



**MATHESON
TRI•GAS**

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Hydrogen Generator Model HPNM-1

Instruction manual



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Introduction

Scope of the manual

This manual provides operation and maintenance instructions for the following Chrysalis II HPNM Models: HYC-HPNM-100, HYC-HPNM-160, HYC-HPNM-250 and HYC-HPNM-500 hydrogen generators.

Specifications

Table 1 *Specifications of the different models of hydrogen generator*

Hydrogen flow rate	Model HPNM-100	0-100 cc/min at STP
	Model HPNM-160	0-160 cc/min at STP
	Model HPNM-250	0-250 cc/min at STP
	Model HPNM-500	0-500 cc/min at STP
STP	Standard temperature and pressure (STP) 68°F & 90 psig	
Weight (dry)	42 lbs.	
Power consumption	Model HPNM-100	90VA
	Model HPNM-160	115VA
	Model HPNM-250	160VA
	Model HPNM-500	300VA
Input voltage	110-230V / 50-60Hz	
Fuse	4A (5x20)	
Pressure accuracy	1.5 psig (± 0.5 %)	
Microprocessor controlled display	Graphic display, 128 x 256 pixels	
Index of protection	IP2x	
Operating conditions:	59°F to +95°F	
- Temperature	0-80% @ 87°F, decreasing linearly to 50% @ 95°F	
- Relative humidity	6,890 ft	
-Max Altitude		
Over voltage category	II	
Pollution degree	2	
Sound pressure level	46 dBA	
Case dimensions	8.6"W x 9.5"L x 16"H	

Notes on FCC compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING!

Any changes or modifications to this equipment not expressly approved by the manufacturer may void the user's authority to operate the equipment.

Correct use

The Matheson Tri-Gas Chrysalis II HPNM hydrogen generator is designed to produce hydrogen for laboratory use. The unit must only be operated for this purpose, according to the specifications and instructions provided in this manual. In particular, the following warnings must be observed at all times:

- Indoor use only
- Never operate the unit in freezing temperatures. This will cause irreversible damage to the electrolysis cell.
- Only use pure water (see "Filling the water tank")
- Only operate the unit in a room with sufficient ventilation (see "Placing the unit").
- Always unplug the unit from the main power supply before accessing the internal components for replacement.
- Only the parts described in the "Spare parts list" can be replaced by the user.

