

# Hydrogen Energy Test and Research Center





President

## Shogo Watanabe

### Greetings

The development and clustering of new hydrogen energy businesses will facilitate the pursuit of lower costs and higher performance in every related product. This can be achieved by encouraging the participation of a broad spectrum of companies, which will in turn create a competitive environment. For the private sector to enter into the new hydrogen energy industry successfully, it is essential to have access to product testing in a hydrogen environment in order to demonstrate the performance and reliability of their products.

However, the large initial investment hydrogen testing requires is an obstacle inhibiting the participation in this new sector of many SMEs as well as venture businesses.

HyTREc will provide material and component testing services that were previously unavailable in Japan; this will assist the private sector in their product development efforts, utilizing the world-leading expertise of Kyushu University and AIST HYDROGENIUS.

It is our sincere wish that as many companies as possible will take advantage of the effective and efficient product R&D environment we offer. HyTREc is here to contribute to the development of new hydrogen energy industries in Japan.



### Purpose of Establishment

The Hydrogen Energy Test and Research Center (HyTREc) was incorporated as a foundation in March 2009 under the leadership of Fukuoka Prefecture in order to facilitate “the development and clustering of new hydrogen energy businesses,” a goal of the Fukuoka Strategy Conference for Hydrogen Energy (Hy-Life Project).

HyTREc will support and facilitate joint R&D initiatives and the entry of small and medium-sized enterprises and start-ups into the emerging hydrogen energy industries by providing testing services such as durability and pressure cycle tests of hydrogen-related components, including valves and sensors.

### Service Portfolio

#### (1) Prototype testing

Will provide testing services, including durability, performance, vibration, air-tightness, pressure cycling, gas permeability, and material evaluation.

#### (2) Development of product testing protocols

Will develop new test methods for hydrogen-related products under contract from the central government or private sector.

#### (3) R&D of hydrogen products

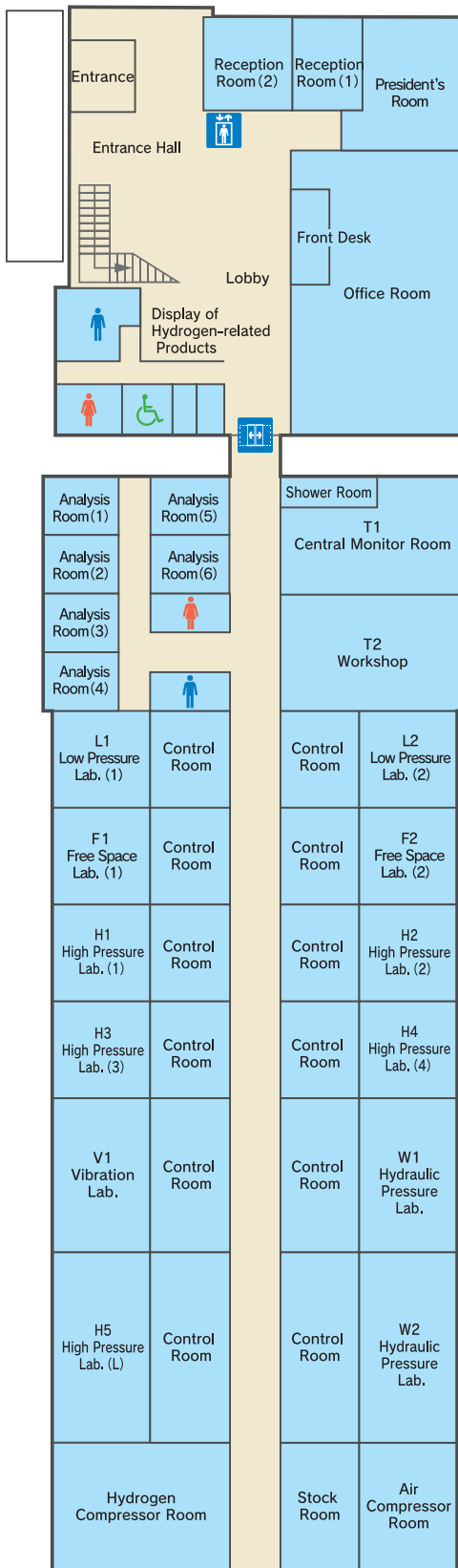
Will develop joint R&D projects with the private sector for materials and components such as valves and joint connections.

