Parker Balston

How to convert helium to hydrogen as a carrier gas in gas chromatography

The benefits of using hydrogen from an in-house gas generator

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How to convert from helium to hydrogen as a carrier gas in gas chromatography

This How to Guide will take you though the steps necessary to convert from Helium to Hydrogen as a carrier gas for Gas Chromatography. The use of Hydrogen from an in-house generator will lead to considerable benefits in cost, safety and convenience in the laboratory. For a detailed explanation of benefits, costs savings, time savings and many other factors affecting the benefits of converting to Hydrogen please see page 8. The order of the steps is important to the successful conversion to Hydrogen. Please follow these steps carefully and you will benefit from a quick and easy conversion to Hydrogen as a carrier gas.

Step 1

Review and document all existing run conditions

1. Leak check the system; leaks may affect the determination of the actual flows you are using for your analysis.
2. Measure and record the existing dead volume time and calculate the Linear Gas Rate (LGR).
3. Measure and record the Septum flow at the initial run temperature.
4. Measure and record the Make-up Gas rate.
5. Measure and record Vent flow at initial run temperature.
6. Measure and record the Fuel gas (Hydrogen) flow rate.
7. Measure and record the Air gas flow rate.
8. Document any flow changes that take place during the run.
9. Document any temperature program rates used.
10. Obtain a good sample chromatogram for comparison with the chromatogram obtained after conversion.

How to convert from helium to hydrogen as a carrier gas in gas chromatography

Step 2

Perform all routine maintenance before switching to hydrogen

1 Change purifiers - Add purifiers to lines as needed to obtain at least 99.9999% pure gas.

2 Change septa - Use a good low bleed septum.

3 Change Injection Port Liners/Inserts and Seals - Clean as needed and avoid contamination with oils. Clean parts with acetone before installation.

⚠ **Caution: Acetone is flammable and can cause health issues. Avoid open flames in the laboratory.**

4 Clean Detector/Detector inserts/Jets.

Step 3

Installation of new lines and purifiers

1 Carrier gas lines – Depressurise and vent the Hydrogen line. Then cut the fuel gas line (Hydrogen) and add a tee. Extend a line into the Carrier Gas in-port behind the GC from the other side of the tee.

2 Add purifiers to this line if gas purity does not meet at least 99.9999% purity. Use hydrocarbon, oxygen and moisture removing purifiers or a combination purifier to obtain the required gas purity.

Hint: Add purifiers that have indicators to show the percentage of usage of the purifier so that you know when to change the purifiers.

