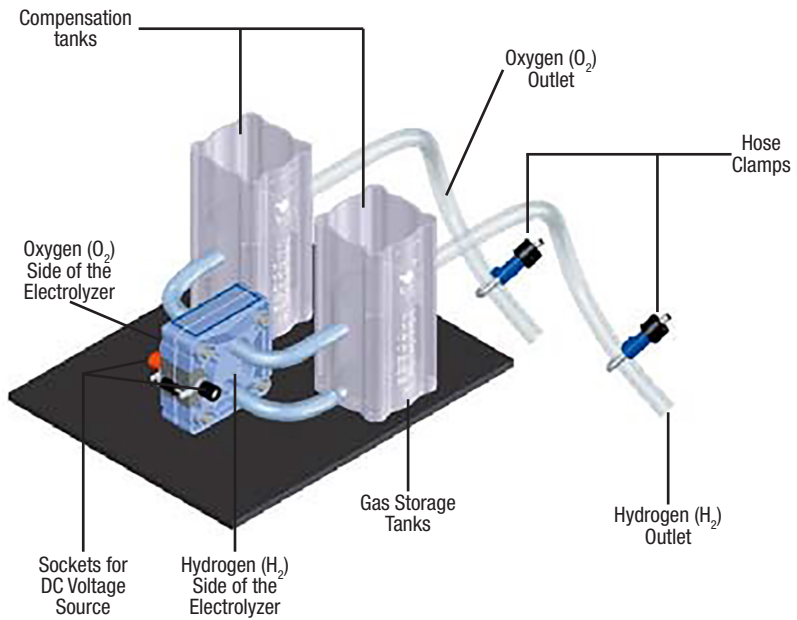


Operating Instructions



E101/E102 - Single Electrolyzer / Double Electrolyzer
E103/E104 - Single Electrolyzer Kit / Double Electrolyzer Kit

General Safety Precautions

- The units may only be set up and operated by a responsible supervisor.
- **WARNING!** Not suitable for children under 12 years old.
- Read the Operating Instructions before setting up the fuel cell. Follow them during use and keep them readily available for reference.
- The equipment may only be used with the H-TEC Education Solar Modules, H-TEC Education battery box, or H-TEC Education plug-in power supply.
- Wear protective goggles.
- Equipment and gases must be used and stored out of the reach of small children.
- Plug-in power supplies can be dangerous - they are not toys!
- Disconnect the unit from the plugin power supply and the solar module before cleaning with liquids.
- Unless instructed to the contrary by the manual, do not reverse or short-circuit the connecting terminals.
- The units must not be operated when empty. Always ensure that they contain sufficient water. Pay attention to the water level marks.
- Remove flammable gases, vapors or liquids from the area surrounding fuel cells and electrolyzers. The catalytic materials involved may cause spontaneous ignition.
- Hydrogen and oxygen may escape from the units. Operate the units in well-ventilated rooms to ensure that the gases do not accumulate and form explosive mixtures.
- The units may only be operated in display cases if adequate ventilation is guaranteed under all circumstances. The operator is responsible for ensuring this.

General Safety Precautions

- Remove from the vicinity of the units anything that could ignite the hydrogen (e.g. open flame, materials that can become charged with static electricity, substances with a catalytic action).
- Remove from the vicinity of the units all substances that could spontaneously ignite in increased oxygen concentration.
- Do not smoke.
- Hoses, plugs and gas tanks are used for pressure compensation. They must not be fixed or secured with clamps, adhesive, etc.
- Only use the gas storage tanks associated with or supplied with the units. Never connect alternative gas storage tanks.
- The units may only be operated at room temperature and ambient pressure.
- Minimum separation distances must be observed when using solar modules and artificial lights. These are: 30 cm between h-tec solar modules and the h-tec Videolight, and 50 cm in the case of the h-tec Spotlight. When using lights from other manufacturers, observe the minimum distance specified by them.
- **WARNING! 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 accepts no responsibility for injuries or damage sustained in the event that these Safety Precautions are not followed.

Starting Up

Introduction

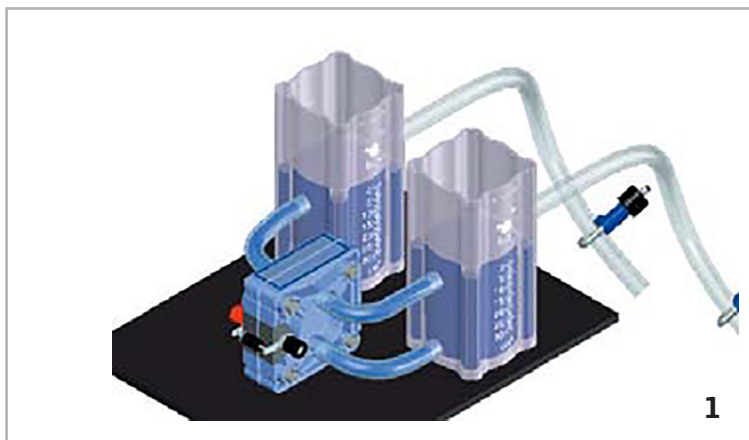
This PEM electrolyser (PEM = Proton Exchange Membrane) uses electricity to break down distilled water into hydrogen and oxygen.

Setting up

Read the Operating Instructions and the General Safety Precautions before using any of the equipment.

