

A

about H Bank

T

Technology

P

roduct

A

pplications

H Bank Technology is an expert in offering total hydrogen solutions to our clients

H Bank Technology Inc. is the leading hydrogen storage and purification system manufacturing and consultant company registered in Taiwan. Our core technical team has been accumulating more than 30 years of experience in studying metal hydrides and its applications. With the background of such indomitable devotion and peerless achievements in metal hydride technology, we have successfully commercialized our technology to meet the demands of different markets, such as instruments, fuel cells, energy saving mixed fuel burners, semiconductor industry, ultra high purity hydrogen, traditional fuels mixed with hydrogen and others.

Fuel cell market



H Bank products are excellent hydrogen storage solutions in renewable energy projects. With the widespread recognition, H Bank's hydrogen storage systems are de facto a symbol of the best hydrogen storage solutions for 1-20 KW fuel cell systems. Our products have been successfully tested in dozens of laboratories in Europe, North America and Asia with different experimental fuel

cells as well as with standard FC products from Plug Power, Ballard, Voller, FC R&D and others. We are offering a wide range of standard products with different capacities and specifications to customers worldwide. In addition, due to our experienced R&D team, H Bank is able to design the right compositions for the storage alloy in a very short period of time and to offer its customers high quality tailor made storage products fully meeting their demands.

Instruments market



In the past few years we have successfully replaced the traditional high-pressure hydrogen cylinders and hydrogen generators used in the VOC/THC stations of Taiwan's Environmental Protection Bureau with our hydrogen storage systems. Currently our products are widely used in dozens of different profile laboratories in Taiwan as well as in over 10 countries. They were tested and currently are used with a

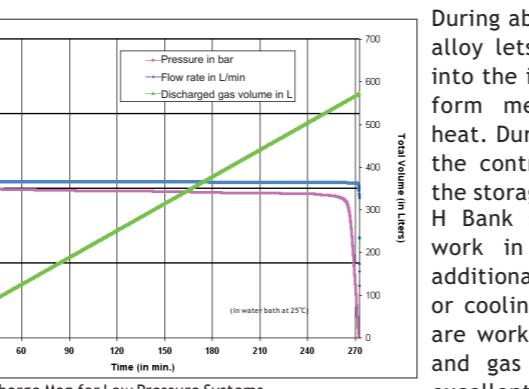
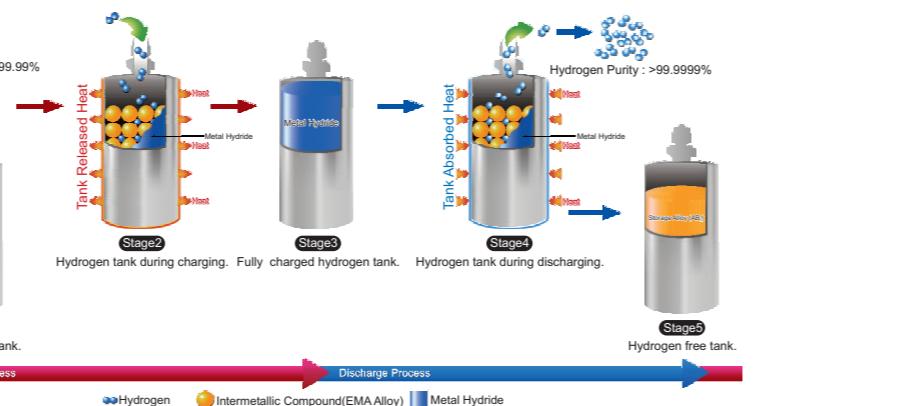
number of GC, GC-MS, GC-FID models produced by almost all worldwide known manufacturers: Agilent, Varian, Thermo, Signal Instruments, HP, Toshiba, SRI, Baseline MOCON Inc and others. Photovac Inc.(USA) and J.U.M. Engineering (Germany) have already designed new models of portable gas analyser with mounted inside our 50 liter hydrogen storage. In all these cases H Bank storages exceeded all expectations regarding safety, reliability, convenience and lifetime.

Energy saving



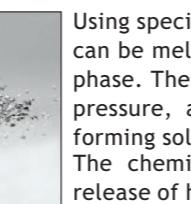
Hydrogen is the only ecological clean and one of the most calorific fuels. Replacing 8-10% wt of traditional fuel with hydrogen can save from 40 up to 60% of fossil fuels. For example, adding 2.5% of hydrogen into the burning mixture of small unmanned airplane engines can save up to 48% of methanol fuel. H Bank Technology is actively collaborating in this R&D field with several companies in design of mixed burners for various applications.