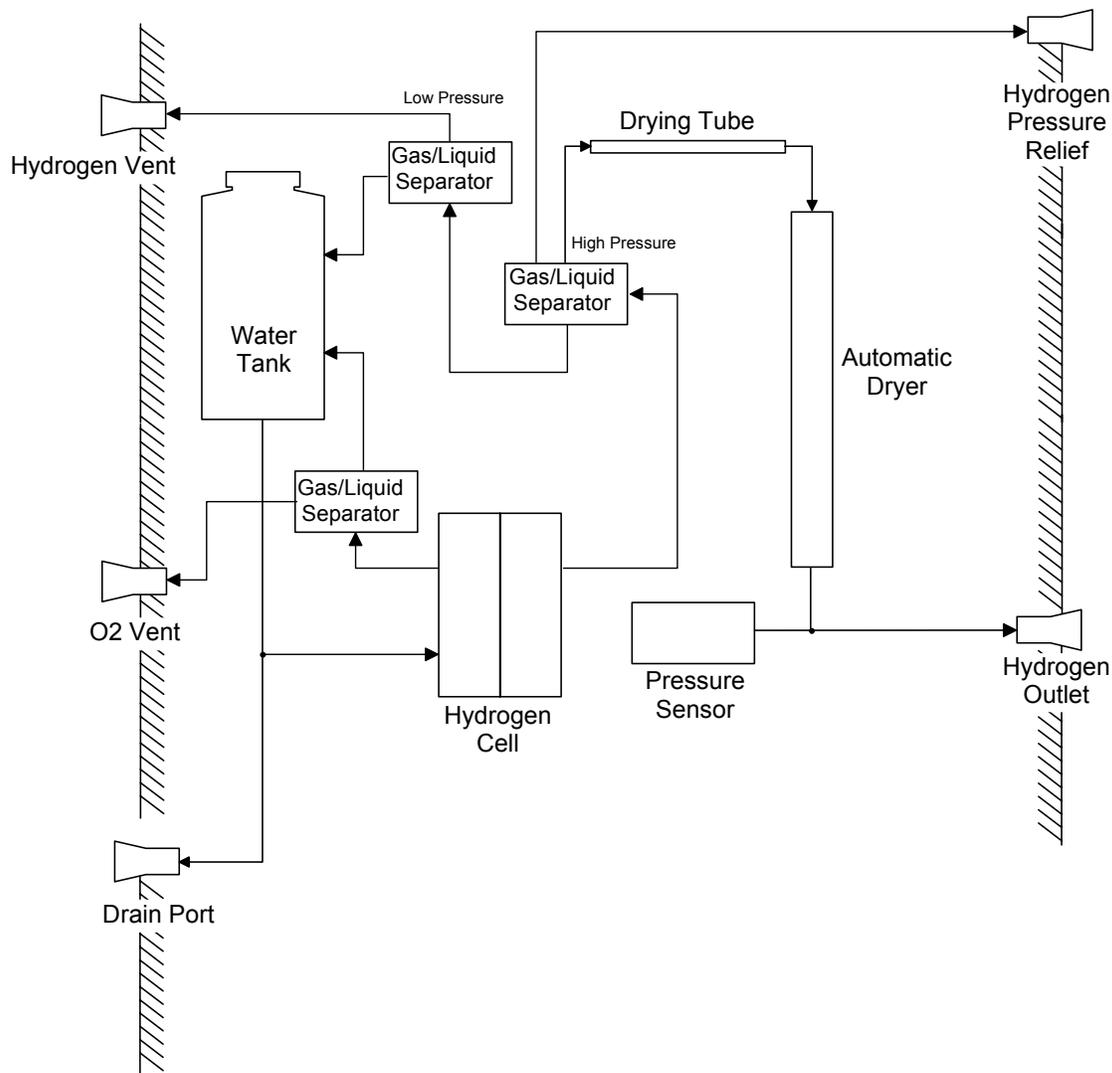
Packing list**Table 2** *List of items included in the shipment*

Quantity	Description
1	Hydrogen generator
1	Instruction manual
1	Deionizer bag
1	Water drain with flexible tubing
1	Power cable

Description

The hydrogen generator produces pure hydrogen (and oxygen as a by-product) by the electrolysis of water. The key element of the generator is an electrochemical cell assembly which contains a solid polymer electrolyte. No free acids or alkalines are used. De-ionized or pure, distilled water is the only liquid which may come into contact with the cell. As this is consumed it must be refilled from time to time as required.

The generated hydrogen gas is accumulated in the hydrogen/water separator and the desiccant housing. The pressure is controlled by a pressure transducer. The outlet pressure is indicated on the display. The hydrogen is dried by passing it through a drying tube and the automatic dryer. The hydrogen then passes through outlet port at the rear.



Installation

Receiving the generator

All units have been carefully inspected before transport. Visual checks for damage and functional tests should be performed upon receipt. Any damage must be immediately noted and reported. The generator must only be returned according to the shipping instructions provided.

Placing the generator

The hydrogen generator must be placed on a flat, level, vibration-free, shock-free surface. Do not place the generator over a source of heat, as this may cause the device to overheat. The unit should not be in contact with any other objects on any side, and the air inlet must not be blocked. **Leave at least 12" cm of free space at the rear for ventilation.** Do not operate the generator in a sealed or unventilated room, or in close proximity to open flame or other sources of ignition. Do not operate the generator at below freezing temperatures. Operation is guaranteed at operating temperatures between 45 and 95°F.

WARNING!

Normal precautions for any hydrogen supply should be taken when using the generator. DO NOT use in sealed or unventilated rooms. DO NOT use in close proximity of open flames or other sources of ignition.

Symbols used on the generator



Earth symbol:

This symbol marks the earth connections to the chassis of the hydrogen generator.