3 Add new make-up gas line preferably for use with Nitrogen.

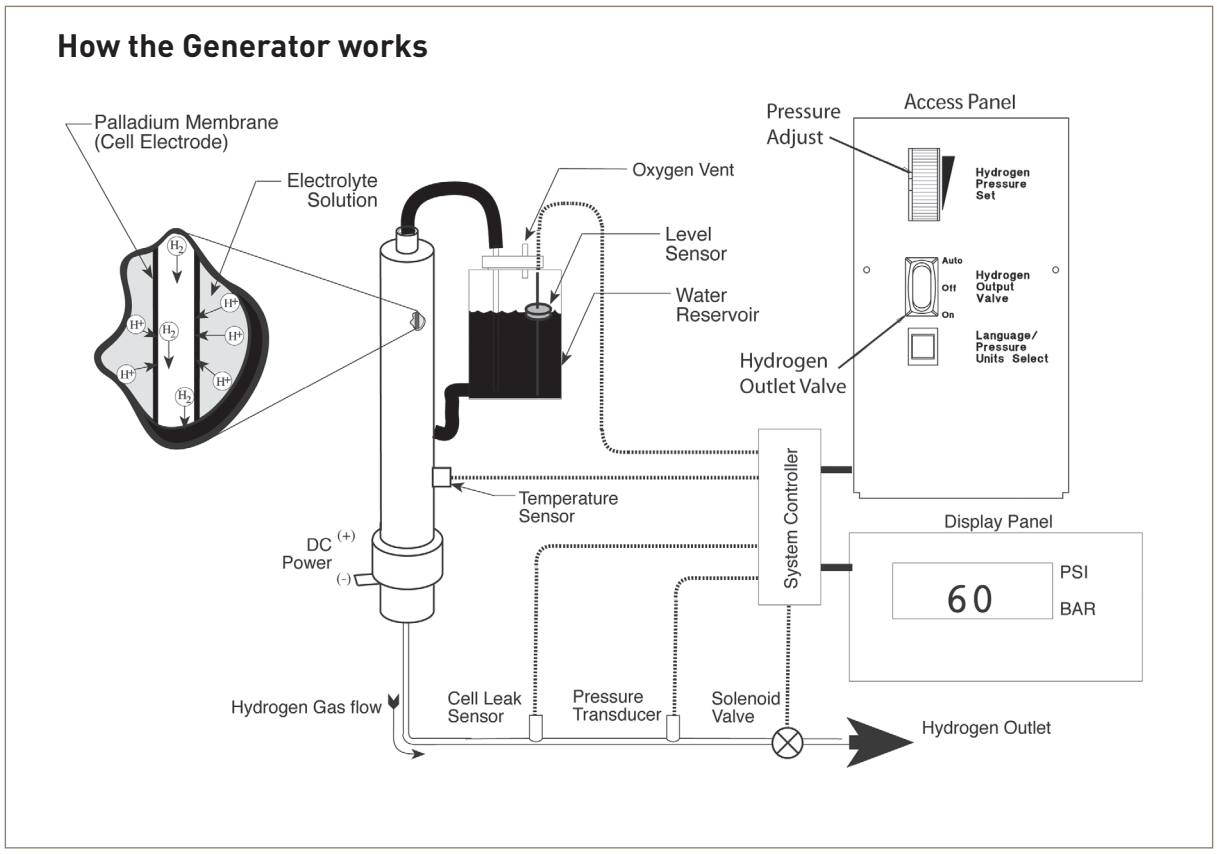

Figure 1: Hydrogen Technology

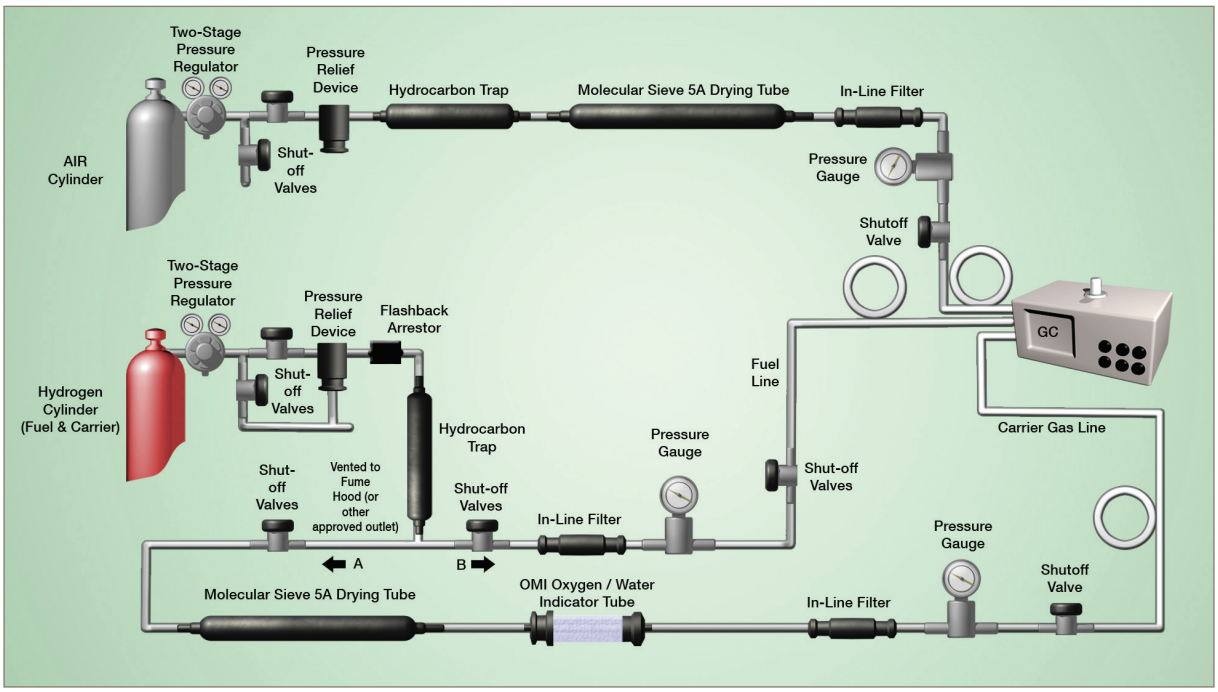

Figure 2: Ideal Configurations for a Single-GC System: Hydrogen Used as Carrier and Fuel Gas

How to convert from helium to hydrogen as a carrier gas in gas chromatography

Step 4

Establish flows for hydrogen and nitrogen (make-up gas)

Carrier Gas

1 Turn gas on and establish column flow with the oven off. With some computer controlled systems, it may be necessary to change the carrier gas input to indicate you are using Hydrogen so that the system makes the correct flow adjustments based on the density of Hydrogen.