Scheme



During absorption our hydrogen storage alloy lets hydrogen gas molecules get into the interstices of metal lattices to form metal-hydride while releasing heat. During desorption this bonding on the contrary needs heat to break, so the storage will cool down. H Bank storages are all designed to work in room temperature without additional energy sources like heating or cooling systems. If H Bank storages are working at recommended pressure and gas flow rate, you will get an excellent performance and a highly stable hydrogen output from our storages as shown in the left diagram.

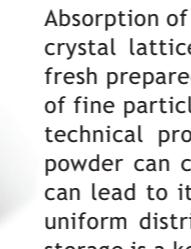
Patented alloys



Using special vacuum technology from rare-earth and transition metals can be melted alloys, which are able to absorb hydrogen from the gas phase. These alloys, at room temperature and under certain hydrogen pressure, are absorbing extremely large quantities of hydrogen by forming solid metal hydrides. The chemical reaction of hydride formation is accompanied with release of heat into environment.

The hydrogen absorption process can be reversed if the hydrogen pressure is lowered below some certain value. In this case, desorption of hydrogen gas is accompanied with heat absorption from environment.

Patented inner structure



Absorption of hydrogen by storage alloy results in 20-25% of swelling of its crystal lattice. This creates abnormal high mechanical tensions in the fresh prepared alloy ingots crushing them into fine powder. The subsiding of fine particles after the hydrogen is removed from the alloy is a serious technical problem; the repeated absorption of gas by subsided alloy powder can create huge mechanical tensions in the storage shell which can lead to its deformation and/or even rapture. Hence, the fixation of uniform distribution of the alloy powder trough the entire body of the storage is a key technical issue. H Bank's patented technology allows fully to exclude this negative effect - we can manufacture hydrogen storages with any geometrical shape and they can pass thousands of absorption/desorption cycles.

10 Liter

HB-SC-0010-Q

- Size : 21⁰×100⁴mm
- Connect : Quick connector SS304 2.5⁰mm stem (MISUMI, Japan),with Swagelok 1/8" tube fitting connector
- Flow rate : < 50 ml/min

300 Liter

HB-SC-0300-N

- Size : 60⁰×280⁴mm
- Connect : Swagelok SS316 needle valve (with 1/4" tube fitting)
- Flow rate : < 0.7(25°C) L/min

50 Liter

HB-SC-0050-Q

- Size : 32⁰×200⁴mm
- Connect : SS-QC4-B-400IS Swagelok quick connector (with 1/4" or 1/8" tube fitting)
- Flow rate : < 0.2(25°C) L/min

100 Liter

HB-SC-0100-Q

- Size : 36⁰×270⁴mm
- Connect : SS-QC4-B-400IS Swagelok quick connector (with 1/4" or 1/8" tube fitting)
- Flow rate : < 0.2(25°C) L/min

500 Liter

HB-FR02-0500-B

- Size : 185¹×120⁴×120⁴mm
- Connect : Swagelok SS316 Ball valve (with 1/4" tube fitting)
- Flow rate : < 1.5(25°C) L/min

2400 Liter

HB-PR 2400

- Size : 335¹×345⁴×300⁴mm
- Connect : Swagelok SS316 needle valve (with 1/4" tube fitting)
- Flow rate : < 2.0(25°C) L/min

Special ODM

Portable GC-FID (J.U.M. Germany) - HBank inside!



H Bank HB-SC-0050-Q can store 50L of H₂ and was designed to be installed in advanced portable GC-FIDs. It can serve as a stable and very pure hydrogen source for portable GC/GC-FID for 25-43 hours. Replacement of traditional high pressure tanks in portable GCs with our storages can reduce the total weight of the equipment by more than 4kg as well as decrease over three times the volume, occupied by the high pressure hydrogen tank. In addition, it will allow to overcome the restrictions. Connected with transportation of high pressure explosive gases.

Beside using H Bank hydrogen storages as an hydrogen source for fuel cells and instruments, there are a lot more applications for our versatile storage solutions. As one of the common industry gases, hydrogen is used in many different areas. H Bank storages help to solve all the safety issues and will improve the convenience level of handling hydrogen in your company. The excellent purification capability and the stable gas flow of H Bank storages will lead to a cost reduction and a higher efficiency of your hydrogen-related applications.

