

PH User Manual



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Change History

Rev.	Comment	Name	Date
1	Document Created	JMK	28/8/08
2	Top fascia removal pg 14, Max Relative Humidity pg 7	JMK	17/02/09
3	Power rating added to technical specification pg 7.	JMK	14/05/09
4	Water condition recommendations added pg 6 & 13	JMK	23/07/09
5	Current rating added pg 7	JMK	24/02/10
6	Layout updated	DR	24/06/10
7	Updated office list	LC	27/01/2011

Warranty Statement

The Company warrants that it has title to the Goods.

Subject to the provisions of this clause the Company warrants that the Goods shall comply in all material respects with any specification referred to in the Order Confirmation (as the same may be amended) and shall, subject thereto, be free from defects in material and workmanship for the lesser of a period of twelve months from the date of delivery or thirteen months from the date of dispatch from the factory.

Save as provided in this clause and except where the Goods are sold to a person dealing as a consumer (within the meaning of the Unfair Contract Terms Act 1977) all warranties, conditions or other terms implied by statute or common law are hereby expressly excluded save to the extent they may not be lawfully excluded. When the Goods are sold to a consumer within the meaning of the Unfair Contract Terms Act 1977 their statutory rights are not affected by the provisions of this clause.

In the event of the Customer making a claim in respect of any defect in terms of clause 2 hereof the Customer must: -

- Reasonably satisfy the Company that the Goods have been properly installed, commissioned, stored, serviced and used and without prejudice to the generality of the foregoing that any defect is not the direct or indirect result of lack of repair and/or servicing, incorrect repair and/or servicing, use of wrong materials and/or incorrect spare parts; and
- Allow the company to inspect the Goods and/or any installation and any relevant packaging as and when reasonably required by the Company.

Subject to the Company being notified of any defect as is referred to in sub-clause 2 hereof within a reasonable time of it becoming apparent and subject always to the terms of sub-clause 4 hereof, the Company shall, in its option, replace or repair the defective Goods or refund a proportionate part of the Price. The Company shall have no further liability to the Customer (save as mentioned in sub-clause 6 hereof).

The Company shall be liable to indemnify the Customer in respect of any claim for death or personal injury to any person in so far as such is attributable to the negligence or breach of duty of the Company or any failure by the Company to comply with the provisions of sub-clause 2 hereof.

Save as provided in sub-clause 2 hereof the Company shall not be liable in respect of any claim by the Customer for costs, damages, loss or expenses (whether direct, indirect, consequential or otherwise) or indemnity in any respect howsoever arising including, but not by way of limitation, liability arising in negligence (other than pursuant to clause 6 above) that may be suffered by the Customer or any third party.

Safety Notice to Users

These instructions must be read thoroughly and understood before installation and operation of your Peak Hydrogen Generator. Use of the Generator in a manner not specified by Peak Scientific MAY impair the SAFETY provided by the equipment.

When handling, operating or carrying out any maintenance, personnel must employ safe engineering practices and observe all relevant local health and safety requirements and regulations. The attention of UK users is drawn to the Health and Safety at Work Act 1974, and the Institute of Electrical Engineers regulations.

ATTENTION - IMPORTANT NOTICE TO ALL USERS

These instructions must be read thoroughly, section by section and understood before installation and operation of your Peak Scientific Hydrogen Generator. Please follow the appropriate safety standards for handling hydrogen gas and other gases as determined by the laws and regulations of your country.

Please save the product packaging for storage or future shipment of the generator.

1. For your own personal safety and to prevent accidental damage to your generator please ensure that you read and understand our Directions for Use Manual.
2. Do not store away the generator when not in operation. The generator should be powered up at least twice a month and a small flow taken for 1 hour. It is recommended that you replace the water monthly to prevent biological growth developing in the tank and tubing. Failure to do this will greatly reduce the life of the generator and render the warranty void.
3. Do not place the external water bottle above the height of the generator. The bottle may be placed at the same level or below the generator.
4. Use only high grade de-ionised water ($1\mu\text{S}/\text{cm}$ or better). Do not attempt to connect pressurised water to the generator.
5. It is recommended that you operate the generator at the lowest pressure permissible for your particular application. Do not automatically set the pressure to maximum if not required.
6. Failure to maintain the Deioniser Bags and Silica Gel as recommended will reduce the operational life of your generator and render its warranty void.