Note:

Single Electrolyzer Kit and Double Electrolyzer Kit are preassembled, so users of these products can skip to Number 3.

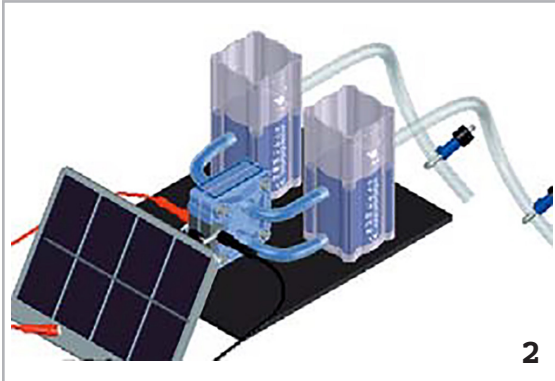


1. Use four hoses to connect the top and bottom connectors of the electrolyzer to the corresponding connectors on the electrolysis side of the gas storage tanks.
2. Fit hoses with hose clamps to the connectors on the fuel cell side of the gas storage tanks.
3. Fit hose clamps to the gas storage tank outlets and close them firmly.
4. Fill both storage tanks with distilled water up to the top mark and then open the hose clamps one after the other. Air will escape from the gas storage tanks and from the electrolyzer. The process is complete when the water level in the storage tanks stops falling (Fig. 1). Close the hose clamps once more.

Gas production/storage

This PEM electrolyser (PEM = Proton Exchange Membrane) uses electricity to break down distilled water into hydrogen and oxygen.

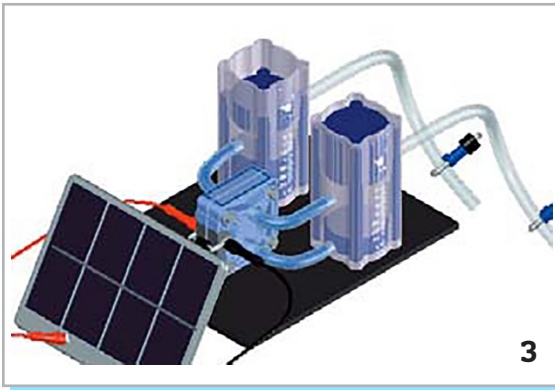
1. Connect a DC voltage source (e.g. solar module, H-TEC Education PowerSupply or BatteryBox). When doing so, make sure that the polarity is correct (red = "+", black = "-") and observe the maximum permissible voltage (Fig. 2).



Important:

The maximum permissible voltage for the Single Electrolyzer and the Single Electrolyzer Kit is 2 V, and for the Double Electrolyzer and the Double Electrolyzer Kit is 4 V.

2. The current breaks down the water into hydrogen and oxygen in a ratio of 2:1. The gases collect in the gas storage tanks and displace the water there into the compensation tanks



Warning:

Make sure that no gases can collect above the compensation tanks.

Emptying the storage tanks

1. Remove the hoses from the fuel cell side of the gas storage tanks and hold the storage tanks over a collecting tray as shown in Fig. 4 until they are completely empty.



Technical data

Single Electrolyzer (E101 & E103):

H ₂ Production:.....	10 mL/min @ 1 A
O ₂ Production:.....	5 mL/min
Maximum operating current:	1.5 A
Maximum operating voltage:	2 VDC
Electrode area:.....	3 cm ³
Guide value for distilled water:.....	<2 µS/cm
Permitted operating pressure:.....	0 - 20 mbar
Gas storage tanks (E101):	30mL H ₂ & 30mL O ₂

Double Electrolyzer (E102 & E104):

H ₂ Production:.....	30 ml/min @ 2.15 A
O ₂ Production:.....	15 mL/min
Maximum operating current:	3 A
Maximum operating voltage:	4 VDC
Electrode area:.....	6 cm ³
Guide value for distilled water:.....	<2 µS/cm
Permitted operating pressure:.....	0 - 20 mbar
Gas storage tanks (E102):.....	80mL H ₂ & 80mL O ₂

Troubleshooting

The electrolyzer does not produce hydrogen when the solar cell is connected.

Possible Cause:

- The light intensity is insufficient.

Solution:

- Check the power specifications of the light source. You must have sufficient sunlight or a halogen lamp with focused light. Energy saving lamps, fluorescent tubes, etc. are not suitable for the operation of solar modules.

Possible Cause:

- You are using a double-cell electrolyzer and are running it with a solar module for single cells.

Solution:

- Use the appropriate solar module - the Tutorial Double Solar Module (A118).

Despite being set up correctly, the electrolyzer does not work.

Cause:

- You have not used distilled water. The cell is permanently damaged.

Maintenance

The electrolyzers we provide in our sets are maintenance-free. The following points should be observed, though:

- Use freshly distilled water for each operation.
- After operation, remove the water from the gas storage tanks.

Disposal

Do not dispose of fuel cells and electrolyzers as general household waste.

 **WARNING**

Fire hazard from catalytic substances
The catalysts for the electrodes of fuel cells and electrolyzers promote burning when they come into contact with flammable substances.
Avoid contact with hydrogen, alcohol fumes or other organic fumes.
Ensure correct disposal.

According to European regulations, used electric and electronic devices may no longer be disposed of as unsorted household waste. The symbol of the crossed-out wheellie bin indicates the requirement for separate disposal.

Your local waste management company can provide you with additional information about disposal options.



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