection, and certification process are made specifically to support the Hydrogen-as-a-full eco-system with process grade valves with the highest quality, durability, and safety.

With decades of proven safe and long-lasting use in hydrogen applications, Habonim Hydrogen- service ball valves deliver un-matched integrity and overall best cost of ownership for Hydrogen systems from manufacturing and storing to re-fueling and transportation applications.



ISO 19880-3 up to 1,000barg (15,000psi)

H99 Series



TPED, ISO 23826 & ISO 19880-3 up to 700barg (10,000psi)

H29 Series



¼" – 1": TPED & ISO 23826 up to 550barg (8,000psi)
1½": TPED & ISO 23826 up to 420barg (6,000psi)

H24 Series

Ultra-High & High-Pressure valves

- Work pressure: up to 1,000 barg (15,000psi) Applies to road, rail and inland waterways in EU.
- Working temp.: -60°C to +260°C (-76°F to +500°F).
- Tube / Pipe size: ¼" to 1-½" (DN8 to DN40).
- Total HermetiX™ Integrity Package.
- Double stem packing for Hydrogen use.
- PEEK seat.
- HNBR O-rings .

Standards & Certifications

See details per series and standards.

- Transportable Pressure Equipment Directive - TPED.
- Ball valves for Gas cylinders – ISO 23826.
- Hydrogen Fueling - ISO 19880-3.
- Safety - ATEX IIC, SIL.
- Fugitive Emissions - ISO 15848-1 & API 641.
- Fire Safe – ISO 10497 & API 607.

Industrial valves

The full range of Habonim valves is offered for Hydrogen use up to class #2500, PN420 (6,000psi).



HYDROGEN SERVICE PROCESS VALVES

Total HermetiX™ Integrity Package

As a standard, most of HABONIM valves are equipped with the Total HermetiX Integrity Package comprised of three main elements and a superior inline sealing mechanisms in some of them:

Zero fugitive-emission no maintenance stem sealing

- HermetiX™ stem sealing design with zero fugitive emission sealing capability.
- Tested or certified according to ISO 15848-1 and API 641 standards.
- Tested for up to 500,000 cycles of operation.

Double body sealing

- Body-to-ends & body-to-bonnet double sealing for superior sealing.
- Selection of sealing materials for diverse applications.
- Fugitive emission prevention.

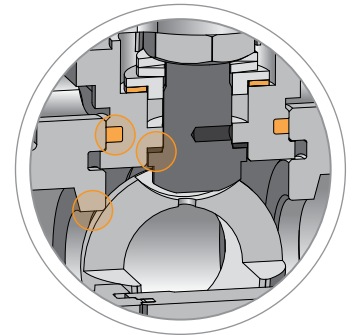
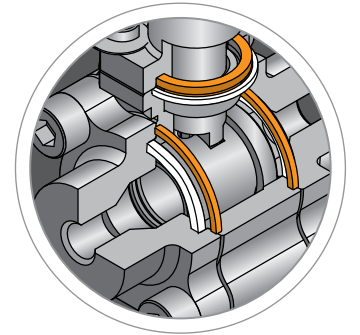
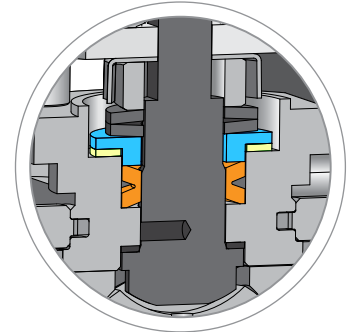
Fire Safe

- According to API 607 & ISO 10497 - where applicable.
- Type-tested and certified by leading certification bodies for marine service – for some valve series.
- Clean Fire Safe construction guarantees no graphite contamination of the media flow.

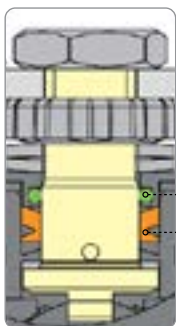
Superior In-line sealing

A variety of implemented mechanism provides extended in-line sealing capabilities such as:

- Bidirectional sealing
- High Pressure full Δp sealing
- High & low pressure sealing
- Others



Hydrogen Double Stem Packing



O-ring
HermetiX

Double stem sealing

CONVENTIONAL



The most popular hydrogen production legacy process is based on Steam Reforming of Natural Gas, or a similar process that uses a reaction of hydrocarbons with water.

Hydrogen produced by steam reforming is classified as 'gray hydrogen' when waste carbon dioxide is released into the atmosphere and as 'blue hydrogen' when the majority of carbon dioxide is captured, stored geologically, or reused within a carbon dioxide non-emitting process.

Typically, steam reforming systems, or steam methane reforming (SMR) systems are similar in construction to refining or industrial gases production systems with quite a large size piping system for a mixture of low and high pressures.

All Habonim Valves are ISO 15848-1 & API 641 Certified



Fugitive Emissions ISO 15848 & API 641

Hydrogen is the smallest molecule, lighter than air, and is a very flammable gas. Therefore, hazardous prevention means are required:

- Forced ventilation out of system closed spaces.
- Prevention of fugitive emissions by using certified emission prevention valves.