2 Turn Oven, Injection port, and Detector on after one hour of flow. (It is important to purge all lines and purifiers before establishing temperatures in the various zones of the GC. It takes a considerable amount of time to purge lines and purifiers.

Hint: If time permits, it would be best to purge the system overnight.

3 Establish Split Vent flow and measure Septum Vent flow.

4 Bring the column/oven up to run temperature and again measure the column flow.

Detector Flows

1 Establish the correct flow of Hydrogen to the detector
(this includes the sum of all sources of hydrogen going into the detector).

2 Establish the correct Make-up gas flow.

3 Establish the correct Air flow.

System Adjustments

1 Ignite the detector and turn on any needed detector electronics. Give the system one hour to stabilise.

Hint: A longer warm up period (e.g. overnight) may lead to a more stable response.

2 Recheck the system to make sure that all run conditions and temperatures are correct.

3 Inject and measure the dead volume time using methane and calculate the Linear Gas Rate (LGR).
Make corrections to the LGR as needed.

Flow = $\pi r^2 L / t_m$

Where: $\pi = 3.1416$

r = radius of the column in cm (convert from mm)

L = Length of the column in cm (convert from meters)

T_R = Retention time of a non retained peak typically methane

Where: $LGR = L / t_m = L / \mu$

Simplified: $Flow = \pi r^2 \mu$ (Remember to use units in cm.)

First Run

- **Inject sample and compare run to previous Helium run.**
- **Consider if you want to speed run up by doubling LGR or if your goal is just to duplicate the Helium analysis times and separation.**

Calibration

- **Re-establish peak identification – there should be no changes unless you are using very polar columns.**
- **If the run is as you desire, proceed to run your Calibration Standards.**

Step 5

Changing from cylinders to gas generators

1. Install gas generators on bench following instructions provided in the installation manuals.
2. Reduce tubing line lengths as much as possible. (See Figure 3).
3. Use high quality GC grade copper or stainless steel tubing or clean new lines with solvents and bake dry under nitrogen flow.
4. Add gas purifiers as needed. Different makes and models of gas generators provide different purities of hydrogen. You will need to add purifiers if the delivered gas is not at least 99.9999% pure.
5. Consider adding Nitrogen generators and high quality air generators to eliminate cylinders and the use of high-pressure gases in the laboratory. A schematic diagram for a typical system using an in-house generator is shown in Figure 4.