#### (4) Seminars and public relations activities

Will organize seminars on the latest technologies and safety training programs concerning hydrogen energy.

# Floor map

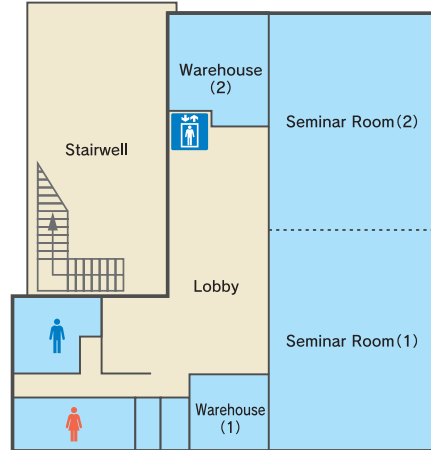
1 F



Office Building

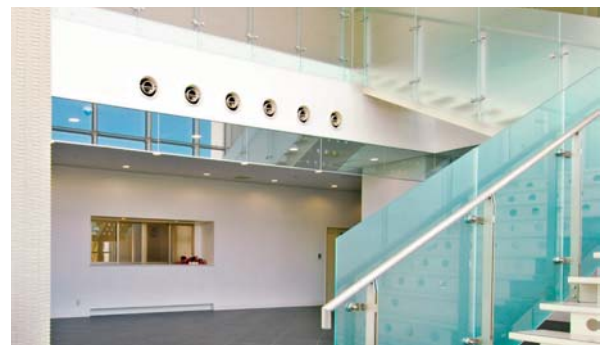
Laboratory Building

2 F



### Seminar Rooms

- Two seminar rooms accommodate 45 persons each, maximum capacity is 100
- Seminar rooms are used for seminars on hydrogen safety, state-of-the-art hydrogen technology, human development and so on.



### Entrance Hall



### Outlook of the office building

Office Building···RS structure, 2 stories  
 Laboratory Building···RC Structure, one story  
 Gross Floor Area···approx. 2,000sq.m  
 Site Area···approx.5,300sq.m

## Laboratory equipment guide

### W 1 Outside hydraulic pressure laboratory

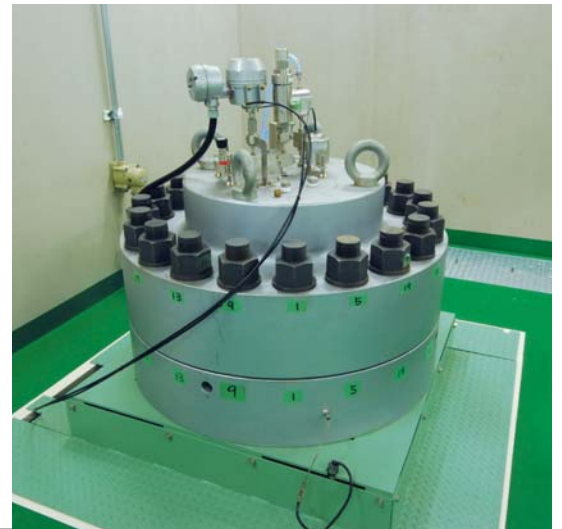
#### Outside hydraulic pressure test equipment

Hydraulic pressure  
in the water vessel:  
0~87.5MPa  
Cycle speed:  
0.5cycle/min.  
Inner dimensions of  
the water vessel:  
 $\phi 400 \times 1100(H)$ (mm)  
Temperature:  
ambient



High pressure water vessel

#### Hydraulic pressure cycle test equipment



### W 2 Burst and endurance laboratory

#### Hydraulic pressure test equipment / Test pit

For pressure cycle test  
Maximum hydraulic  
pressure:130MPa  
Cycle speed:  
4 cycles /min.

For burst test  
Maximum hydraulic  
pressure:343MPa

Test pit dimensions:  
2400(W) × 3200(L)  
× 2000(H) mm



Hydraulic pressure test equipment



Test pit

The durability of a container is tested by setting a hydrogen gas-filled container in the water vessel and then applying/reducing pressure to the water inside the water vessel (outside the container). This method can reduce test time compared to the gas cycle test.

This laboratory is used for the burst and endurance test of a container by applying hydraulic pressure. The test is done in a pit for safety.