7. Do not attach any additional tanks or gas cylinders to your generator without first consulting Peak Scientific.
8. Ensure your entire installation, both pipe work and analysers, are completely gas tight. Even minor leaks will affect the operation of your generator and generally reduce its operational life.
9. Has your generator been correctly sized for your application? If in doubt, consult your dealer or Peak Scientific.
10. Ensure the ambient temperature inside your laboratory does not rise above 25°C. Extremes of operating temperature will reduce cell life.

IMPORTANT - Please ensure that all original packaging is kept in case the generator has to be returned. In event of shipping generator please ensure the TRANSPORT PIPE (located at rear) has been fitted.

Technical Specification

	PH200	PH300	PH600
Mass Flow Rate (cc/mm)	200	300	600
Purity (%)	99.9995		
Delivery Pressure (PSI / Bar)	0-100 / 0-6.9		
Gas Flow Indicator	10 Element LED Separation Tank Window		
Dual Pressure Safety	Yes		
Leak Detection	Yes		
Water Purity Requirement	<1.0 μ Siemens/cm OR >1Mohm-cm		
Outlet Port	1/8" OD Tubing		
Dimensions	310 x 490 x 410mm		
Weight	25Kg		
Maximum Relative Humidity	70%		
Operating Temperature	Min 10°C Max 25°C		
Electrical Requirement	115V 50/60 Hz 230V 50/60 Hz		
Current Rating	3.6A		
Power Rating	PH200	PH300	PH600
	340W	340W	460W

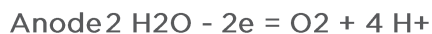
Principle of Operation

The Peak Scientific Hydrogen Generator uses an ion exchange membrane that is extensively used in industrial and laboratory applications. The reliability of this type of membrane is assured as it was originally developed for NASA. To produce the highest purity of hydrogen that an analytical laboratory requires, Peak Scientific employ the services of a platinum catalyst in the electrode area.

Electrolysis of water is the best method of producing high purity hydrogen on demand. The most important element of the generator is the electrolyser cell where the electrolysis reaction takes place. This consists of two electrodes (an anode and a cathode), which are separated by the ion exchange membrane.

When a continuous voltage is applied to the electrodes on the electrolyser cell, the following reactions take place: -

At the anode (the positively charged electrode), the water molecules lose two electrons forming an oxygen molecule and four hydrogen ions.



The oxygen that is produced in this half of the reaction is safely vented to atmosphere at the back of the generator. The four hydrogen ions that have been produced then pass through the ion exchange membrane (attracted by the negatively charged cathode) and collect four electrons reducing them to two hydrogen molecules.



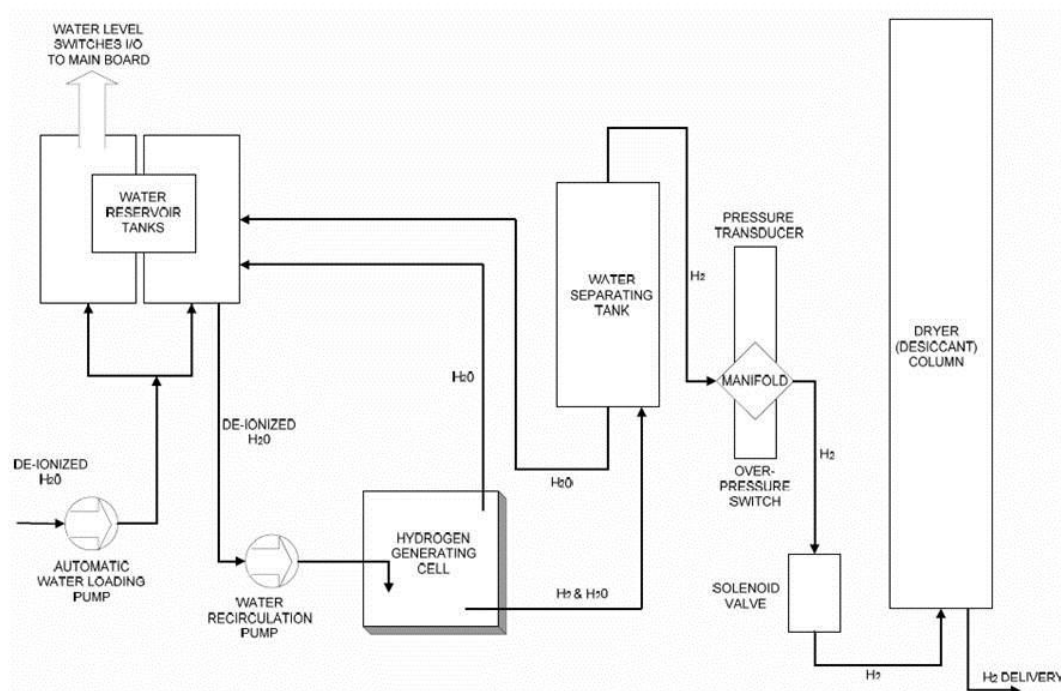
The hydrogen produced is separated from the oxygen by the ion exchange membrane, which is impervious to molecular oxygen. Deionised water is the raw material of the system and must have a purity of 1µs/cm or better to prevent damage to the membrane.