PRODUCTION

CONVENTIONAL

- Piping style: Low/High Pressure - Industrial use
- Pressure range: Up to 414 barg; 4,000 psi; class #2500
- Piping diameters: 1/2" to 10"; DN15 to DN250
- Connections styles: Welded; Threaded
- Fugitive emission: API 641; ISO 15848-1
- Fire Safe: API 607; ISO 10497
- HE - H₂ gas embrittlement: Non-critical - use St. St.
- Cleaning level: Industrial level

Total HermetiX™ | **Port** Standard Port Full Port Tube Size
 Ordering Code | **End Connections** Threaded Cone & Thread Flanged Welded

Temp.: -60°C - +260°C (-76°F +500 °F)	Category	Ball Valve	Design Type	Series	TH	Port	End Con.	Valve Size (Inches)																MWP (ANSI Class)																	
								1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16
								High Pressure	Trunnion	3 Piece	See High Pressure	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									2500/1500															
High Pressure	Floating	3 Piece	See High Pressure	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2500/1500																															
Industrial Use	Trunnion	3 Piece	See Industrial	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									900/600/300/150																							
		2 Piece		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									600/300/150																							
	Floating	3 Piece		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	900/600/400/300/150																															
		2/1 Piece		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	300/150/PN40/PN16																															
		DS/DBB		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	600/300/150/PN16																															
		Multiport/Diverter		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	600/300/150																															
		Control		Control	See Control	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	900/400/300/150/PN40/PN16																													

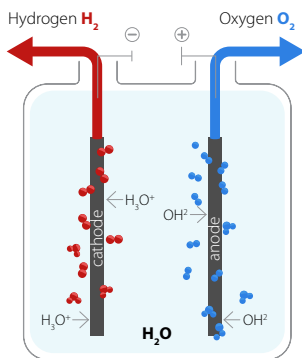


ELECTROLYSIS

Green Hydrogen production is mainly based on utilizing clean energy to produce hydrogen from water using electrolysis.

PEM - Polymer electrolyte membrane electrolysis is the electrolysis of water in a cell equipped with a solid polymer electrolyte.

SOEC - Solid Oxide Electrolyzer Cell is the electrolysis of water in a cell using a solid oxide, or ceramic, electrolyte. Some technologies allow using CO₂ to produce Hydrogen as part of transforming excessive CO₂ to clean energy.

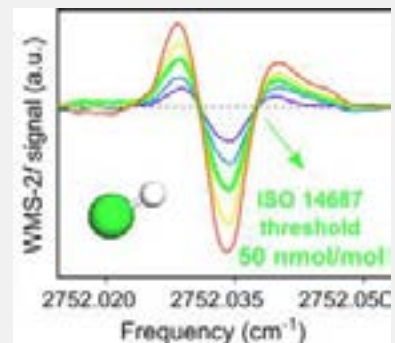


PEM Alkaline Solid Oxide



Hydrogen Purity & Clean Valves

- Fuel Cells efficiency is damaged by Hydrogen impurities
- ISO 14687-2 defines Hydrogen purity > 99.97% :
 - sulphurs (< 4 nmol/mol); halogenates (< 50 nmol/mol, picture)
 - or carbon monoxide (< 200 nmol/mol)
- Valve production with no grease & particles
- O₂ cleaning grants clean internals at commissioning



HABONIM Hydrogen service cleaning

Process of cleaning, assembling and packing that refers to international standards in partial or in full:

- ASTM A380
- CGA G 4.1
- EN 12300





PRODUCTION

ELECTROLYSIS

Piping style: Low Pressures - High Purity
Pressure range: Up to 725 psi; 50 barg; class #300
Piping diameters: 1/2" to 6" DN15 to DN100
Connections styles: Welded; Flanged
Fugitive emission: API 641; ISO 15848-1
Fire Safe: API 607; ISO 10497
HE - H₂ gas embrittlement: Non-critical - use St. St.
Cleaning level: Cleaned for H₂ service

Total HermetiX™ | **Port** Standard Port Full Port Tube Size
 Ordering Code | **End Connections** Threaded Cone & Thread Flanged Welded

Temp.: -60°C - +260°C (-76°F +500 °F)	Category	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)											MWP (ANSI Class)				
									¼	⅜	½	¾	1	1¼	1½	2	2½	3	4	6	8	10	12	14
Industrial Use	Floating	3 Piece	<input checked="" type="checkbox"/>	See Industrial	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	900/600/400/300/150											/			
		2/1 Piece	<input checked="" type="checkbox"/>	See Industrial	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	300/150/PN40/PN16															
		DS/DBB	<input checked="" type="checkbox"/>	See Industrial	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	600/300/150/PN16															
		Multiport/Diverter	<input checked="" type="checkbox"/>	See Industrial	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	600/300/150															
		Control	<input checked="" type="checkbox"/>	See Control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	900/400/300/150/PN40/PN16											/				



HYDROGEN COMPRESSION & FIXED STORAGE

The most common way to store hydrogen in stationary storage is as a compressed gas.
Gas compression and High-pressure large bulk storage are used in a variety of technologies and scales.



