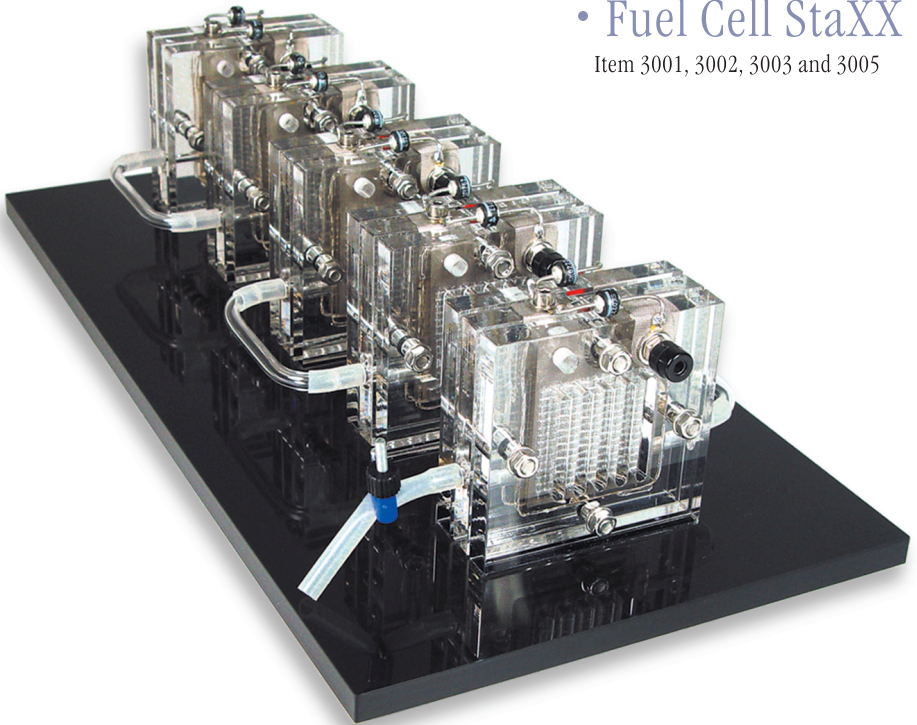


Operating Instructions



• Fuel Cell StaXX

Item 3001, 3002, 3003 and 3005



Fuel Cell

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Introduction and Intended Use

Hydrogen gas is oxidized within a fuel cell. In the process, the chemical energy stored in the hydrogen gas is converted directly, i.e. without combustion, to electrical energy. This process takes place in the heart of the fuel cell, the membrane electrode assembly (MEA).

The MEA comprises two electrodes (cathode: oxygen side and anode: hydrogen side) and the proton exchange membrane (PEM). The PEM is a special plastic film which is permeable to protons but which presents a barrier to electrons.

Hydrogen gas is split by catalysis into electrons and protons in the fuel cell. Owing to the chemical imbalance, the protons (cations) diffuse through the PEM. The resulting potential difference can be tapped on the electrodes in the form of a no-load voltage. As soon as an electric circuit is connected to the fuel cell, the surplus electrodes flow to the cathode, where they combine with the oxygen and the protons to form water (H₂O).

In the fuel cells described here, this water precipitates in the form of droplets on the housing.

The equipment has been developed for teaching and demonstration purposes only.

Any other use is prohibited.

Danger!

The hydrogen (H₂) and oxygen (O₂) reacting together in the fuel cell represent a source of danger if handled improperly. In order to avoid any risks you **must** follow the General Safety Precautions when working with the fuel cell.



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Hydrogen Energy Systems

wishes you many enjoyable hours learning about this technology with the fuel cell.

General Safety Precautions

- The system is intended for teaching and demonstration purposes in schools, universities, institutions and companies only.
- It may only be set up and operated by a competent person.
- Read the Operating Instructions before setting up the fuel cell. Follow them during use and keep them readily available for reference.
- Wear protective goggles.
- The system is not a toy. Operate the fuel cell and keep it and the gases produced out of the reach of small children.
- Do not operate the system dry. Always ensure that it contains sufficient water.
- Remove inflammable gases, vapours and liquids from the vicinity of fuel cells and electrolyzers. The catalysts contained in the system can trigger spontaneous combustion.
- Hydrogen may escape from the system. To prevent the gases collecting and forming explosive mixtures only use the system in well-ventilated rooms.
- Never operate the system in a display case, as escaping hydrogen can concentrate to form an explosive mixture.