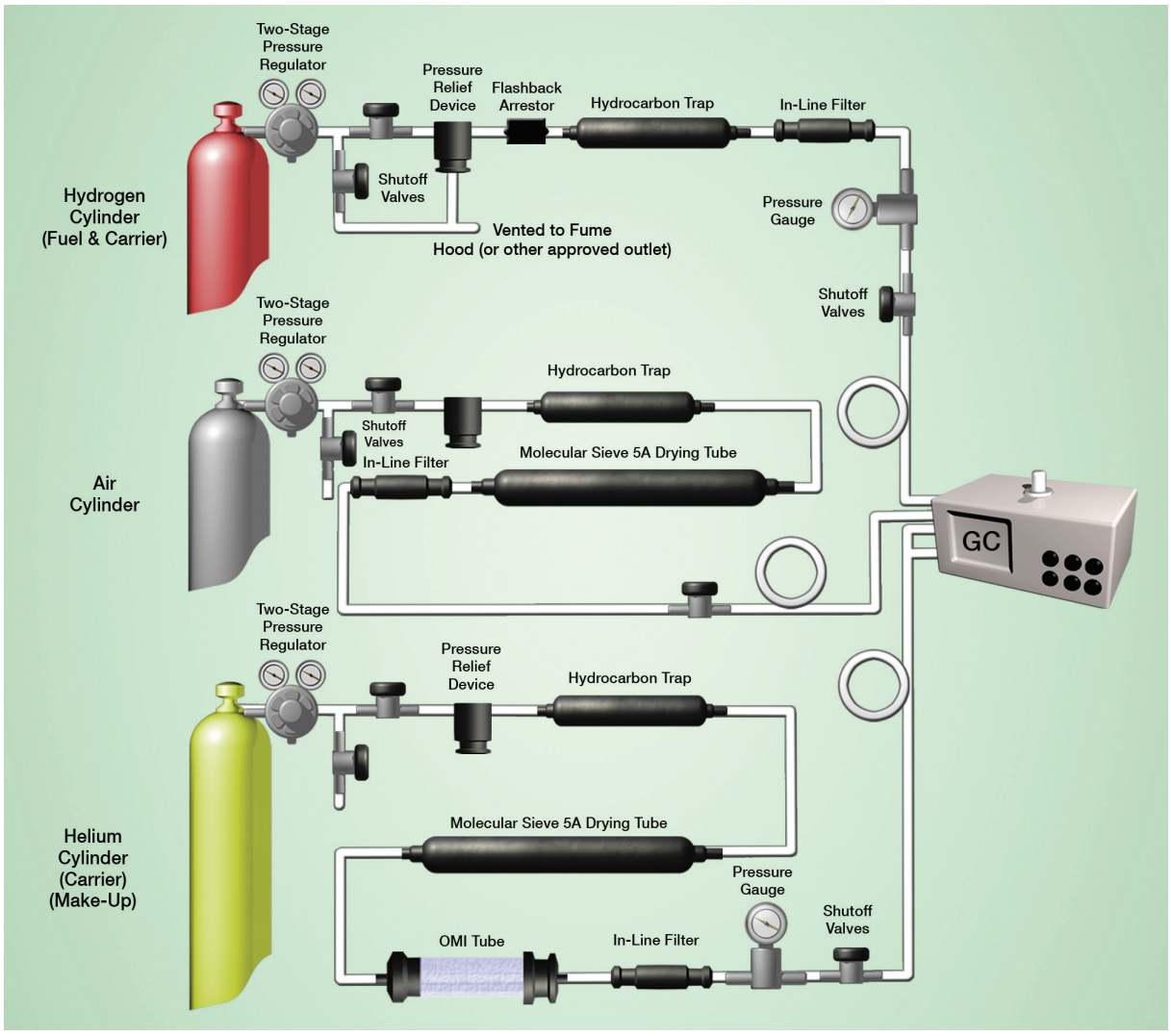

Figure 3: Standard Configuration for a Single GC System: Gas Delivered from Cylinders