HGE: H₂ Gas Embrittlement

- H₂ molecule diffuses into metal surface
- P & T variations create cracks by fatigue
- Crack propagation = HGE
- HGE risk increases with P/decreases with polishing-coating
- Rule of thumb: materials HRC < 32 are not affected by HE



Habonim H₂ Valve Materials non-susceptible to HGE

- Body: SS316L shell; A479 (forged bar, no cast) for HP valves
- Embrittlement risk is proportional to hardness
- Trim (ball & stem) in HP H₂ valves need to be hard (fatigue): trim materials are key HABONIM's know - how!

HYDROGEN COMPRESSION & FIXED STORAGE

- Piping style:** High Pressures
- Pressure range:** 300 to 550 barg; 4,300 to 8,000 psi; Class #2,500; #3,500
- Piping diameters:** 1/2" to 2" DN15 to DN100
- Connections styles:** Coned & Threaded; Welded
- Fugitive emission:** API 641; ISO 15848-1; With special HP H₂ stem seal
- Fire Safe:** API 607; ISO 10497
- HE - H₂ gas embrittlement:** Very critical - use Hydrogen service valves
- Cleaning level:** Cleaned for H₂ service

Total HermetiX™ | **Port** Standard Port Full Port Tube Size
 Ordering Code | **End Connections** Threaded Cone & Thread Flanged Welded

Temp.: -60°C - +260°C (-76°F +500 °F)	Category	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)												MWP (ANSI Class)					
									1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16
									High Pressure	Trunnion	Threaded body	<input checked="" type="checkbox"/>	H29	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	1,000bar (15,000psi) with TPED - 700bar (10,000psi)								
	Floating	3 Piece	<input checked="" type="checkbox"/>	H24	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	550bar (8,000psi)		Class 2500		2500		2500 (Δp up to 255bar/3700psi)											
		3 Piece	<input checked="" type="checkbox"/>	H28	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			2500		900		400											
		3 Piece	<input checked="" type="checkbox"/>	H47	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			900		400													



LIQUEFIED HYDROGEN (LH₂)



Hydrogen in a liquid form is much more efficient for storing large quantities, or when there is a need for storing a lot of energy using Hydrogen.

Legacy uses of Liquid Hydrogen (LH₂) are rocket-fuel, laboratories, and some others, yet the emerging market of Hydrogen as a fuel for commercial transportation and energy storage is expanding the use of LH₂ storage and transportation.

Habonim valves are in use for LH₂ applications for many years in the aerospace and rocket launch market, storage tanks, and testing systems.

Our technology is optimized to accommodate the very low cryogenic temperatures while providing high sealing levels and low emissions in manual and automated valves.



The energy stored in 1 liter (or Gallon) of LH₂ is almost 5 times larger than that of 1 liter (or Gallon respectively) of H₂ gas at 200bar (~3,000psi) pressure and more than double the energy of 1 liter (or Gallon respectively) of H₂ gas at 500bar (~7'250psi)

LIQUEFIED HYDROGEN (LH₂)



- Piping style:** Low Pressures; Double wall vacuumed piping
- Pressure range:** Up to 725 psi; up to 50 barg; up to Class #300
- Piping diameters:** 1/2" to 4" DN15 to DN100
- Connections styles:** Welded, Flanged
- Fugitive emission:** API 641; ISO 15848-1; With special HP H₂ stem seal
- Fire Safe:** API 607; ISO 10497
- HE - H₂ gas embrittlement:** Not critical
- Cleaning level:** Cleaned for Hydrogen use (covers also Cryogenic use)

	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)												MWP (ASME Class / DIN PN)			
								1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	
								300				300								150			
Temperature: Cryogenic Down to -269°C (-452°F)	Trunion Mounted Ball	3 Piece	OC	C91	⊗	⊙	⊙	⊙					150										
			OC	C92	⊗	⊙	⊙	⊙					300										
		2 Piece	OC	C81	⊗	⊙	⊙	⊙					150										
			OC	C82	⊗	⊙	⊙	⊙					300										
	Floating Ball	3 Piece	OC	C47	⊗	⊙	⊙	⊙	600				300										
			OC	C47-BD	⊗	⊙	⊙	⊙	300				150										
			OC	C28	⊗	⊙	⊙	⊙	2500														
		Diverter 3 Pcs.	OC	DC47	⊗	⊙	⊙	⊙	600														
		Multiport 3 Pcs.	OC	C61		⊙	⊙	⊙	600				300										
		Multiport 3 Pcs.	OC	C62		⊙	⊙	⊙	600				300										
		1 Piece	OC	C31	⊗	⊙		⊙					150										
			OC	C32	⊗	⊙		⊙					300										
		1 Piece 2 Piece	OC	C73	⊗		⊙	⊙					150										
			OC	C74	⊗		⊙	⊙					300										
	OC	C77	⊗		⊙	⊙					PN16												
	OC	C78	⊗		⊙	⊙					PN40												





CYLINDER DISTRIBUTION (CGH₂)

Cylinder filling

Use ball valves for systems exclusively used for H₂.