Failure to use this grade of deionised water will invalidate the warranty of your generator.

The water is automatically loaded (either at power-up or periodically during operation) and the rate, at which the water is consumed, depends on the amount of hydrogen used - 1cc of water produces 1244cc of hydrogen. Some electrical energy is lost as heat, which is removed from the generator by the ventilation system.

Hydrogen is generated only on demand and the amount of gas produced is controlled electronically by the amount of current applied to the Cell. By maintaining the user's preset pressure and using this as a reference value, the generator will produce the exact amount of hydrogen required. As soon as the demand from the consuming application stops, then no gas is generated and the generator will maintain the supply lines at the preset pressure.

System Schematic



General Safety

The construction of the PH series generator conforms to CEI / OSHA regulations as they do not store any appreciable amount of hydrogen internally. The generator only produces gas when the application places a demand on the unit. The unit also meets the European Electromagnetic Compatibility and Low Voltage Directives. The Generator is CE approved and has the CE mark attached.

The **maximum** quantity of hydrogen stored in the generator at any one time is 250cc at a pressure of 6.9bar (100psi). This means that the Hydrogen Generator can be safely installed in your laboratory and does not classify the surrounding area as dangerous.

All the PH series hydrogen generators have the necessary control circuitry, both electrical and mechanical, to ensure the shutdown of the instrument in the event of a fault or faults occurring.

Generator Safety Features

The PH series hydrogen generator has the following safety features to ensure safe and reliable operation:

1. To avoid any build up of hydrogen from leaks inside the unit; the generator features forced air ventilation. This ensures that a hydrogen / oxygen mixture cannot form inside the generator.
2. On power-up the generator self checks for internal leaks and if required it will shutdown at the end of the System Check informing the operator with a visual alarm.
3. The generator will detect any hydrogen leaks that occur within the generator, the user's application and gas lines. In the event of a major leak the generator will automatically shutdown within 20 minutes.
4. The hydrogen pressure inside the generator should only reach a maximum of 6.9 bar (100psi) and this is controlled in two ways:
 - a. Gas pressure is monitored and controlled electronically by a pressure sensor
 - b. A mechanical pressure switch (Fail Safe) will electronically isolate the entire generator should the internal pressure reach 7.5 bar (110psi)
5. When the generator is in alarm status the following occurs:
 - a. The current to the cell is stopped so no hydrogen is generated therefore preventing a hazardous situation.
 - b. The delivery valve is open allowing the unit to depressurise.
 - c. An audible and visual alarm relevant to the fault condition is displayed. The generator can sense for internal and external leaks, excessive gas demand and lack of water from an external source.

Unpacking & Contents

Although Peak Scientific takes every precaution with safe transit and packaging, it is advisable to fully inspect the unit for any signs of transit damage.

Any damage should be reported immediately to the carrier and Peak Scientific or the distributor from whom the unit was purchased.

If possible, unpack the generator and allow to stand at room temperature for a few hours. This will allow any condensation that may have formed during transportation to evaporate from inside the generator.

Contents

Each shipping box should contain the following: -

Hydrogen Generator

Power Cord

1.5m (6 ft) Length of Tygon (use as Water Feed Hose)

Barbed Water Inlet Fitting

Instruction Manual

Inner cap and deioniser bag (to be fitted in water tank during installation).