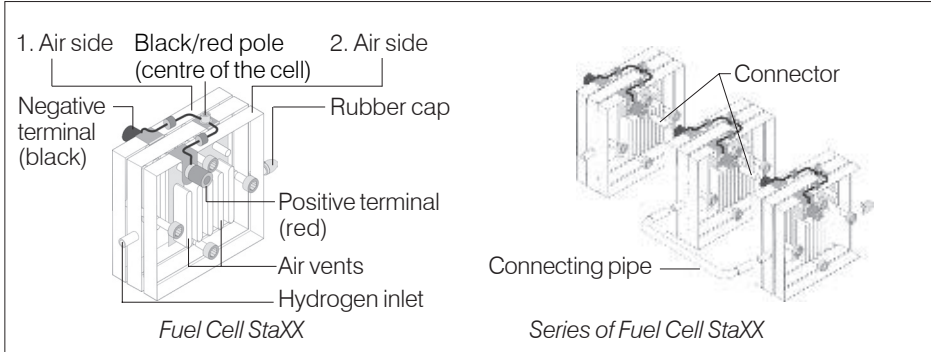
- Remove from the vicinity of the system anything that could ignite the hydrogen (naked flame, materials that can become charged with static electricity, substances with a catalytic action). 
- Remove from the vicinity of the system all substances that could spontaneously ignite with increased oxygen concentration.
- Do not smoke. 
- Hoses, plugs and tanks are used for pressure compensation. They must not be fixed or secured with clamps, adhesive, etc.
- Only use the gas storage tanks belonging to or supplied with the system to store gas. Never connect other alternatives.
- Only operate the system at room temperature and ambient pressure.
- Never apply an external voltage to the fuel cell. This will destroy it and explosive gas will accumulate in the storage tanks.
- Do not position any solar modules and lights in use closer than the minimum permitted distance (30 cm between h-tec solar modules and the h-tec Videolight, and 50 cm between them and the h-tec Spotlight, or see other manufacturers' stipulations).

General Safety Precautions

- The surface of solar modules can get very hot during extended operation.
- Tell your students about any potential dangers and carefully supervise experimentation.

h-tec will not accept any responsibility for injuries or damage sustained in the event of these Safety Precautions not being followed.

Cell and Materials

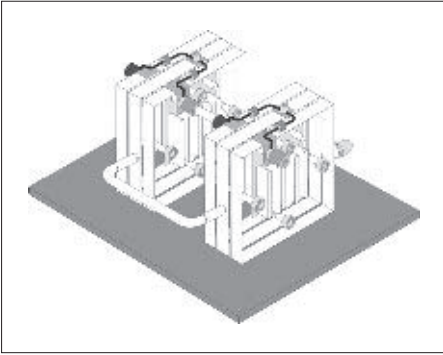


The Fuel Cell StaXX is a two-cell fuel cell stack. Using the black/red pole in the centre of the cell the voltages of the individual cells can be tapped off. For the first cell it is the positive pole and for the second it is the negative pole. The centre of the cell houses the hydrogen side of the two individual cells. The outer sides of the cell feature air vents for the supply of oxygen. The two indi-

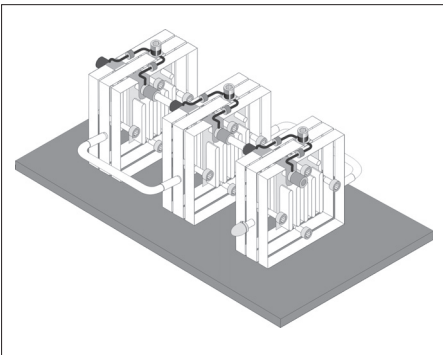
vidual cells are connected electrically in series.

The Fuel Cell StaXX can be extended to form larger stacks. Simply connect further Fuel Cell StaXX in series using the ConnectionSet StaXX (Item No. 3020, comprising a connecting pipe and an electrical connector).