Compressor output to storage tank

- Ball valves up to DN50, welded
- Pressure 200 to 700 barg



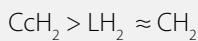
H₂ Storage alternative technologies:

- CH₂ - Compressed HIGH PRESSURE H₂ 350/700 bar
- LH₂ - LIQUID H₂
- CcH₂ - LIQUID CHEMICAL H₂

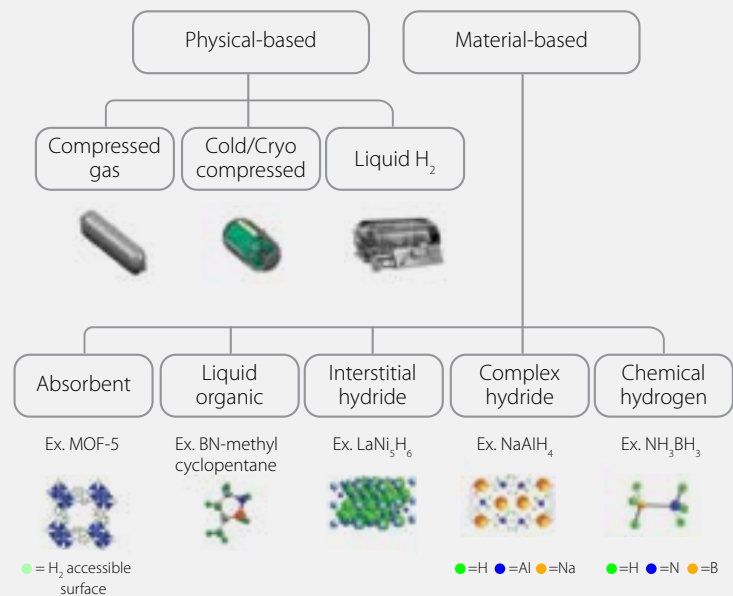
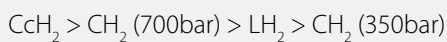
Considerations:

- Safety
- Energy balance (OPEX)
- Infrastructure (CAPEX)

Energy / Gravimetric capacity:



Volumetric density:





CYLINDER DISTRIBUTION (CGH₂)

Piping style: High Cycle - High Pressure - High Purity
Pressure range: 300 to 550 barg; 4,300 to 8,000 psi; Class #2,500; #3,500
Piping diameters: 1/2" to 2" DN15 to DN50
Connections styles: Coned & Threaded; Welded
Fugitive emission: API 641; ISO 15848-1; With special HP H₂ stem seal
Fire Safe: API 607; ISO 10497
HE - H₂ gas embrittlement: Very critical - use Hydrogen service valves
Cleaning level: Cleaned for H₂ service

⊗ Total HermetiX™ | Port ⊙ Standard Port ⊙ Full Port ○ Tube Size
 ⊙ Ordering Code | End Connections ⬡ Threaded ⬢ Cone & Thread ⊕ Flanged □ Welded

Temp.: -60°C - +260°C (-76°F +500 °F)	Category	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)																MWP (ANSI Class)																			
									1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16
									High Pressure	Trunnion	Threaded body	⊙	H29	⊗			⬢ ⊕ □	1,000bar (15,000psi) with TPED - 700bar (10,000psi)								Class 2500																		
			⊙	H24	⊗	⊙	⊙	⬡ ⬢ ⊕ □	550bar (8,000psi)																																			
		Floating	3 Piece	⊙	H28	⊗	⊙	⬡ ⊕ □			2500		2500 (Δp up to 255bar/3700psi)																															
			3 Piece	⊙	H47	⊗	⊙	⬡ ⊕ □			900		400																															





ROAD/RAIL/SHIPPING TRANSPORT (CGH₂)

Cylinder Bundles are built on truck-trailers, MEGC / ISO containers, etc., and their filling systems.

Working pressures as per the cylinder technologies, mainly Fiberglass and composite materials:

- 500 barg (7,000psi)
- 700 barg (10,000psi)
- Certified for transportation: TPED (Europe) & ISO 23826



ISO 23826:2021 Gas cylinders - ball valves - specification and testing

Specifies design, type testing, marking, manufacturing tests and examinations requirements for ball valves used as:

- Closures of refillable transportable gas cylinders, pressure drums and tubes.
- Main valves for cylinder bundles.
- Valves for cargo transport units [e.g. trailers, battery vehicles, multi-element gas containers (MEGCs)].

Which convey compressed gases, liquefied gases and dissolved gases. Source: www.iso.org

Test Highlights:

- 2,000 Cycles test under 1.2 times the maximal working pressure.
- Inline and Atmospheric leak test at -40°C (-40°F), -20°C (-4°F), 65°C (149°F) & ambient:
- Under 1.2 times the maximal working pressure.
- Under low pressure.
- Cycle of high and low pressure.
- Sealing tested with Hydrogen media.
- Burst test under 2.25 times the maximal working pressure, with water.
- Flame impingement test.
- Excessive torque test.