All gas generator system flow schematic

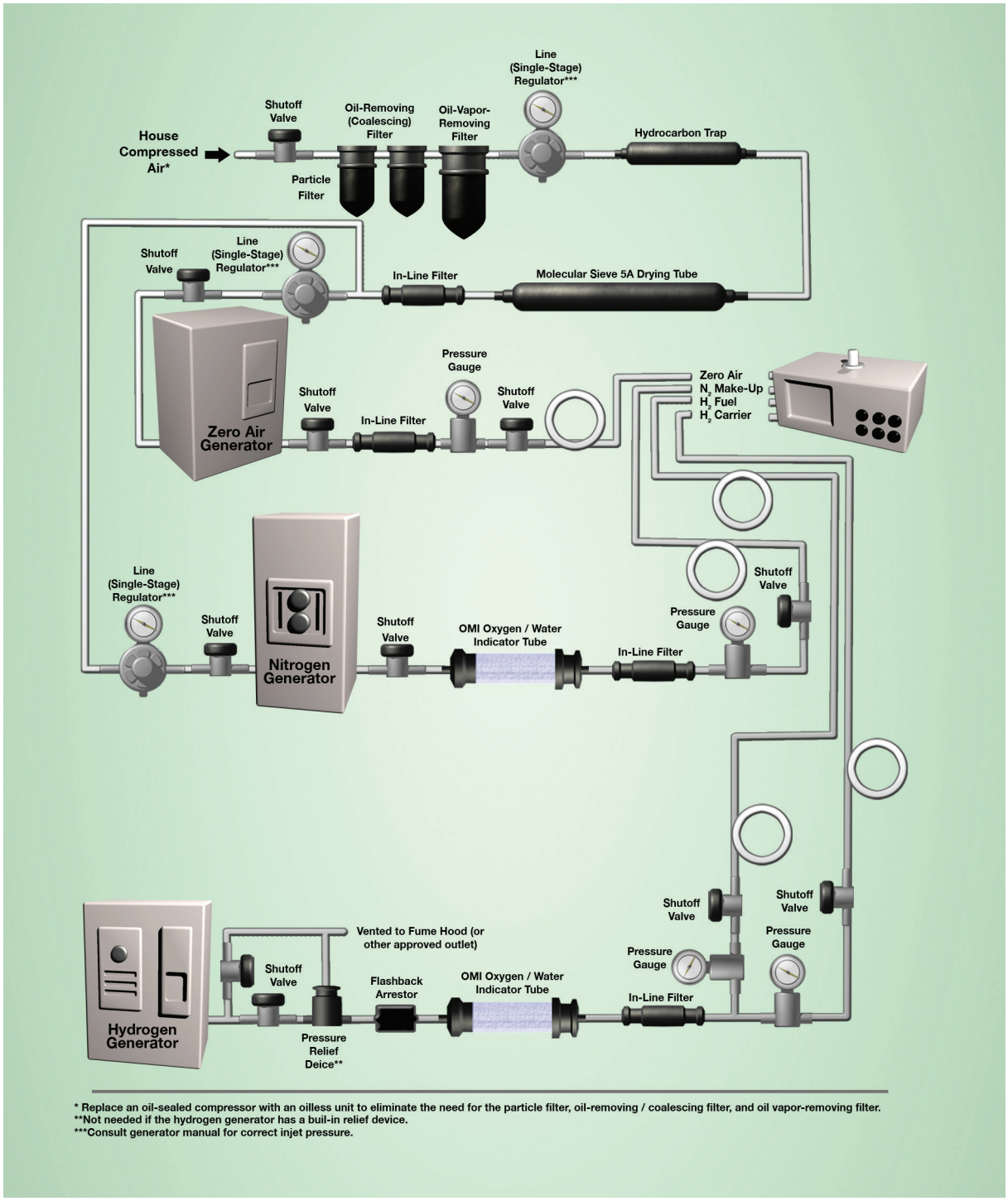

Figure 4: Ideal Configurations for a Single-GC System: All Generator System

Figures 5 to 7 demonstrate the equivalence of helium and hydrogen in typical separations.

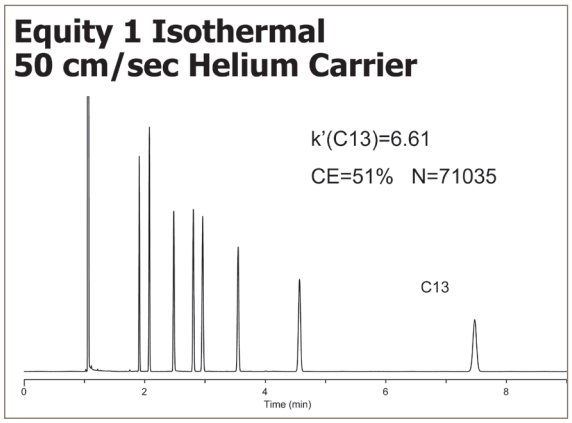

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Figure 5: Equity 1 Isothermal 50cm/sec Helium Carrier

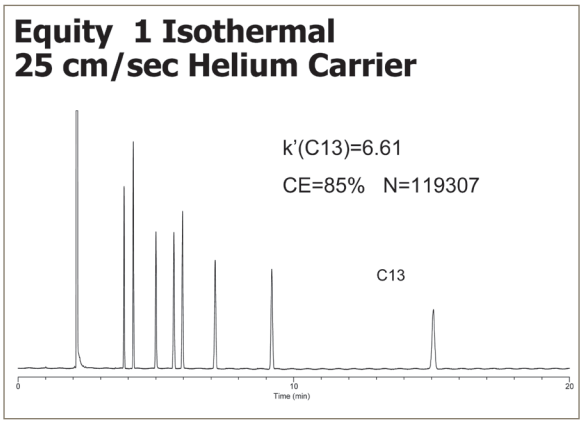

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Figure 6: Equity 1 Isothermal 25cm/sec Helium Carrier

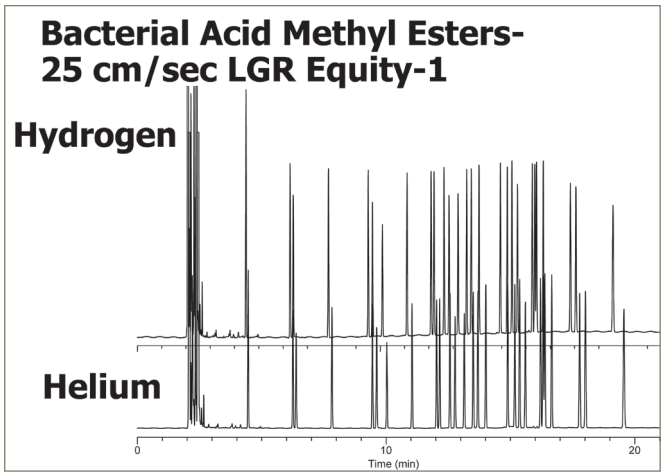

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Figure 7: Bacterial Acid Methyl Esters - 25cm/sec LGR Equity-1

Benefits of in-house gas generators

In-house gas generators provide a number of significant benefits to the laboratory, including a dramatic improvement in safety, an increase in convenience, and a lower cost.

