HORIBA

FUEL CELL TESTING FOR SOFC & SOEC

EVALUATOR HT-SERIES & SINTERING STATIONS

EVALUATOR HT TEST STATIONS

HORIBA FuelCon's Evaluator HT test stations are proven solutions for our customers´ specific requirements: long-term studies, performance tests, system qualification and material characterization of solid oxide single cells, components, stacks, hot boxes or complete systems. Our tailor-made solutions are designed to characterize components such as interconnector plates, sealings, electrodes, MEA or complete single cells and short stacks. Our product line ranges from test and diagnostic solutions to equipment testing for integrated manufacturing and quality management of SOFC or SOEC stacks with sintering and reduction test stations.

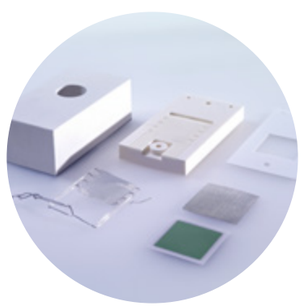
For each product development stage, we have a suitable test station. From the basic cell research to examine catalysts, membranes, the gas diffusion layers or the cell design in total, to the proof of concept evaluation in regards to performance, efficiency and durability, up to the prototype analysis for behavior studies under different and dynamic conditions and last but not least the fuel cell system testing for monitoring the functionality of all components together. Different test station classes guarantee an aligned design with various test item sizes ranging from 300 W to 50 kW.

Due to the flexibility in the design, the test stations find their home at many use cases. They are installed at R&D institutes and universities, labs of OEMs (Original Equipment Manufactures), test service providers and production lines for stacks at reputed companies. In addition, they are practical for all experience levels of users and complexity of the testing task.

The high-temperature testing stations are ideally suited for cell and stack developers performing initial application studies, duty cycle tests, life time and endurance tests as well as performance evaluations. Simultaneously the test stations are strategically designed to perform embedded electrochemical analysis like impedance spectroscopy. The test stations are perfectly custom-made for flexible adaptation (base and adapter plate) for various stack designs. Altogether, extremely reliable control system with PLC and PC for safe and non-interrupted long term testing is an integral part of the HT test systems.

To make this variety of applications possible, all test stations are equipped with a humidification system, electronic flow control, temperature and pressure control, nitrogen purge and electronic load management. Robust SQL database ensures secure data logging and data management which smoothenes long term testing up to 40,000 h.

TECHNICAL FEATURES AND YOUR BENEFITS



- Ultra flexibility in design
  - **Fully available for upgradation from SOEC to SOFC and vice versa**
  - **2 quadrant load for smooth change between SOFC and repetitive SOEC mode**
- Homogeneous temperature distribution through the furnace
  - **Included multi-zone temperature control**
- Modular frame design
  - **Clamshell or top hat furnace depending on the Evaluator class type**
- Unique 'HOT Stand by' function
  - **With 4 level alarm management system including safety gas purge**
- Various humidification methods
  - **Direct combustion, direct injection, counter flow and bubbler humidification processes**
- Reformer and desulfurized options
  - **For gases like CO, CO_2, CH_4**
- TrueXessory HT cell housing
  - **Full ceramic single cell housing allowing highly reproducible electrode contacting**
- Various stack adaptation methods
  - **For easy exchange of cell/stacks -> with up to 40 kN compression force**

TECHNICAL FEATURES AND YOUR BENEFITS

- Superior quality materials and components
  - **High reliability with approved test station components and long operating time of our test stations**
  - **Low maintenance and calibration cost**
- Precise control and measurement accuracies
  - **Data protection with tracebility**

- Powerful automation software HORIBA TestWork
  - **Fully automated, unattended operation with complete flexibility in the test program creation**
  - **High control and measurement accuracies for better test data quality**
  - **Synchronized time stamps for all data for easy cause effect analysis after tests**
- Reliable control system with PLC and PC
  - **Safe and non- interrupted long-term testing**

- Multi-level event and alarm system with a safety PLC
  - **Separate, independent safety controller to maximize the safety for the test item, the operators and the test station itself**
- Design according to risk assessment ISO 12100 and CE conformity marking
  - **Minimized risk for standard operation**

- Flexible adaption for additional testing methods
  - **Embedded electrochemical analysis - impedance spectroscopy and cell voltage monitoring**
- Control of all devices with one automation system
  - **Easy and smooth operation of the complete test station**