ROAD/RAIL/SHIPPING TRANSPORT (CGH₂)

Piping style:	High/Ultra-High Pressure - High Purity - transportation
Pressure range:	5,000 to 10,000 psi; 350 to 700 barg
Piping diameters:	Up to 1"; up to DN250
Connections styles:	Coned & Threaded
Fugitive emission:	API 641; ISO 15848-1; With special HP H ₂ stem seal
Fire Safe:	API 607; ISO 10497
HE - H ₂ gas embrittlement:	Critical - use Hydrogen service valves
Cleaning level:	Cleaned for Hydrogen service
Specific Standards & Regulations	TPED II (mandatory in EU), ISO 23826

Total HermetiX™ | **Port** Standard Port Full Port Tube Size
 Ordering Code | **End Connections** Threaded Cone & Thread Flanged Welded

Temp.: -60°C - +260°C (-76°F - +500 °F)	Category	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)											MWP (ANSI Class)					
									1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14
High Pressure	Trunnion	Threaded body	<input checked="" type="checkbox"/>	H99	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	1,000bar (15,000psi)																
			<input checked="" type="checkbox"/>	H29	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	1,000bar (15,000psi) with TPED - 700bar (10,000psi)																
	Floating		<input checked="" type="checkbox"/>	H24	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	550bar (8,000psi)	Class 2500															





PIPING DISTRIBUTION (CGH₂)

Local Hydrogen Distribution

There are two main use cases for pipes transferring Hydrogen. Local distribution of Hydrogen is the first and is a growing one, transforming available energy into hydrogen and utilizing the hydrogen as an energy source elsewhere is becoming more popular. As an outcome, piping systems for the distribution of hydrogen in relative proximity is expanding. Either as a local network in industrial areas, or to connect a hydrogen manufacturing site to hydrogen consumption points, as sometimes the hydrogen is manufactured as a side product of an existing facility and is consumed as energy in other facilities located elsewhere.

Mixing Hydrogen into Natural Gas Feedstock

Mixing hydrogen into a Natural Gas supply is another use, injecting up to 15% hydrogen volume into a Natural Gas system has a negligible impact on the system and its efficiency and allows for a reduction in the total carbon signature of such a system equivalently. A common implementation is basically injecting hydrogen into a Natural Gas piping system and allowing all downstream users to enjoy the carbon footprint reduction. Both use cases have no special requirements from the piping system and medium pressure hydrogen-use valves are in service.





PIPING DISTRIBUTION (CGH₂)

Piping style: Medium Pressures - Industrial use
Pressure range: 50 to 90 barg; 700 to 1,300 psi; class #600
Piping diameters: 2" to 12"; DN50 to DN300
Connections styles: Welded
Fugitive emission: API 641; ISO 15848-1
Fire Safe: API 607; ISO 10497
HE - H₂ gas embrittlement: Critical - use Hydrogen service valves
Cleaning level: Industrial level
Specific Standards & Regulations ASME B31.12; Eventually EN 10204 3.2

⊗ Total HermetiX™ | Port ⊙ Standard Port ⊕ Full Port ○ Tube Size
 ⊙ Ordering Code | End Connections ⊕ Threaded ⊕ Cone & Thread ⊕ Flanged ⊕ Welded

Temp.: -60°C - +260°C (-76°F +500 °F)	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)													MWP (ANSI Class)									
								1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16						
Floating	Trunnion	3 Piece	⊙	93	⊗	⊙ ⊕	⊕ ⊕														600									
		2 Piece	⊙	83	⊗		⊕ ⊕														600									
		3 Piece	⊙	47	⊗	⊙ ⊕	⊕ ⊕	900						400																
	Floating	3 Piece	⊙	26	⊗	⊙	⊕ ⊕	900						600																
		DS/DBB	⊙	47DS	⊗	⊙	⊕ ⊕	600																						
		Multiport/ 3 Piece	⊙	61		⊙ ⊕	⊕ ⊕	600						300																
			⊙	62		⊙ ⊕	⊕ ⊕	600						300																
		Diverter/ 3 Piece	⊙	D47	⊗	⊙ ⊕	⊕ ⊕				600						300													
		Side-Entry/ 3 Piece	⊙	S47	⊗	⊙ ⊕	⊕ ⊕				600						300													
		3 Piece	⊙	47	⊗	⊙ ⊕	⊕ ⊕	900						400																





INDUSTRIAL
USE

HYDROGEN IN INDUSTRIAL PROCESSES

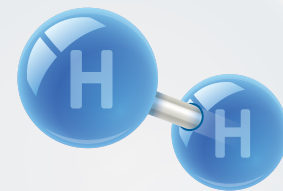
Hydrogen is used in diverse industries and processes. Hydrocracking in petroleum refining, many chemicals' productions and reactions, food ingredients manufacturing, and many more.

These legacy applications and others like rocket fueling, laboratories, and research have diverse tubing and piping systems in use, for low, medium, and high pressures and require industrial standards and certifications to accommodate this flammable highly volatile gas.