Four spare Deioniser Bags (1 year supply)

1/8th inch Swagelok Blanking Plug

Desiccant Cap Tool

Installation

Location

The generator should be located on a flat surface for operation - this will ensure that the water level sensors within the unit operate correctly. Some components in the generator produce heat during operation and therefore an adequate airflow must be maintained around the generator to allow the ventilation system to perform efficiently. The rear of the generator will become warm to the touch during operation - a minimum clearance of 15 cm (6") from other bodies is recommended. Do not locate the generator in a sealed or unventilated room, or in close proximity to any ignition sources.

Caution - Remove Transport Pipe

Before installation, remove the transit pipe fitted to the vent ports at the rear of the generator. Do not obstruct or connect the vent ports to any application. Failing to observe this could lead to permanent damage of the generator.

Install inner cap and deioniser bag in the water tank.



Transit Pipe

Remove circular hatch on top of generator, remove water tank cap and insert the inner cap which comes with a deioniser bag.

Do not expose the unit to freezing conditions. Please adhere to the operating temperatures below:

Recommended Operating Temperature

Extremes of operating temperature should be avoided in your laboratory, as these will reduce the operating life of your generator

Minimum Operating Ambient Temperature: 10 °C (50 °F)

Maximum Operating Ambient Temperature: 25 °C (77 °F)

External Connections

To prevent sudden de-pressurisation when the generator passes SYSTEM CHECK, please ensure that the Generator is connected to your application before Switch ON.

Connect an external supply of deionised water to the external water bottle using the supplied tubing. A single charge of water to the internal tank will produce over 300 litres of hydrogen. Water loading takes place automatically by means of a water pump located within the generator.

Ensure that only Deionised Water is supplied to the Hydrogen Generator. Under no circumstances attempt to connect ordinary tap water or caustic solutions to the generator.

The deionised water used must have a conductivity of less than or equal to $1\mu\text{S}/\text{cm}$ at 20°C . Use of water in the unit with a purity of less than specified will result in a lower efficiency of hydrogen production and failure of the generator. As a consequence use of impure water will void the manufacturers warranty in place at the time of purchase of the unit.

Ensure water used is free of foreign bodies or biological growth – it is recommended that you drain the generator and replenish with new water if there is any evidence of this in the tanks. Failing to do this will result in cell failure and will void the manufacturer's warranty. Details on how to drain the generator can be found on page 19.

Connect the Hydrogen Output of the Generator to your application. To ensure the best purity and to avoid the ingress of moisture and oxygen, please use Teflon or Stainless Steel tubing. Ensure that the outlet fitting is gas tight to prevent leaks.

NOTE:

If the generator is on the same line as a gas cylinder, fit a non-return valve close to the outlet of the generator. This will prevent damage to the generator should excessive cylinder pressure come on line.

Connect the generator to a suitable power supply as per the voltage written on the serial plate.

If the generator is installed in a confined area, the ports on the rear of the unit marked "Hydrogen Vent" and "Oxygen Vent" can be connected to an exhaust hood or vent system by using 1/4" OD tubing

NOTE:

The hydrogen and oxygen vent ports must not be obstructed in any way in order to prevent back-pressure developing in the internal water tanks,

Maintenance

All maintenance activities should be performed by suitably trained personnel. Ensure that the generator is disconnected from the mains supply and all internal gas pressure has been released.

The routine maintenance required for the Peak Hydrogen Generator is limited to:

- Replacing or regenerating the silica gel desiccant when indicated by the change in colour from **orange/yellow** to **green**.
- Replacing the deioniser bag inside the generator

The above parts should be replaced at the following intervals:

Silica Gel Desiccant:

Depending on model size and the gas consumption of your application the desiccant will require changing every two to eight weeks.

Deioniser Bag:

Ensure the deioniser bag is changed every **three months**. The generator is supplied with 4 bags (1 years supply).

Replacement of Silica-gel

When the silica gel is saturated, the generator should be switched off and sufficient time allowed for the hydrogen delivery lines and desiccant column to depressurise. This process can be speeded up by gently loosening the hydrogen connection at the rear of the generator to allow the gas to escape.

To replace the desiccant material: -

1. Depressurise the generator.
2. Power down generator.
3. Remove top fascia - slide to front (fig1).
4. Remove the Outer Column Hex Lid - **use tool provided to assist removal** (See fig. 2)
5. Remove the Desiccant Cartridge.
6. Discard the saturated silica gel (green).
7. Replace with new or regenerated silica gel (orange).
8. Insert the Desiccant Cartridge back into the column.