GENERAL SPECIFICATIONS

Test Station Class	Evaluator C50-HT	Evaluator C1000-HT	Evaluator S5-HT	Evaluator S25-HT
				
Current	Up to 100 A	Up to 360 A	Up to 1,000 A	Up to 1,000 A
Current Accuracy	±0.05 % FS ± 0.08 % of value* other accuracies on request			
Voltage	Up to 6 V	Up to 35 V	Up to 600 V	Up to 1,000 V
Voltage Accuracy	±0.03 % FS ± 0.05 % of value			
Power	Up to 300 W	Up to 3,600 W	Up to 10 kW	Up to 50 kW
	True-0-volt-mode and additional power supply (SOEC mode) available upon request			
Anode Flow [Nl/min]	Up to 1	Up to 20	Up to 100	Up to 1,000
Cathode Flow [Nl/min]	0.05 to 5	1 to 100	5 to 500	50 to 5,000
Control Accuracy	±0.1 % FS ±0.5 % of actual value			
Gas Temperature Range	Ambient to 750 °C		Ambient to 800 °C	
Gas Temperature Control Accuracy	±5 K (steady state)			
Active Test Item Temperature Setting	Up to 1,050 °C by clamshell furnance		Up to 1,050 °C by top hat furnance	
Data Logging	SQL database			
Safety Gas Purge	Programmable and separate Nitrogen / safety gas purge function for anode and cathode			

*All values are subject to change without further notice

SINTERING AND REDUCTION TEST STATION

The sintering process includes interconnection of several ceramic MEAs in place to form the SOFC stack. However, this is a crucial task and requires a good amount of precision and reproducibility.

Strikethrough to maximize the production without impacting the stack performance, the parameters during the sintering and reduction processes must be clearly defined.

HORIBA FuelCon's sintering and reduction stations allows not only accurate control and management of the anode and cathode gas flow, but also precise control of the gas composition, temperature, electrical load parameters, cell voltages and mechanical pressure making the test stations technically superior.

A further key characteristic of HORIBA FuelCon´s sintering and reduction station is the special electrochemical analytic tools that enable a significant time reduction in the assembly process.
These tools allow the operator to evaluate the quality and performance parameters of the stack during the process.

The editable process scripts keep the sintering process parameters confidential and ensure the protection of our customers´ know-how.

TECHNICAL FEATURES AND YOUR BENEFITS

- Simultaneous testing
  - **Parallel sintering of various numbers of stacks**
- Equipped with ergonomic test item shuttle system
  - **Highly convenient test item handling**
- Integrated test item cabin in various configurations and concept
  - **Suitable solutions for different test item sizes and gas feeding concepts**
- Cooling loop with integrated heating
  - **Fast conditioning of the test item & accelerated furnace cooling**
- Lifting Unit and Compression control
  - **Electrically actuated top hat lifting device**
- Full adaptability in the test item overview
  - **Camera and Scanner for test item identification in mass-production**
- Fully automated contacting system with multi coupling
  - **Reduction in preparation times and manual labour with increasing safety and minimum errors**
- Perfectly automated adaption
  - **Full control over the test station to create simple and complex test procedures with HORIBA TestWork**
  - **Operator optimized graphical user interfaces for an intuitive control and easy monitoring of operator panels**

OUR BENEFITS AT A GLANCE

HORIBA FuelCon is one of the world´s leading manufacturers of innovative testing and manufacturing systems for fuel cells and electrolyzers. Over 20 years of experience in this field of work built our competence and knowledge, which we put to use in every test system we design. This allows us to give you standardized solutions for your general testing demands, as well as fully customized ones for your specific testing requirements.

We always focus on the reliability and quality of our products and on proximity to our customers. To meet even the most complex requirements, we use intelligent engineering, a maximum value chain in our company and the highest safety standards in all development steps. With years of experience in the automation of test and production processes, we are your competent partner for the testing, qualification and validation of your future developments.

As part of the HORIBA Group with over 8,000 employees and 50 companies around the globe, you can rely on a strong local distribution and service network. The broad expertise of HORIBA in different measurement technologies gives us the opportunity to offer solutions beyond the sole fuel cell or electrolyzer testing. This includes gas & material analysis devices, powertrain & vehicle test beds and large-scale test field automation software.

HORIBA

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