Hydrogen is the chemical element with the symbol H and atomic number 1. Hydrogen is the lightest element. At standard conditions, hydrogen is a gas of diatomic molecules having the formula H_2 . It is colorless, odorless, tasteless, non-toxic, and highly combustible.

Hydrogen is the most abundant chemical substance in the universe, constituting roughly 75% of all normal matter. Most of the hydrogen on Earth exists in molecular forms such as water and organic compounds. For the most common isotope of hydrogen (symbol $1H$) each atom has one proton, one electron, and no neutrons. Source: www.wikipedia.com



HYDROGEN
 H_2



INDUSTRIAL
USE

HYDROGEN IN INDUSTRIAL PROCESSES

- Piping style:** Low/High Pressure - Industrial use
- Pressure range:** Up to 4,000 psi; up to 414 barg; up to class #2500
- Piping diameters:** 1/2" to 10" DN15 to DN250
- Connections styles:** Welded; Threaded
- Fugitive emission:** API 641; ISO 15848-1
- Fire Safe:** API 607; ISO 10497
- HE - H₂ gas embrittlement:** Non-critical - use St. St.
- Cleaning level:** Cleaned for high purity H₂ use

- ⊗ Total HermetiX™ | Port ⊙ Standard Port ⊙ Full Port ○ Tube Size
- ⊙ Ordering Code | End Connections ⬡ Threaded ⬢ Cone & Thread ⊕ Flanged □ Welded

	Category	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)											MWP (ANSI Class)														
									1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16									
Temp.: -60°C - +260°C (-76°F +500 °F)	High Pressure	Floating	3 Piece	⊙	See High Pressure	⊗	⊙	⊙	⬢	⊕	□	2500/1500																						
	Industrial Use	Trunnion	3 Piece	⊙	See Industrial	⊗	⊙	⊙		⊕	□							900/600/300/150																
			2 Piece	⊙		⊗		⬡	⬢	⊕	□							600/300/150																
		Floating	3 Piece	⊙		⊗	⊙	⊙	⬡	⬢	⊕	□	900/600/400/300/150																					
			2/1 Piece	⊙		⊗	⊙		⬢	⊕	□	300/150/PN40/PN16																						
			DS/DBB	⊙		⊗	⊙		⊕	□	600/300/150/PN16																							
			Multiport/ Diverter	⊙		⊗	⊙	⊙	⊕	□	600/300/150																							
		Control	⊙	⊗		⊙	⊙	⬡	⊕	□	900/400/300/150/PN40/PN16																							
		See Control	⊙	⊗		⊙	⊙	⬡	⊕	□																								





INDUSTRIAL
USE

ENERGY SOURCE

Hydrogen and especially green or blue hydrogen that are manufactured by an environmentally clean process are ideal to be used as a storage for access energy later to be transformed back to energy, (mainly electricity) in a clean process mainly based on fuel-cell technology.

More than one technology is developed to allow the large-scale and efficient transformation of hydrogen to electricity or heat, all with the purpose of utilizing the stored energy in a clean way.

These processes have the stored hydrogen feedstock on one end and the transforming device that turns it into energy on the other. These processes usually are done locally at low to medium pressures and have a small to medium piping size in use. Cost-effectiveness is a major key factor in such systems designs as they are distributed near the end use points of the energy, hence relatively small scale with a challenging ROI and low maintenance requirements.

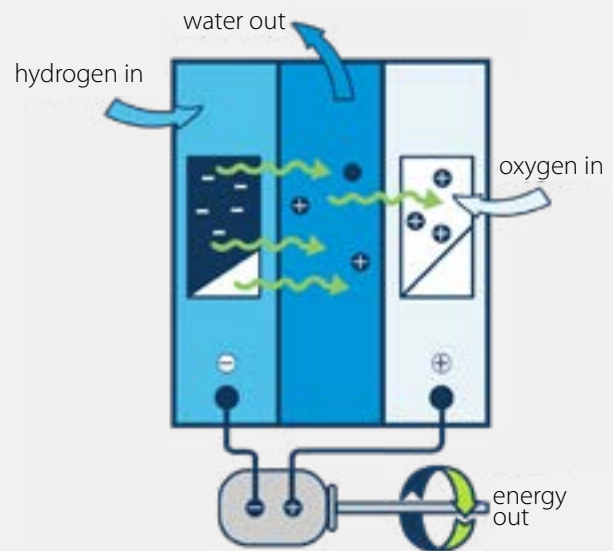


Hydrogen Fuel Cell

A fuel cell is an electrochemical cell that converts the chemical energy of hydrogen and oxygen (usually) into electricity through a pair of redox reactions. Fuel cells are different from most batteries in requiring a continuous source of fuel and oxygen to sustain the chemical reaction, yet can produce electricity continuously for as long as hydrogen fuel and oxygen are supplied.

Fuel cell energetic efficiency can reach 80-90% and is used in mobile devices like cars, trucks, space vehicles, and more or in stationary power generation facilities.