Gas connections

Pure dry hydrogen at regulated pressure is available at the hydrogen outlet port at the rear of the generator. This port must be connected to 1/8" tubing using a stainless-steel or copper Swagelok connector. Teflon connectors are not suitable. The pressure at this port is adjusted and shown on the display. The hydrogen relief port at the rear of the unit can be connected to an exhaust hood or other vent system.

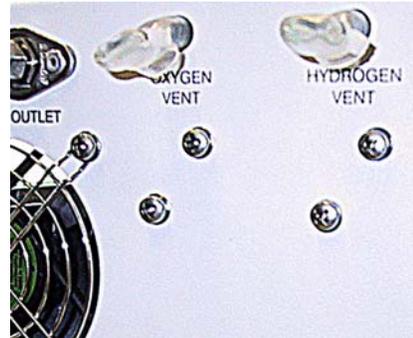
WARNING!

The line from the relief port should never connect in such a way that back pressure can develop.

IMPORTANT!

Remove the plugs from the oxygen vent and hydrogen vent before operating the unit.

Keep these plugs for transporting the unit.



Electrical connections

Check the setting of the voltage selector on the rear of the unit. The set voltage is indicated by the white arrow. To change the voltage, proceed as follows:

- Using a small screwdriver, remove the voltage selector insert.
- Replace the voltage selector insert so that the white arrow points to the correct voltage.

Remote connections (optional)

The hydrogen generators are fitted with an optional remote control feature, which allows the user to check the status of the machine from a remote position, and to start/stop the production of hydrogen.

The contacts used in the remote control are potentially free relay contacts. The contacts can be configured via software as normally-open or normally-closed (see the *Configuration* section). The maximum voltage and current ratings for the contacts are **1A / 48V**. The pin configuration of the remote connector is shown in the table below.

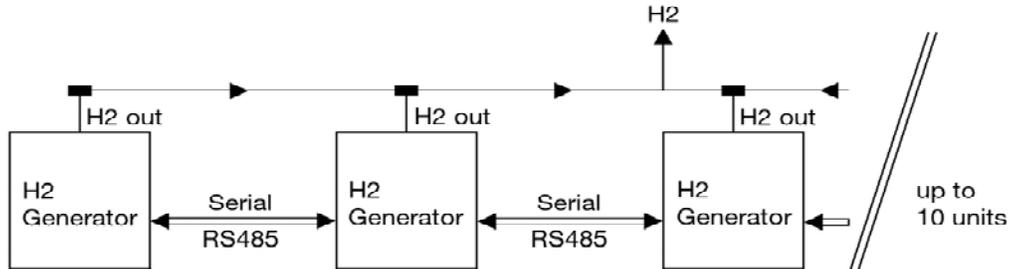
Table 3 Remote connector pin configuration

Pin	Description
1+2	Start (12-30 VDC polarity not important)
3+4	Standby (System not OK)
5+6	Reaching normal pressure (Overproduction)
7+8	Refill water (Low water)
09+10	Low water level (Too low water)
11+12	Bad water
13+14	Change water (Bad water pre alarm)

Cascading (Option)

The RS-485 interface allows up to 10 generators to be operated in parallel mode. One unit has to be defined as the master, while the others operate in “Slave” mode. All the slaves need to be configured with individual ID numbers. Communication between the generators requires a standard D-sub 9 pin serial cable. The serial ports are connected as follows:

Master RS 485 port 1 → Slave 1 RS 485 port 1 - Slave 1 RS 485 port 2 → Slave 2 RS 485 port 2



Configuration

For operation in cascading mode all generators must have an ID number. Each ID number is unique. The master unit must also have an ID number.

Configuring the Master

1. Go into the **configure** menu and set the **master** to NO.
2. Go into the **number of slaves** menu and set the number off units connected to the master.
3. Go into **slave ID number** and set the desired value.
4. Go back to **master** and set the value to yes

Configuring the Slaves

1. Go into the **configure** menu and set the **master** to NO.
2. Go into **slave ID number** and set the desired value.