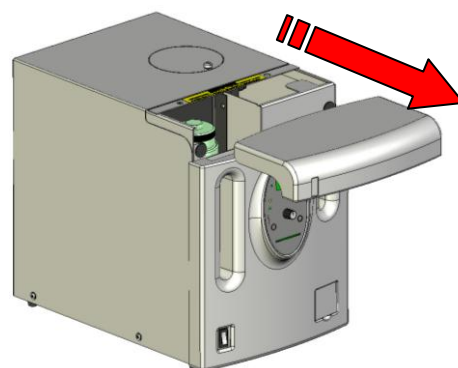


Fig 1



Fig 2

9. Refit Outer Column Lid (use tool provided).
10. Replace and secure the top fascia.

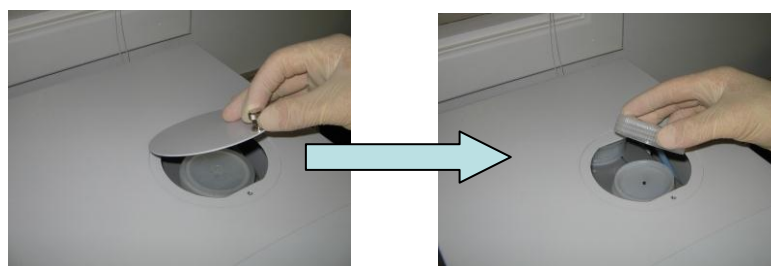
Replacing the Deioniser Bag

The Deioniser Bag is used to minimise the amount of impurities inside your Generator. It will **NOT** protect your Generator against low quality water.

To change the Deioniser Bag:

1. Depressurise fully and switch the generator off.
2. Isolate the mains AC power supply.
3. To avoid possible contamination wear **powder free** disposable gloves.
4. Remove the circular hatch on top of the lid of the generator and the Outer Plastic Lid of the Water Tank.
5. Carefully remove the Inner Plastic Cap with attached Deioniser Bag
6. Fit a new Deioniser Bag into the hole of the Inner Plastic Cap and then fit the Deioniser Bag and Cap back onto the Water Tank.
7. Replace Outer Plastic Lid of Water Tank and secure the circular hatch.

Please record and date each regular changing of the Deioniser Bag as evidence that your Generator is being properly maintained.



1. Remove hatch

2. Remove water tank cap
for access to deioniser bag

Health & Safety Data - Silica Gel

This sheet to be retained by the 'Health & Safety Officer'

The recipient of this Health & Safety Data sheet is required to ensure that all personnel handling, using or likely to come into contact with the material are made aware of the Health & Safety information contained herein.

Important Note

This hydrogen generator incorporates *Envirogel* as a non-hazardous alternative to Blue Cobalt Chloride Silica Gel. *Envirogel* is Silica Gel but contains a different chemical used to visibly indicate the saturation level.

The *Envirogel* will change from an **Orange/Yellow** colour when active to a **green** colour when saturated. It can be **regenerated** in an oven similar to "Blue Silica Gel" but the **reactivation** temperature must not exceed 110°C max.

Either the "Blue" or "Envirogel" Silica gel can be used in this hydrogen generator.

Trade Names

Silica Gel, standard silica gel, desiccant silica gel, Beaded Silica Gel, Tell-tale Silica Gel, Self-Indicating Silica Gel.

Grades

Ideal: 3-5mm diameter, Allowable: 2-5mm diameter.

Chemical Name

Envirogel - orange/yellow to green Indicating Silica Gel.

Appearance

Indicating Grade:-Orange/yellow granules or beads of Envirogel silica gel containing 112926-00-8 amorphous silica 98.2% (SiO₂), and activated colouring agent 0.2% max. The *orange/ yellow* colour turns to *green* after exposure to water vapour.

Non-indicating Grade: - White translucent granules or beads of hydrated silica gel.

Physical/Chemical Properties

Melting point	>1000°C
Boiling Point	>2000°C
Bulk Density	720kg per cu meter (typical)
Flash Point	Not applicable
Explosion Limits in air	Not applicable
Auto ignition	Not applicable

Exposure Limits

Data obtained from Guidance Note (manufacturer data sheet), Silica amorphous, total inhalable dust: UK EH40: OES 6mg/m³ 8h TWA. Silica amorphous, respirable dust: UK EH40: OES 2.4mg/m³ 8h TWA.