Individual fuel cells produce relatively small electrical potentials, about 0.7 volts, so cells are "stacked", or placed in series, to create sufficient voltage. Stationary fuel cells power plants becomes bigger all the time, reaching capacity of close to 80 MW already. Source: wikipedia.org





INDUSTRIAL
USE

ENERGY SOURCE

- Piping style:** Medium Pressures - Industrial use
- Pressure range:** 700 to 1,300 psi; 50 to 90 barg; class #600
- Piping diameters:** 1/4" to 1"; DN06 to DN25
- Connections styles:** Coned & Threaded; Welded
- Fugitive emission:** API 641; ISO 15848-1; With special HP H₂ stem seal
- Fire Safe:** API 607; ISO 10497
- HE - H₂ gas embrittlement:** Critical - use Hydrogen service valves
- Cleaning level:** Cleaned for high purity H₂ use

⊗ Total HermetiX™ | **Port** ⊙ Standard Port ⊚ Full Port ○ Tube Size
⊙ Ordering Code | **End Connections** ⊕ Threaded ⏏ Cone & Thread ⊗ Flanged □ Welded

Temp.: -60°C - +260°C (-76°F +500 °F)	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)															
								MWP (ANSI Class)								MWP (ANSI Class)							
								1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14
Floating	Trunnion	3 Piece	⊙	93	⊗	⊙	⊙	⊗	600								600						
		2 Piece	⊙	83	⊗		⊕	⊗	600								600						
		3 Piece	⊙	47	⊗	⊙	⊙	⊕	⊗	900				400				600					
	Floating	3 Piece	⊙	26	⊗	⊙		⊗	600				600				600						
		DS/DBB	⊙	47DS	⊗	⊙		⊕	⊗	600				600									
		Multiport/ 3 Piece	⊙	61		⊙	⊙	⊕	⊗	600				300				600					
			⊙	62		⊙	⊙	⊕	⊗	600				300				600					
		Diverter/ 3 Piece	⊙	D47	⊗	⊙	⊙	⊕	⊗	600				300				600					
		Side-Entry/ 3 Piece	⊙	S47	⊗	⊙	⊙	⊕	⊗	600				300				600					
		3 Piece	⊙	47	⊗	⊙	⊙	⊕	⊗	900				400				600					

Relevant HABONIM Series: H93/H83/H47/H26/47DS/H61/H61/D47/S47/H47



DISPENSING - CGH₂

Hydrogen-powered vehicles are basically electrical motored vehicles of all sorts that use a fuel cell to continuously transform hydrogen to electricity, such vehicles have a hydrogen tank onboard and need to be refueled like any petrol or gas vehicle.

The available space and physical constraints of each vehicle impact the volume of the onboard hydrogen tank. In order of allowing the required traveling distance before refueling, different hydrogen gas pressures are used in different types of vehicles.

The onboard hydrogen tank working pressure defines the fueling stations and dispensing systems working pressures to go up to 1,000bar (10,000psi).

Standards like ISO 19880 Gaseous hydrogen — Fuelling stations — Part 3: Valves define the requirements and certification of the valve to be used in those high-pressure hydrogen fueling stations.



Vehicle Type	Full	Onboard tank pressure	Dispensing & Fuel station systems pressure
Cars	CH ₂	700-750 bar (10,000-11,000 psi)	1,000 bar (15,000 psi)
Industrial machinery & trucks	CH ₂	500-550 bar (7,250-8,000 psi)	600-700 bar (8,700-10,000 psi)
Trucks	CH ₂	300-350 bar (4,350-5,000 psi)	450-550 abr (6,500-8,000 psi)



ISO 19880-3:2018, Gaseous hydrogen - Fuelling stations - Part 3: Valves

This international standard specifies the requirements and test methods for valves designed and manufactured for gaseous hydrogen stations, specifies the safety performance requirements, and proof of design type-test methods for components to be used in hydrogen stations.

The standard specifies a list of stringent testing in the purpose of validating the valve design is suitable for high-cycle outdoor safe use under very high pressures with hydrogen media.

Some of the tests are:



100,000 Cycles
Under Pressure



-40°C
Under Pressure Cycles
+ Full Δp cycles



+80°C
Under Pressure Cycles
+ Full Δp cycles



Pressure Tests
valve rating x 2.5

DISPENSING - CGH₂

- Piping style:** High/Ultra-High Pressure - High Purity - transportation
- Pressure range:** 4,300-5,000 psi; 7,250-8,000 psi ; 10,000-11,000 psi 300-350/500-550/700-750 barg
- Piping diameters:** 1/4" to 1/2"; DN06 to DN15
- Connections styles:** Coned & Threaded
- Fugitive emission:** API 641; ISO 15848-1; With special HP H₂ stem seal
- Fire Safe:** API 607; ISO 10497
- HE - H₂ gas embrittlement:** Critical
- Cleaning level:** Cleaned for high purity H₂ use
- Certification:** ISO 19880-3

- ⊗ Total HermetiX™ | **Port** ⊙ Standard Port ⊙ Full Port ○ Tube Size
- ⊙ Ordering Code | **End Connections** ⊕ Threaded ⊕ Cone & Thread ⊕ Flanged ⊕ Welded

Temp.: -60°C - +260°C (-76°F +500 °F)	Category	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)										MWP (ANSI Class)								
									1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	
									High Pressure	Trunnion	Threaded body	⊙	H99	⊗			⊕ ⊕	1,000bar (15,000psi)									
	Floating	Threaded body	⊙	H29	⊗			⊕ ⊕ ⊕	1,000bar (15,000psi) with TPED - 700bar (10,000psi)																		
			⊙	H24	⊗	⊙	⊙	⊕ ⊕ ⊕ ⊕	550bar (8,000psi)	Class 2500																	

Relevant HABONIM Series: H99/H29/H24



PRODUCTION-STORAGE-FUELING-USE (CGH₂)

On-site end-to-end renewable energy supply systems are becoming more and more popular.