The configuration is now complete.

Operating in Master-Slave Mode

If the configuration and the serial connection are correct, the slaves will show “Slave Mode” when powered up.

Connect the gas outlets of all the generators to the same line.

IMPORTANT!

The cascading function will only work properly if the gas outlets on all the generators are connected to the same gas line.

Initial start-up

Filling the Deionized Water Reservoir (Tank)

To fill the hydrogen generator with deionized water, remove the “black” plug under the sliding arm at the top of the unit. Carefully fill the tank with deionized water to within $\frac{1}{2}$ ” of the “MAX” level indicator located at the sight glass on the front of the hydrogen generator. Move the sliding arm to close the opening of the tank.

The conductivity of the water used in the generator must not exceed $2\mu\text{S}$.



WARNING!

Do not fill the water tank higher than the marked "max" level.

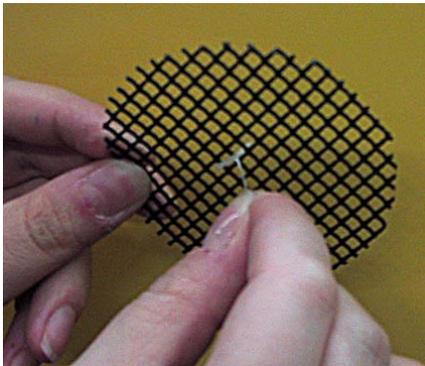
CAUTION!

To prevent contamination of the cell assembly, it is important to use only deionized water in the generator. Water containing metallic impurities will contaminate or damage the cell, and will void the warranty.

Installing the deionizer bag

After having filled the tank with water, the deionizer bag (supplied) must be placed in the tank. Inspect the bag thoroughly for holes or tears, indicated by loose deionizer beads on the outer surface. If the bag is damaged in any way, discard and replace it with a new one. Only use original parts (see *Spare Parts*). Wash the deionizer bag in deionized water before proceeding.

Insert the free end of the "T" fastener through the hole in the centre of the water filler cap, until it is securely fastened. The bag should not block the outlet at the bottom of the tank. Once in place, the bag should not be allowed to dry out.



Operation

The operating status of the unit is shown on the main screen on the graphic display.

The main screen has three options at the bottom, corresponding to the three buttons on the unit, which are used to run the various functions and access the configuration and diagnostics of the unit, following the tree structure shown in the figure below.