Silica Gel: ACGIH: TLV 10 mg/m³ 8h TWA. Activation agent: ACGIH: 0.5mg/m³ 8h TWA.

Hazards & Precautionary Measures

Fire

Non-flammable. Earth containers electrically when pouring to prevent static electric spark.

Inhalation

Envirogel has little adverse effect on the lungs and does not produce significant disease or toxic effect when exposure is kept below the permitted limits. However existing medical conditions may be aggravated by exposure to dust.

Ingestion

This material should not be taken internally. It may cause irritation in the mouth and digestive traces owing to an increase in temperature caused when silica gel is in contact with moisture. If ingested consume copious amounts of cold drinking water and seek medical advice.

Always wash hands before handling foodstuffs.

Skin & Eyes

Silica Gel is very absorbent and may have a drying effect on skin and eyes. An increase in temperature occurs when the product is in contact with moisture droplets. May cause irritation to skin and eyes. Wear adequate eye protection and gloves when handling large quantities. If eye contact occurs, wash with copious amounts of cold water and seek medical advice.

Protective Measures

Sensible handling to prevent the creation of dust and spillage. Ventilate enclosed areas when handling. Gloves, dust masks, goggles and overalls should be worn to minimise contact. Barrier creams may avoid irritation of exposed areas.

First Aid

See above. Wash affected parts with copious amount of cold water. Change protective clothing. If ingested seek medical advice.

Health & Safety Data - Deioniser Resin Bags

This sheet to be retained by the 'Health & Safety Officer'

The recipient of this Health & Safety Data sheet is required to ensure that all personnel handling, using or likely to come into contact with the material are made aware of the Health & Safety information contained herein.

General Description

Bag containing ion exchange resin. 60% Cation and 40% Anion by mass.

Chemical Components

Polystyrene divinylbenzene cation and ion exchange resin.

Form	Solid beads
Flash Point	N/A
Colour	Tan
Ignition Temperature	427 °C (Estimated)
Odour	None
Explosion Limits	N/A
Decomposition Temperature	Over 220 °C
Melting Point	0 °C (In water)
Boiling Point	100 °C (In Water)
Vapour Pressure @ 25 °C	17mm CFH @ 20 °C (Water)
Viscosity @ 25°C	N/A
Solubility in Water	Negligible
Specific Gravity @ 25°C	1.1-1.3
pH @ 25 °C	7-9.5 in aqueous slurry
Eye Protection	Safety Glasses (BS2092C)
Storage	Store in a cool place above 0 °C, out of direct sunlight
Fire & Explosion Hazards	Toxic combustion products may include sulphur dioxide and sulphur trioxide
Disposal	This product can be disposed as ordinary waste if local regulations permit

Emergency & First Aid Procedures

Spillages

Floor may be slippery. Use care to avoid falls. Wear protective glasses.

Sweep up and transfer to containers for recovery and disposal.

Extinguishing Media

Carbon Dioxide (CO₂), Water Fog and Dry Powder.

Fire Fighting and Protection

Wear HSE approved, pressure demand, self-contained breathing apparatus or equivalent.

First Aid

Skin Contact

Wash effected areas with soap and water. Consult doctor if irritation persists.

Eye Contact

Product can cause severe eye irritation. Flush eyes with large amounts of water for at least 15 minutes. Consult a doctor if irritation persists.

Inhalation

This product should present no hazard if operated under normal conditions. If irritation persists, move patient to fresh air.

Ingestion

If resin has been confined to the mouth, administer 250 ml. of water as a mouthwash. Avoid swallowing. This product is considered non-hazardous if ingested in small amounts; however, it is advisable to seek medical advice.

Toxicological Data

No toxicity data available on this product

Occupation exposure limits

STEL/TLV = None established.

Incompatible Materials (to avoid hazardous reactions)

Avoid contact with concentrated nitric acid and any other strong oxidising agents at all times.

Operation

Instrumentation and Controls

"POWER" Switch: Turning the unit ON, this switch starts the cooling fans, initiates the generator's SYSTEM CHECK self test procedure and then Hydrogen Delivery.

Digital Pressure Display: The digital display normally indicates the actual pressure generated by the unit - it can display either in psi or in bar which is user selected by means of the PSI-BAR button.