Such a typical system comprises of:

- Renewable energy generation devices like a wind turbine, solar panel system, or others.
- Hydrogen electrolysis device to turn the access renewable electricity into hydrogen.
- Low-pressure hydrogen tank or storage.
- Hydrogen compression system.
- High-pressure hydrogen tank or storage.
- Dispensing system.

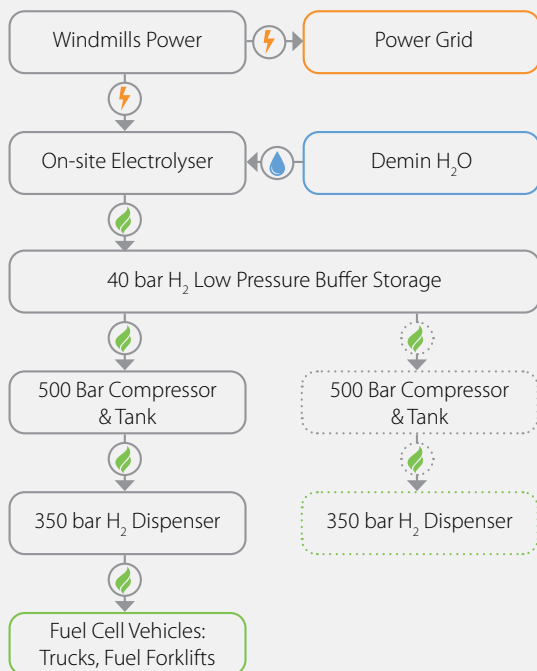


A system like this can be built to fuel a variety of vehicle types with few working pressures.

Such local systems can be integrated with the local power grid and local H₂ or Natural gas pipe systems allowing bi-directional electricity and hydrogen flow.



20 MW power to H₂ self-generation, self-consumption fueling and H₂ surplus selling



PRODUCTION-STORAGE-FUELING-USE (CGH₂)

- Piping style:** High/Ultra-High Pressure - High Purity - transportation
- Pressure range:** 4,300-5,000 psi; 7,250-8,000 psi; 10,000-11,000 psi 300-350 / 500-550 / 700-750 barg
- Piping diameters:** 1/4" to 1"; DN06 to DN25
- Connections styles:** Coned & Threaded
- Fugitive emission:** API 641; ISO 15848-1; With special HP H₂ stem seal
- Fire Safe:** API 607; ISO 10497
- HE - H₂ gas embrittlement:** Critical
- Cleaning level:** Cleaned for high purity H₂ use
- Specific Standards & Regulations:** ISO 19880-3

- ⊗ Total HermetiX™ | Port ⊙ Standard Port ⊙ Full Port ○ Tube Size
- ⊙ Ordering Code | End Connections ⬡ Threaded ⏏ Cone & Thread ⊕ Flanged □ Welded

Temp.: -60°C - +260°C (-76°F +500 °F)	Category	Ball Valve	Design Type	OC	Series	TH	Port	End Con.	Valve Size (Inches)											MWP (ANSI Class)				
									1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12
High Pressure	Trunnion	Threaded body	⊙	H99	⊗			⏏ ⊕	1,000bar (15,000psi)															
			⊙	H29	⊗			⬡ ⏏ ⊕	1,000bar (15,000psi) with TPED - 700bar (10,000psi)															
	Floating	Threaded body	⊙	H24	⊗	⊙ ⊙	⬡ ⏏ ⊕ □	550bar (8,000psi)	Class 2500															









VP0007634 CAT- Hydrogen Processes ver01_280822

About Habonim

Ball Valves & Actuators for the most demanding, challenging and hazardous applications are our passion and profession for the last 70 years.

We believe in designing, manufacturing and supplying control and shutoff components and solutions that improves the overall safety, integrity and sustainability of the systems they are installed in.

Designed, manufactured and tested according to the highest standards, our products allow us to partner within systems that flow and control varied gases and liquids in diverse markets especially where extreme temperatures and pressures are involved, hazardous materials are used and system performances are critical.

We are leading in cryogenic ball valve-based control solutions, emergency shutoff and specially designed solutions.

Believing that supplying and developing the most effective, safe and reliable products for the global leaders in the LNG and Gas distribution market continually challenges us to improve our capabilities and products.

Best coping with our prestigious customers' most challenging requirements technically, operationally and commercially is our promise fulfilled for decades.

Performing in Demanding Applications



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