Minimising safety hazards

An in-house generator is considerably safer than cylinder gas; only a small amount of the generated gas is present at low pressure at any given time and the gas is ported directly to the instrument. If a leak occurs, only a small quantity of gas is dissipated into the laboratory. In contrast, serious hazards exist if gas is supplied using a high-pressure gas cylinder. If a full cylinder of hydrogen was suddenly vented into the laboratory, up to 9000 L of gas would be released, displacing laboratory air and reducing the breathable oxygen content.
An in-house gas generator also eliminates the possibility of injury or damage from the transportation and installation of a gas cylinder. A gas cylinder is heavy and can be a hazard to staff and facilities if the valve is compromised during transport (in many facilities, specially trained technicians replace gas cylinders). A leaking hydrogen cylinder could lead to an explosion.

Maximising convenience

An in-house gas generator can supply gas on a 24 hr/7 day/week basis with no user interaction (other than routine annual maintenance). In contrast, when cylinder gas is employed, the user must monitor the level of gas in the cylinder and ensure that there is sufficient gas for the desired analyses. The in-house system obviates the need to obtain replacement cylinders; when it is necessary to get a replacement gas cylinder, the chromatographer may need to get an individual who is qualified to handle the cylinders. Cylinders are typically stored outside in a remote area for safety reasons and replacing cylinders can be a significant inconvenience, especially in inclement weather. In addition, a pressurised cylinder could be a significant hazard if the laboratory is located in a seismic zone.

A major benefit of in-house gas generators is that once they are installed, you don't have to worry about the gas supply. Maintenance requirements are minimal, simply replace the filters and perform routine maintenance and monitor the water in the hydrogen generators.

Minimising the cost

An important advantage of an in-house generator is the dramatic economic benefit compared to the use of gas cylinders. The running cost of an in-house generator is extremely low; since the gas is obtained from water and maintenance is a few hundred Euros a year for periodic filter replacement.

In contrast, when a gas cylinder is used, the actual cost is significantly greater than the cost of the cylinder. In addition, the time required transporting the cylinder, installing it, returning the used cylinder to storage, and wait for the system to equilibrate must be considered. While the calculation of the precise cost of the use of gas from cylinders for a given user is dependent on a broad range of local parameters and the amount of gas that is used, significant potential savings can be obtained by the in-house generation of gas.
A comparison of the cost of supplying gas via cylinders versus the cost for use of an in-house gas generator is presented in Table 1. The comparison is based on the GC application using one hydrogen cylinder per week at a cost of €45 per cylinder. A high purity helium cylinder costs approx €500. The hydrogen generator has a flow capacity of >800ml/min.

Table 1 Annual costs: In-house generation vs. high-pressure cylinders (€)

	In-house Generator (€)	Hydrogen cylinders €	Helium cylinders €
Maintenance	600	0	0
Cylinders	0	2340	26,000
Cylinder rental	0	252	252
Labour (changing cylinders)	0	781	781
Order processing	23	270	270
Shipping	38	2792	2792
Invoice processing	8	90	90
Inventory control	0	54	54
Total	668	6581	36,820

Specifications and ordering information

Hydrogen Generators for Fuel and Carrier Gas Specifications

Hydrogen Generators	Models	Specifications
Hydrogen Purity		>99.99999%
Oxygen Content		<0.01 ppm
Moisture Content		<1.0 ppm
Max Hydrogen Flow Rate	H2PD-150	150 ml/min
	H2PD-300	300 ml/min
Electrical Requirements	H2PD-150, H2PD-300	230 VAC - 50Hz
Hydrogen Outlet Pressure		Adjustable, 0 to 60 psig or 0 to 100 psig
Certifications		IEC 1010-1; CSA; UL 3101; CE Mark
Dimensions	H2PD-150, H2PD-300	12” w x 12” d x 22” h (30cm x 33cm x 58cm)
Outlet Port	H2PD-150, H2PD-300	1/8” Compression
Shipping Weight	H2PD-150, H2PD-300	58 lbs (26 kg)

Ordering Information

Description	Model Number
Hydrogen Gas Generator	H2PD-150, H2PD-300
Electrolyte Solution	920071
Pressure Regulator	W-425-4032-000
Installation Kit	IK7532

Note: To ensure consistent product performance and reliability, use only genuine Balston replacement parts and filter cartridges.