## H 1 ~ H 5 High pressure hydrogen laboratory

Hydrogen booster  
Accumulator  
Pressure and flow  
control unit  
Explosion-resis-  
tant chamber  
Temperature con-  
trol device

Working pressure: 99MPa  
Hydrogen flow rate:  
15m<sup>3</sup>/hr  
Temperature range:  
-40°C~85°C  
Inner dimensions of  
the explosion-resis-  
tant chamber:  
φ 1000×2000mm

This laboratory is used for high pressure hydrogen testing of containers, valves, flow me-  
ters, connectors and so on. The surrounding temperature can be controlled.

Explosion-resistant chamber/ Pressure and flow control unit



Inside the explosion-resistant chamber

Hydrogen booster/ Accumulator



## L 1 ~ L 2 Low pressure hydrogen laboratory

Hydrogen property  
preparation system  
Environmental test  
equipment

Operating pressure:  
0.9MPa  
Hydrogen flow rate:  
50L/min.  
Temperature range:  
-70°C~180°C  
Inner dimensions:  
1000(W)×998(H)  
×810(D)mm  
Hydrogen property  
preparation:  
humidification, CO,  
CO<sub>2</sub>, impurities etc.

Environmental testing that changes the surrounding temperature of a sample can be done.  
The supplying hydrogen property can be controlled to simulate conditions inside of a fuel  
cell.



Hydrogen property  
preparation system



Environmental test equipment



Inside the environmental test  
equipment

## V 1 Vibration test laboratory

Vibration test equipment  
Environmental test equipment  
Hydrogen property preparation system

Exciting force: 2300kgf (sine wave)  
Frequency: ~3000Hz  
Maximum weight: 200kg (including jig)  
Temperature range: -73~180°C  
Inner dimensions: 1168(W)×1270(H)×1118(D)mm  
Hydrogen property preparation: humidification, CO, CO<sub>2</sub>, impurities etc.



Hydrogen property preparation system



Environmental test equipment/  
Vibration test equipment



Inside the environmental test equipment

The vibration test equipment can be used for vibration testing of up to 200kg weight. Property controlled hydrogen gas can be supplied to the test sample and the surrounding temperature is also controlled.

## F 1 ~ F 2 Free space laboratory

Pressure of hydrogen: 0.9MPa~110MPa (with a mobile booster)  
Gas utility: H<sub>2</sub>, N<sub>2</sub>, He, Air  
Room space: 5000×5000mm



Free space laboratory



Control room

Customers can set up their own test equipment in the free space laboratory.

## Common facility

Two mobile boosters,  
Hydrogen purifier

① Mobile booster:  
Maximum pressure: 110 MPa  
Flow rate: 7m<sup>3</sup>/hr

② Hydrogen purifier  
Capacity: 30m<sup>3</sup>/hr  
Impurity level: less than 100ppm



① Mobile booster

Two mobile boosters are prepared. Each booster can be used according to test requirement.



② Hydrogen purifier

The used hydrogen is collected, purified and re-used.

## Analysis room

Surface analyses, measurement of charged hydrogen and chemical analyses can be done.

Scanning electron microscope (SEM)  
+ Electron dispersive x-ray spectroscopy (EDS)

Resolution: 3 nm  
Detectable element: Be~U



Confocal scanning laser microscope (CSLM)

Magnification ratio: 110~17000  
XY plane resolution: 1 nm  
Light source: 405nm semiconductor laser



Digital microscope

Optical magnification ratio:  
1 ~ 1400



High speed camera

Sensitivity: ISO5000(Color)  
Frame per second:  
50(1280 × 1024pixel) ~  
600,000(16 × 4 pixel)



Hydrogen analyzer

The amount of hydrogen contained in metal/ resin is measured by increasing the temperature at constant speed. Maximum temperature: 1000°C



Gas chromatograph

Measurement of qualitative/quantitative analysis of inorganic gas and volatile organic compound



Ion chromatograph

Simultaneous analysis of cation and anion is possible.

Detector: Electric conductivity type



High performance liquid chromatograph

Qualitative/quantitative analysis of organic compounds  
Detector: Variable ultraviolet-visible wavelengths detector



## Workshop

Workshop machines can be used for manufacturing of jigs and processing of samples.



Lathe



Milling machine



Workshop area

# Utilization of HyTReC

## Test Charge

Test charges are set for each laboratory. Test charges include the following.