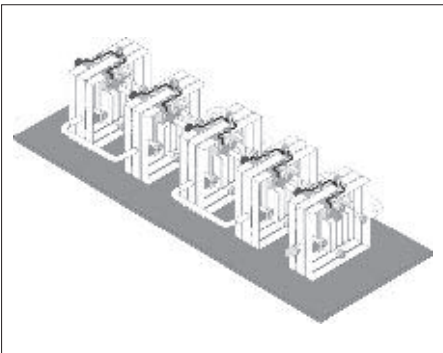
The following preassembled stacks are available:



Fuel Cell StaXX2 (Item No. 3002)

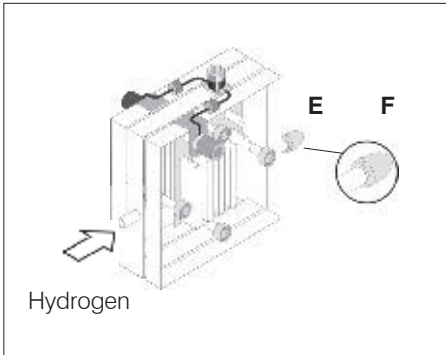
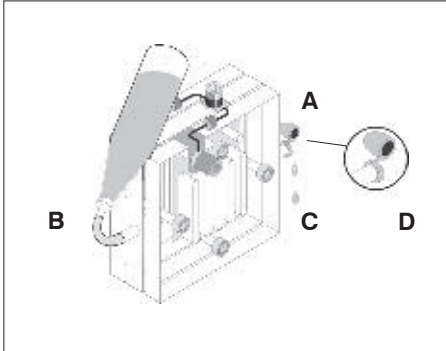


Fuel Cell StaXX3 (Item No. 3003)



Fuel Cell StaXX5 (Item No. 3005)

Operating Instructions



1. Read the General Safety Precautions.
2. Attach a rubber cap to the hydrogen outlet. Leave the cap open (A).
3. Pour distilled water into the hydrogen inlet (B) until it flows back out the hydrogen outlet (C) again.
4. Close the hydrogen outlet by the rubber cap (D).
5. Connect a hydrogen supply to the hydrogen inlet.
6. Carefully remove the rubber cap (E) from the hydrogen outlet.
7. Excess water flows out. Allow a little hydrogen to flow out in addition to the water, in order to flush out any contaminants present in the cell. Close the hydrogen outlet by the rubber cap (F).
8. Connect an electrical load or a multimeter to the positive terminal (“+”: red) and the negative terminal (“-”: black) of the fuel cell. The black/red pole in the centre of the cell can be used if you only want to use one cell of the two-celled fuel cell stack.
9. The equipment is now ready for operation and can be used for demonstrations or experiments. The moisture is initially distributed unevenly within the cells. Distribution improves progressively during operation, which leads to a continual improvement in the performance.

Strong impacts, such as a short circuit for several seconds, have a favourable effect on the water distribution which will result in a quicker improvement of performance.
10. Should the cell fail to deliver the desired performance, air has probably entered the hydrogen hose. Expel this air by opening the rubber cap briefly.

Important!

Should you require a higher output voltage, two DC/DC converters are available in the h-tec range:

StaXX 2 DC/DC Converter

Item No. 3042

Selectable output voltages:
4.5/6.0/7.5/9.0/12.0/14.0 V
suitable for Fuel Cell StaXX 2

StaXX 3 DC/DC Converter

Item No. 3043

Selectable output voltages:
3.0/4.5/6.0/7.5/9.0/12.0/14.0 V
suitable for Fuel Cell StaXX 3

Maintenance

Although fuel cells of the type used do not require any maintenance, you should:

- Use fresh, deionised water for each session.

Before putting the cell away:

- Connect a hose between the two hose sockets to ensure that a small amount of water remains in the cell.

Technical Data

	FC StaXX	FC StaXX 2	FC StaXX 3	FC StaXX 5
Item No.	3001	3002	3003	3005
H x W x D (in mm)	90 x 100 x 65	100 x 200 x 250	100 x 200 x 325	100 x 200 x 470
Weight	260 g	1.110 g	1.570 g	2.280 g
Electrode area (Number of cells x surface area)	2 x 16 cm ²	4 x 16 cm ²	6 x 16 cm ²	10 x 16 cm ²
Power	1 W at 1.0 V	2 W at 2.0 V	3 W at 3.0 V	5 W at 5.0 V
Generated voltage	0.8 - 1.92 V	1.6 - 3.84 V	2.4 - 5.76 V	4.0 - 9.6 V
Short-circuit-proof	yes	yes	yes	yes

Notes