A library of GC/MS application notes using generated hydrogen as a carrier gas over and above helium can be found on SharePoint, please use the following navigation:
SHAREPOINT: Filtration and Separation / Products / Hydrogen Generators Analytical / Brands

Hydrogen Generators

for Gas Chromatography
Palladium

Hydrogen on Demand, up to 300 ml/min

Ultra high purity hydrogen generators from Parker Balston are designed as hazard-free alternatives to high-pressure hydrogen cylinders. Deionised water and an electrical supply is all that is required to generate hydrogen for weeks of continuous operation.

Automatic water-feed is available as standard for remote installations or where minimal operator attention is required. With an output capacity of up to 300 ml/min, one generator can supply 99.99999% pure fuel gas for up to 7 FID's or several GC's with carrier gas or several GC/MS with carrier gas.

Contact Information:

Parker Hannifin Manufacturing Limited.
Filtration and Separation Division
Dukesway, Team Valley Trading Estate
Gateshead, Tyne and Wear
England NE11 0PZ

Tel: +44 (0)191 402 9000
Fax: +44 (0)191 482 6296
Email: balstonukinfo@parker.com
www.parker.com/dhFNS

Product Features:

- **Produces a continuous supply of 99.99999% pure hydrogen gas at up to 4.1 bar**
- **Designed to run 24 hours a day**
- **Ideal for carrier gas requirements for GC/MS**
- **Eliminate dangerous hydrogen cylinders from the laboratory**
- **Simple low cost annual maintenance**
- **Ideal for fuel and carrier gas requirements on GC-FID**

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Certified Safety

Parker Balston hydrogen generators utilise an exclusive palladium membrane to produce hydrogen on demand. A built in pressure transducer monitors the down stream requirements. This ensures the hydrogen generator produces only enough gas for the application keeping internal storage to an absolute minimum.

A sophisticated control system connected to a liquid crystal display, continuously monitors the vital operating parameters to ensure a safe and consistent performance.

That's why Parker Balston hydrogen generators meet the strict safety guidelines to be certified for CE, CSA and UL approval.

Proven Technology

Parker Balston's exclusive Palladium Membrane is proven in thousands of GC installations worldwide.

Maintenance requires only a few minutes per year - no inconvenient extended downtime. Simply change the electrolyte every 12 months.

Hydrogen gas is produced by electrolytic dissociation of water. The resultant hydrogen stream then passes through a palladium membrane to ensure ultra high purity.

Only hydrogen and its isotopes can penetrate the palladium membrane; therefore, the purity of the output gas is consistently 99.99999+%

Principal Specification

Model	H2PD-150	H2PD-300
Purity	99.99999+%	99.99999+%
Flow Rates	150 ml/min	300 ml/min
Outlet Connection	1/8" compression	1/8" compression
Delivery Pressure (Adjustable)	0.7 to 4.1 bar	0.7 to 4.1 bar
Auto Water Fill	Yes	Yes
Water Quality Required	> 5 Mohm	> 5 Mohm
Ambient Temperature	10 to 35°C	10 to 35°C
Electrical Requirements	230VAC - 50Hz	230VAC - 50Hz
Power Consumption	200 Watts	200 Watts
Dimensions (H x W x D)	580 x 300 x 300 mm	580 x 300 x 300 mm
Weight (Shipping)	23 Kg (26)	23 Kg (26)

Ordering Information

Description	Model Number
150 ml/min Hydrogen Generator	H2PD-150EU OR H2PD-150UK
300 ml/min Hydrogen Generator	H2PD-300EU OR H2PD-300UK
Installation Kit	IK7532

Maintenance Items	Model Number	Change Frequency
Electrolyte Solution	REAG-920071	12 Months

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Zero Air Generators

for Gas Chromatography

Zero Air on demand, up to 30,000 ml/min

The Parker Balston Zero Air Generator can produce up to 30,000 ml/min of high purity zero grade air. Compressed air is pre filtered down to 0.01 micron and then purified using a state-of-art combined heated catalyst module.

There are no moving parts and no noise, making the generator extremely reliable and ideal to install in the laboratory. Simple and quick to install, the Zero Air Generator requires minimal maintenance just once a year.

The resultant air is free of total hydrocarbons (THC) to < 0.05ppm making it ideal for all FID applications. The low levels guarantee a low signal to noise ratio, ensuring a flat constant base line with no peaks or fluctuations.