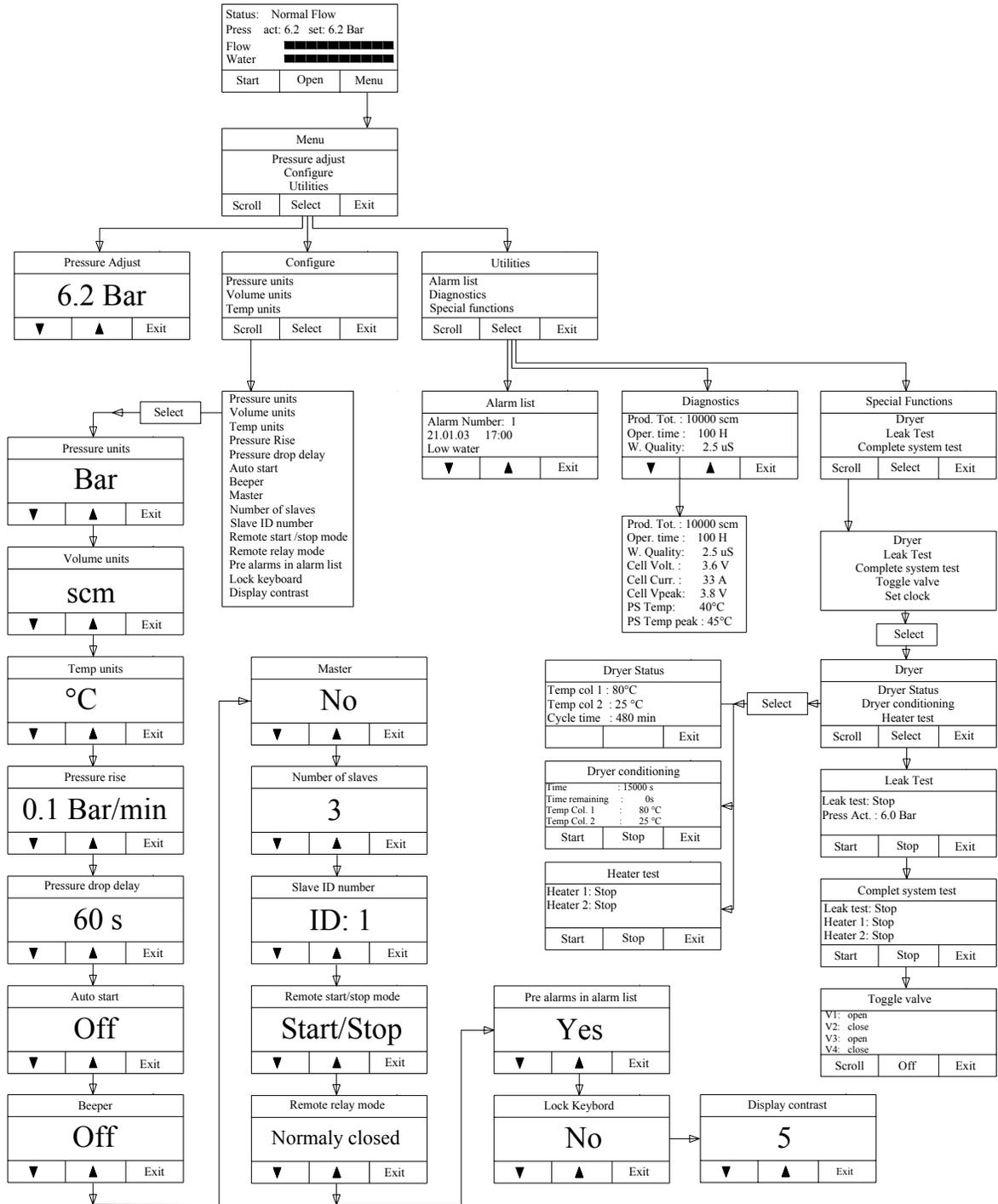


Figure 1 *Menu tree for the operation of the unit*

Configuration parameters

Item	Description	Options / Range	Default
Pressure units	<i>Sets the desired unit of measure for the pressure</i>	bar / psi / kPa	bar
Volume units	<i>Sets the desired unit of measure for the volume</i>	scm (standard cubic meters) scf (standard cubic feet)	scm
Temp. units	<i>Sets the desired unit of measure for the temperature</i>	°C and °F	°C
Pressure rise	<i>Sets how fast the pressure has to increase. If the pressure increases at a slower rate, a low pressure alarm is activated.</i>	0.1 - 1 bar/min 1.4 - 14 psi/min	0.1 1.4
Pressure drop delay	<i>Sets a delay in seconds to ignore a pressure drop (override low pressure alarm)</i>	0 - 60 s	60
Auto start	<i>Sets whether the unit automatically starts production when power is switched on.</i>	YES / NO	NO
Beeper	<i>Sets whether the audible signal is activated in the event of an alarm.</i>	ON / OFF	ON
Master	<i>Configures the unit as the Master for cascading operation</i>	YES / NO	NO
Number of slaves	<i>Enter the number of slaves connected to the master</i>	0 - 32	0
Slave ID number	<i>Sets the slave ID number</i>	0 - 32	0
Remote start/stop mode	<i>Configures the remote start/stop function</i>	Start/stop, Start only, Direct control	start/stop
Remote relay mode	<i>Configures the remote relay contacts.</i>	Normally open (NO) Normally closed (NC)	NC
Pre alarms in alarm log	<i>If set to Yes, the pre alarms are also shown in the alarm log.</i>	YES / NO	NO
Lock Keyboard	<i>If set to Yes, the keyboard will be locked automatically after the generator is in the main window for more than 20s. To unlock the keyboard, press the unlock button and hold for 5s.</i>	YES / NO	NO
Display contrast	<i>Adjusts the contrast of the display.</i>	0 - 10	5