"Pressure Adjust" Dial: The generator outlet gas pressure can be preset by adjusting this dial in conjunction with the "Pressure Set" button as described below. The pressure can be set between 0 and 100 psi.

"Pressure Set" Button: This button toggles the display between the actual pressure and the preset pressure. By default the display will indicate the actual gas pressure within the generator and the gas lines. When the "Pressure Set" button is pressed, the display indicates the user's preset delivery pressure. By pressing this button and adjusting the "Pressure Adjust" dial, the preset pressure can be changed.

"H2 Flow" Bar-graph Display: This bar-graph display indicates how much hydrogen the unit is producing. The display has ten LED's which light up in proportion to the amount of hydrogen being produced by the generator - each LED represents 10% of the output capacity of the generator. For example, 5 LED's lit on a CFH300 represents 50% of the output capacity - 150cc/min. The generator will run at full capacity to reach the preset pressure in the shortest space of time and then reduce the flow to match the consumption of the application it is connected to.

The bar-graph can also be used as a diagnostic tool. This is outlined in the Fault Finding section of the manual.

"System Check" LED: This LED will light up when the unit is first switched on and will remain lit for a maximum of 6 minutes. During this time the unit is performing self-test functions, senses for internal leaks and builds to the preset pressure. If these tests are passed successfully, the SYSTEM CHECK LED will extinguish and the unit will go into Hydrogen Deliver Mode. If any abnormalities are detected during the tests then the LED will flash and the unit will shut down. Please follow the Fault Finding section if this is the case.

"H2 Delivery" LED: On successful completion of the System Check the Delivery Valve will open and the H2 Delivery LED will light up.

"Low Water" LED: When the unit detects that its internal water supply is getting low it automatically operates an internal feed pump to get water from the external supply. Should water fail to load then the LED will start to FLASH, an audible alarm will sound and the generator will shut down.

"Auto Shut Down" LED: In the event that the generator produces Hydrogen at its maximum capacity for 20 minutes it will automatically shut down Hydrogen production and close the delivery valve, indicating a massive Hydrogen leak or that the generator is unable to satisfy the demand of the application. The LED will flash and an audible alarm will sound.

Window Feature



Hydrogen generation is visible through viewing port.

Water Drain Feature



1. Remove hatch



2. Fit hose with barbed fitting to drain



3. To remove hose push down on

Generator Start-up

CHECK:

1. Transport pipe has been removed
2. H₂ Outlet is connected to application
3. Deionised water is connected
4. Mains power is connected

Turn the power switch ON. The digital display will light up, the cooling fans will rotate and the internal pump may automatically run to load water if the internal tanks are not full.

At this point, quickly set your desired working pressure. Depress the “Pressure Set” button and dial in the working pressure using the “Pressure Adjust” dial. Once the pressure has been set, release the button. The display will now indicate the actual pressure inside the Generator. The preset pressure can be checked at any time by depressing the “Pressure Set” button

The generator will now run through it’s SYSTEM CHECK to ensure that it is gas tight by pressurising itself internally to the preset pressure. During this time, no hydrogen is delivered for a maximum of 6 minutes.

At the end of the SYSTEM CHECK, the generator expects to have generated enough gas to reach the desired delivery pressure. If you make any large adjustments to the set point pressure near the end of the timing period, the generator may not have enough time to generate the extra hydrogen required and it will shut down. Simply switch off and on again and the generator will now have enough time to reach the set point pressure.

Once the generator has passed the SYSTEM CHECK to the preset pressure, the SYSTEM CHECK LED will go out and the delivery valve will open to allow hydrogen to flow to the consuming application (H₂ Delivery Mode). The pressure will drop as the generator becomes exposed to the increased volume of the silica gel column and the gas lines. The generator will run at full capacity to reach the preset working pressure as soon as possible. Once this pressure has been reached, the generator will only generate the exact amount of gas required (as long as it is within the output capacity of the generator). The amount of gas generated is automatically regulated by maintaining the preset pressure.

The quality of the hydrogen gas at the consuming application will depend on the cleanliness of the delivery lines and any accessories fitted in-line after the Hydrogen Generator. Gas leaks, traces of moisture, air, reducible oxides, and other contaminants must be flushed out of the gas lines before the actual purity of the hydrogen generated is seen at the consuming application.