Our customers are already using our storages in the following manufacture and modification processes in need of ultra-clean hydrogen and absolutely stable gas flow:

- ▶ Plasma cleaning, plasma etching, CVD, ALCVD in the semiconductor industry
- ▶ Surface coating of optical lenses, nano-diamond film modification, heat atmosphere treatment, optical fiber coupling
- ▶ Portable H₂/O₂ torch tools and special welding & melting applications
- ▶ Hydrogen lamps, H-maser clocks, thermogravimetry
- ▶ Chemical synthesis, material treatment, hydrogen plasma and nuclear physical fields

A very special application is the hydrogen waste recycling, which can help to cost down your manufacturing or even to gain profits from selling recycled and highly purified hydrogen.

H Bank hydrogen storages are also safely storing isotopes of hydrogen such as deuterium and tritium.



H Bank storages as ODM products

H Bank Technology is experienced in integrating hydrogen storages into all kind of products. We are able to adjust the technical specifications according your requirements: capacity, shape, pressure, connections and flow rate. We will offer you our deep knowledge of hydrogen storage technology to provide you with the best support during integration and the best fitting storage for your product. As a technology-driven company H Bank Technology will enhance your products with one of the worldwide best, safest and most flexible hydrogen solution.

Q: Is your storage a high pressure cylinder?

A: No. Our storages can be charged at a pressure of 10 - 35 bar, but they are operating at a pressure below 10 bar.

Q: How can your storages store hydrogen at such a low pressure?

A: Inside our storage is metal hydride, that is capable to chemically bind hydrogen in a solid form. That makes our storages highly safe and very compact.

Q: How do I know when I nearly used up the hydrogen in your storages?

A: If the pressure in our storages drops below 1.5 bar at room temperature they need to be recharged.

Q: Is there any need for pressure gages or pressure regulators when using your storages?

A: No, there is no need. Our storages are releasing hydrogen at a constant pressure.

Q: Is it possible to store other gases beside hydrogen in your storages?

A: No, our storages only store hydrogen. If you try to store other gases in our storages they might become out of order.

Q: How long does it take to charge your storages?

A: Recharging is a simple and convenient process for our customers. The charging time depends on the capacity of our storage. For our 50L storage it takes 80 minutes for recharging at room temperature and only 10 minutes while using a room temperature water bath.

Q: How long can I use H Bank storages?

A: Our storages have an enormous lifetime of over 3000 charge/discharge cycles. Even after 3000 cycles our storages only have lost 10 percent of their capacity. If you charge and discharge our storages every day you can use H Bank storages for far more than 8 years.

Q: May I use a hydrogen generator to charge your storages?

A: Many of our storages can be charged directly from a common hydrogen generator.

Q: How much pressure H Bank storages can stand?

A: In tests our storages were exposed to a pressure of 100 bar and showed a reversible diameter change of only 0.1 mm in the middle of the cylinder.

Q: How does moisture and condensation water influence your storages?

A: Because our storages are all fully stainless steel (SS316L) manufactured, moisture and water can't cause any issues for our storages. Different from aluminum hydrogen tanks you can even put our storages in water for faster charging without fearing corrosion.

Q: What will happen if your tank breaks?

A: Because the hydrogen is chemically bound in our alloy, even gunshots at our storages don't lead to an explosion. If there is a leakage the hydrogen will be released very slowly, so there is no danger of a potentially explosive hydrogen concentration in the environment of our storage.

Q: Do I need to heat the storage to release the hydrogen?

A: No, there is no need for heating. H Bank storages are designed to work without any additional energy sources at room temperature. However, optional additional heating or cooling can improve the gas flow rate or the charging time if necessary.

Portable hydrogen supply



▲ HB-SC-0050-Q for Portable GC , SRI 8610 C



▲ HB-SC-0050-Q for Portable GC , Signal

After replacing standard hydrogen cylinders with H Bank storages the running time of your analyzer can be 10 times longer than before and the total weight of the instrument can be reduced by 50%.

Hydrogen station in laboratories



▲ HB-FR02-0500-B for THERMO Quest Trace - GC



▲ HB-SC-0300-N for SHIMADZU GC-14B

No more high pressure cylinders inside the laboratory and no need for hydrogen pipelines. Higher purity hydrogen from our storages will lead to more accurate analyzing results.