Diagnostic display

Item	Description	Max.
Production Tot.	<i>Total production of hydrogen</i>	99.999 scf 4000.00 scm
Operating time (h)	<i>Total number of hours the unit operation</i>	99.999 hours
Wat. quality (μS)	<i>Actual water conductivity</i>	-
Cell current (A)	<i>Actual cell current</i>	-
Cell voltage (V)	<i>Actual cell voltage</i>	-
Cell voltage peak (V)	<i>The maximum cell voltage in the life of the cell</i>	-
PS. temp. (°C)	<i>Actual temperature of the power supply</i>	-
PS. temp. peak (°C)	<i>The maximum temperature of the power supply reached</i>	-

Special functions

Item	Description
Dryer	<i>Accesses the dryer functions (see below)</i>
Dryer status	<i>Shows the temperatures of the drying columns and the position of the cycle</i>
Conditioning	<i>When the conditioning cycle is started, the dryer performs 4 fast cycles. During this time the output valve is closed.</i>
Heater test	<i>The heater has to show a reaction of 10°C to pass the test</i>
Leak test	<i>The outlet valve is closed, the pressure is set to the max., when the pressure reaches the max., production is stopped and the pressure drop is measured over 1 minute. If the pressure drop is below the preset value, the test is passed. Important: The leak test will only work if the generator is in standby mode.</i>
Complete system test	<i>Combination of leak test and heater test</i>
Toggle Valve	<i>Used to switch the valves manually (for advanced diagnostics only) Important : after exiting this window, the valves will return to the status prior to entering the window</i>

Normal Display

Item	Description
Start/Stop	<i>Starts/Stops the production of hydrogen</i>
Open/Close	<i>Opens/Closes the hydrogen supply valve</i>
Menu	<i>Accesses the "Pressure Adjust", "Configure" and "Utilities" menus</i>

Maintenance

With proper care and maintenance, your hydrogen generator should provide you with years of trouble-free operation. There are no adjustments to be made to the generator. The only routine service operations are those described below.

Nonetheless, the generator should be inspected approximately every 2 years. Contact your supplier or Matheson Tri-Gas directly.

Routine maintenance

The following section describes the maintenance operations required for the correct operation of the hydrogen generator.

Cleaning

The internal components of the hydrogen generator do not need to be cleaned and should not be accessed by the user for cleaning. To clean the outside of the unit, only use a damp cloth (no detergents, acids or aggressive or abrasive substances).

Water refilling

The tank must be refilled when the water level approaches the lower level, and the **Refill Water** pre-alarm message appears.

Deionizer bag replacement

Rinse the water tank and replace the deionizer bag approximately **every six months**, or whenever the **Change Water** message appears.

Installing the new deionizer bag

See page 11 (see *Installing the deionizer bag*)

Returning the unit

In the event of any faults or damage, first notify the agent or distributor who supplied the unit. If this is not possible, inform Matheson Tri-Gas directly. Please also provide full details of the problem, including the model and serial number. Instructions will then be provided for the service or the return of the unit. Only if return authorization is provided by Matheson Tri-Gas as per these instructions, will the device be received and repaired by Matheson Tri-Gas. If the one year warranty has expired, or the fault is due to misuse of the unit, all repair and shipping costs are to be paid by the customer. All other costs are borne by the customer, except as otherwise expressly agreed upon.

WARNING!

*If the unit has to be transported, make sure that the water tank is **completely** empty, and place the plug (supplied with the unit) on the oxygen vent at the rear of the unit. Close the water tank with the cap. Use suitable packaging.*

The unit should be transported in an upright position; this warning should be reported on the outside of the packaging.

Spare parts list

The table below provides a list and description of the replaceable parts of the hydrogen generator. Please also refer to the corresponding figures.

Table 4 *List of replaceable spare parts*

Part Number	Description
DI-BAG	Deionizer bag

IMPORTANT!

The manufacturer reserves the right to change or modify its products without prior notice.