Generator Switch Off

To avoid the possibility of any problems the next time you switch ON your Generator, we strongly recommend that you always follow this procedure before switching OFF the power to your Generator. This will ensure that the Generator is fully depressurised before Switch OFF.

1. Rotate the "Pressure Adjust" Dial fully anti-clockwise. This will effectively stop all hydrogen production.
2. Gradually vent all hydrogen pressure on your Analyser and associated pipe work.
3. Observe the digital Pressure Display on your Generator; the pressure should be slowly falling towards zero psi/bar.
4. When the Pressure Display reads zero psi/bar, then switch OFF the Generator.
5. Remember on Switch ON to readjust the "Pressure Adjust" Dial to your usual desired operating pressure.

Event of a Power Failure

In the event of an interruption to the mains power supply to your Generator during normal operation, please note the following:

1. When the mains power is resumed, your Generator will automatically perform its "System Check". After passing "System Check" the Generator will then re-pressurise your pipe work when it enters the Hydrogen Delivery Mode.
2. Should your Generator consistently fail to successfully pass its "System Check" following a mains power supply failure, please contact your Dealer or Peak Scientific for corrective action.

Fault Finding

<u>Symptom</u>	<u>Possible Causes and Action Required</u>
Nothing happens at switch ON	<ol style="list-style-type: none"> 1. Check power supply and secure connection. 2. Check mains fuse and replace with T10 amp fuse if required.
Fans rotates but no display	<ol style="list-style-type: none"> 1. Ribbon connector has become dislodged inside. Contact Peak Scientific Instruments Ltd for further advice. 2. Generator pressure has gone above the maximum permissible pressure. Check if there is any other high-pressure gas supply on the same. If not, contact Peak Scientific Ltd.
SYSTEM CHECK LED flashing.	<ol style="list-style-type: none"> 1. Internal leak inside generator. Contact Peak Scientific Instruments Ltd for further advice. 2. Large change in pre-set pressure. Switch the generator off and back on again, reset pressure and do not adjust during check. 3. Reduced efficiency due to poor water quality. Contact Peak Scientific for further advice.
LOW WATER LED flashing.	<ol style="list-style-type: none"> 1. No water in the external supply. Refill and retry. 2. Blocked or twisted water supply line. Trace blockage and rectify.
AUTO SHUTDOWN LED flashing. Refer to the notes below for further Advice and information.	<ol style="list-style-type: none"> 1. A quick check is to blank off the rear of the generator and to let it reach its pre-set pressure. All of the LED's on the bargraph display should go out if the generator itself is gas tight. 2. Gas demand exceeds the output capacity of the generator. Reduce demand until the preset pressure can be maintained. 3. Leak in external gas line. Check all joints and fittings. Seal all leaks no matter how small they may be. 4. Check silica gel cartridge especially if it has been replaced. If the advice below and none of the above points resolve the problem, contact Peak Scientific for further advice.

Further Advice and Notes on Fault Finding

Installing the generator to supply gas through long and/or large bore tubing.

Long gas lines and large bore tubing can have a large internal volume. This means that it may take some time for the generator to pressurise the gas line to the set point pressure. In certain cases, the set point pressure may not be reached within the 20 minute time limit before the capacity excess alarm sounds resulting in the Generator shutting down.

To overcome this problem, please do the following:

1. Close off all of the gas consuming applications. This will allow the generator to initially pressurise the gas lines.
2. Set the delivery pressure at 1 Bar/14.5 psi and let the generator pressurise the tubing.
3. Once this pressure has been reached, increase the delivery pressure in 1 Bar/14.5 psi increments.
4. Keep increasing the set pressure until the desired pressure has been reached.
5. Gradually turn on one application at a time and allow the pressure to stabilise with each application.

Using the bar-graph display as a diagnostic tool

The bar-graph indicates how much gas the generator is producing. For example, a PH600 will generate a maximum of 600cc/min, so each of the 10 LED's on the bar-graph represents 60cc/min. If the consuming application is known to use 180cc/min, then we should expect 3 LED's to be lit. If this is the case, then the generator and the gas lines are gas tight. If we have more than 3 LED's lit, then we know there is a leak somewhere. By closing the outlet of the generator we can determine if the problem is with the generator or with the gas lines

Maintenance Log

Work Done	Remarks	Date	Name

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