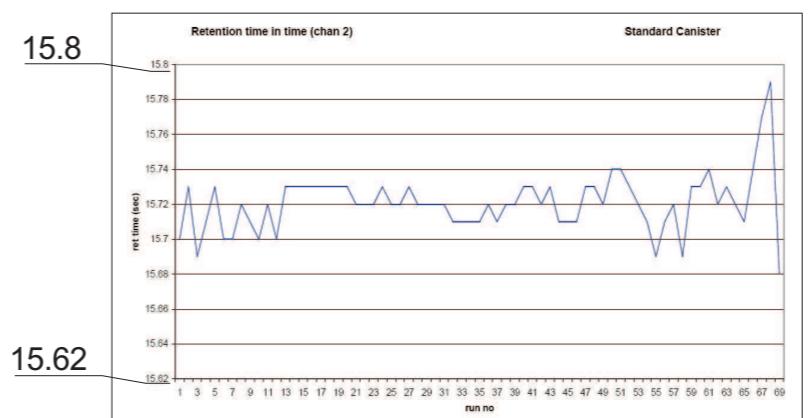
24-hour nonstop hydrogen supply system

▲ HB-PR 2400 for Air Quality Inspection Station
BASELINE-MOCON Inc., Series-8800▲ 4 units HB-FR02-0500-B for VOC inspection Station ,
PERKIN ELMER

H Bank storages are the best and safest solution for unmanned environment control stations.

Highly stable gas flow

Continuous 25 hour hydrogen supply, during retention time maximum instability is ± 0.06 seconds!

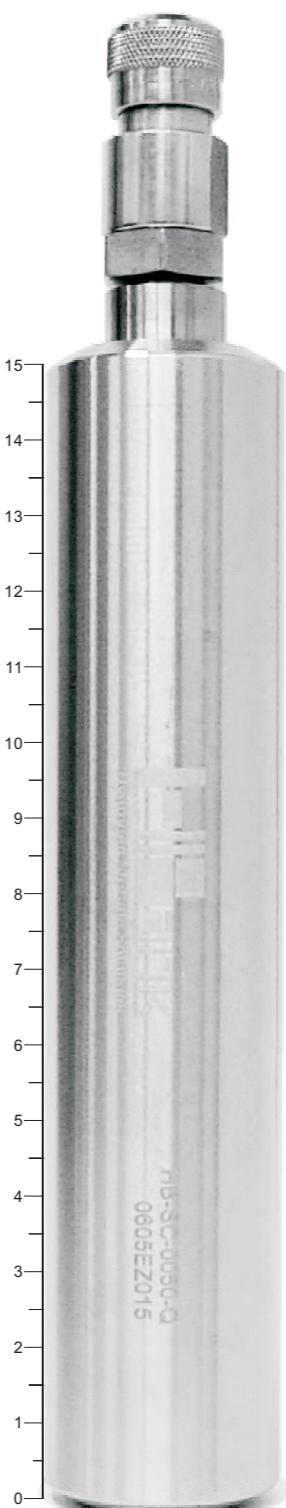


▲ Retention time (sec) vs. run no
[Experiment results by Jos Curvers for Varian BV (March 18, 2008)]

The HB-SC-0050-Q solid-state hydrogen storage is releasing hydrogen at a constant hydrogen gas flow rate. This test was using the HB-SC-0050-Q solid-state hydrogen storage for Varian's CP-4900 micro gas chromatograph. Every 20 minutes the test unit was taking one air sample. The hydrogen gas flow rate was stable with 10 - 15 ml/min, storage was working continuously for 25 hours.

Comparison between H Bank hydrogen storages, high pressure cylinders and hydrogen generators

	H Bank hydrogen storages	High pressure gas cylinders	Hydrogen generator
Safety	High ★★★	Low ★	Medium ★★
Size	Small ★★★	Medium ★★	Big ★
Reliability	High ★★★	Medium ★★	Low ★
Maintenance cost	Low ★★★	Medium ★★	High ★
Hydrogen purity	High ★★★	Medium ★★	Medium ★★
Pressure stability	High ★★★	Medium ★★	Low ★
Lifetime	Very long ★★★	Long ★★	Very short ★



- Safety - under 10 bar pressure storage
- Portable - 500 liters gas in 8 kg storage
- Rechargeable - at least 3000 recharge cycles
- Highest purity - over 6.5N purity hydrogen