- Utilization of a laboratory and equipment
- Preparation, operation and clearance of a test
- Test report
- Consultation concerning test methodologies and test conditions
- Overhead costs

The customer can use the following apparatus free of charge

- Analytical instruments (Gas chromatography, mass spectroscopy, ion chromatograph, SEM, 3D laser microscope, digital microscope, etc.)
- Workshop and machine tools
- Internet connection

## Security control

HyTReC controls information security strictly because the tests deal with technologies under development by customers.

- Conclusion of non-disclosure agreement with a customer
- Access control to the test area by IC security card
- Monitoring of each laboratory and main area of the facility by security cameras
- Security guard patrol at night and on holidays

## Facility safety features

250mm thick reinforced concrete walls

Hydrogen leak detector

Ventilation of 30 times per hour

Door opening sensor to prohibit entry while testing

Observation window(s) made of bulletproof glass and fireproof glass

Explosion-proof monitor camera and monitoring in the central monitor room

Explosion-resistant chamber made of 8 mm thick stainless steel (High pressure hydrogen lab.)

High pressure hydrogen booster and pressure accumulator are set up inside the barrier

Explosion-proof type electric devices in hydrogen lab.



Forced ventilation fan

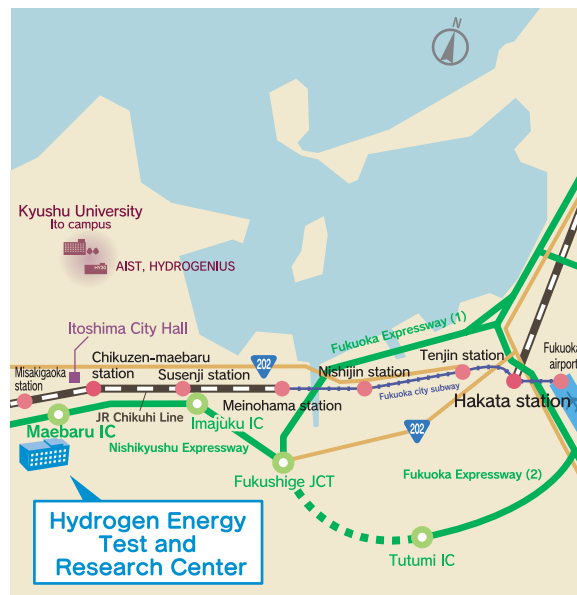
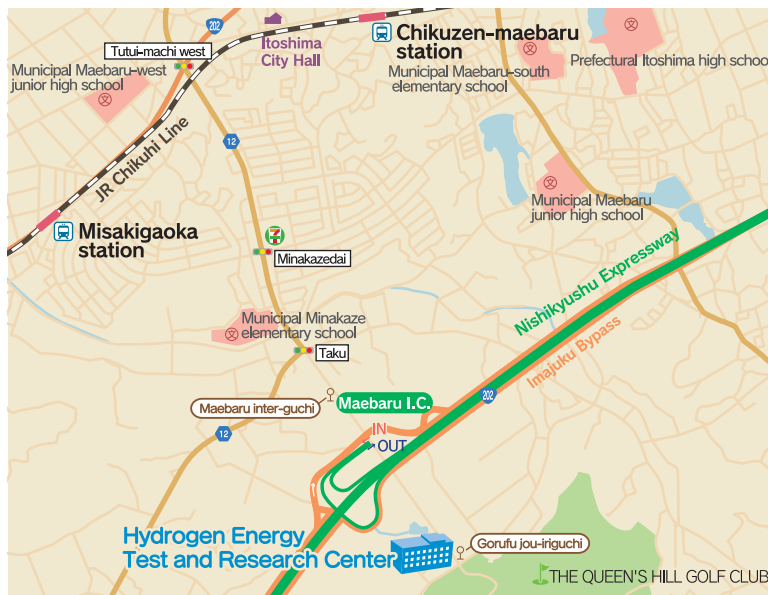


Dual structure window consisting of bulletproof glass and fireproof glass



Central monitor room

## Access



- **By car**...About 35 minutes from Fukuoka airport via Fukuoka Expressway and Nishikyushu Expressway. Get off at Maebaru I.C.
- **By bus**...Showa-bus, Itoshima-go, from Hakata station bus terminal. Get off at Maebaru Interchange and walk for ten minutes.
- **By train**...Fukuoka city subway Kuko-line bound for Meinohama and Karatsu. Get off at Chikuzen-Maeburu Station.



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