Contact Information:

Parker Hannifin Manufacturing Limited.
Filtration and Separation Division
Dukesway, Team Valley Trading Estate
Gateshead, Tyne and Wear
England NE11 0PZ

Tel: +44 (0)191 402 9000
Fax: +44 (0)191 482 6296
Email: balstonukinfo@parker.com
www.parker.com/dhFNS

Product Features:

- **Ultra high purity air for GC FID applications**
- **Payback period typically less than one year**
- **Silent operation and minimal operator attention required**
- **Eliminate inconvenient and potentially dangerous air cylinders from the laboratory**
- **Models available to service up to 75 FID's**
- **Increases the accuracy and repeatability of analysis**

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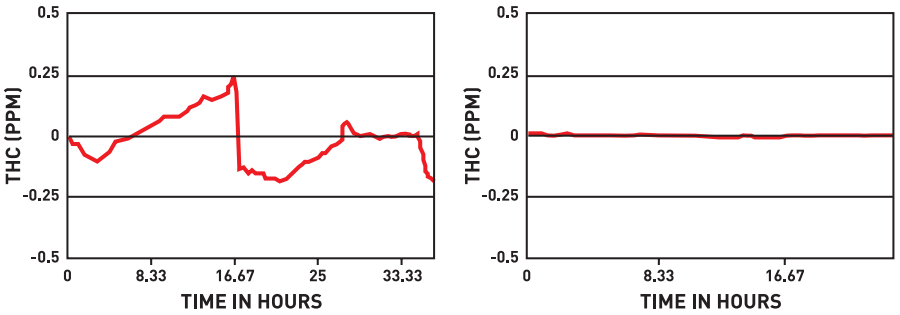
The chromatograms compare baselines produced by a Parker Balston Zero Air Generator and cylinder air.

The baseline produced by the Parker Balston Generator is very flat, with no fluctuations or peaks, in comparison with the chromatogram of the cylinder air supply, which has many peaks ranging from 0.25 ppm to -0.25 ppm.



Principal Specification

Model	75-83	HPZA-3500	HPZA-7000	HPZA-18000	HPZA-30000
Purity	< 0.1ppm THC	< 0.05ppm THC	< 0.05ppm THC	< 0.05ppm THC	< 0.1ppm THC
Flow Rates	1,000 ml/min	3,500 ml/min	7,000 ml/min	18,000 ml/min	30,000 ml/min
Number of FID's*	Up to 2	Up to 8	Up to 17	Up to 45	Up to 75
Inlet Pressure	2 to 8 bar	2 to 8 bar	2 to 8 bar	2 to 8 bar	2 to 8 bar
Drop-Clean Pressure	0.6 bar	0.6 bar	0.6 bar	0.6 bar	0.6 bar
Inlet Connection	1/4" NPT (Female)	1/4" NPT (Female)	1/4" NPT (Female)	1/4" NPT (Female)	1/4" NPT (Female)
Outlet Connection	1/4" NPT (Female)	1/4" NPT (Female)	1/4" NPT (Female)	1/4" NPT (Female)	1/4" NPT (Female)
Ambient Temperature	10 to 35°C	10 to 35°C	10 to 35°C	10 to 35°C	10 to 35°C
Electrical Requirements	230VAC - 50Hz	230VAC - 50Hz	230VAC - 50Hz	230VAC - 50Hz	230VAC - 50Hz
Power Consumption	150 Watts	220 Watts	220 Watts	440 Watts	440 Watts
Dimensions (H x W x D)	250 x 300 x 80 mm	420 x 270 x 340 mm	420 x 270 x 340 mm	420 x 270 x 340 mm	420 x 270 x 340 mm
Weight (Shipping)	2 Kg (3)	16 Kg (19)	16 Kg (19)	16 Kg (19)	16 Kg (19)

*400 ml/min per FID

Ordering Information

Description	Model Number
1,000 ml/min Zero Air Generator	75-83EU or 75-83UK
3,500 ml/min Zero Air Generator	HPZA-3500EU or HPZA-3500UK
7,000 ml/min Zero Air Generator	HPZA-7000EU or HPZA-7000UK
18,000 ml/min Zero Air Generator	HPZA-18000EU or HPZA-1800UK
30,000 ml/min Zero Air Generator	HPZA-30000EU or HPZA-30000UK
Installation Kit	IK76803

Maintenance Items	Model Number	Change Frequency
Maintenance Kit for Model 75-83	MK7583	12 Months
Maintenance Kit for Models HPZA-3500, HPZA-7000, HPZA-18000, HPZA-30000	MK7840	12 Months

Catalogue: S3.2.015c_EN 07/11

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UHP Zero Nitrogen Generators

for GC carrier gas and make up applications

Nitrogen on demand, up to 3,200 ml/min

The Parker Balston Ultra High Purity (UHP) Zero Nitrogen Generators are engineered to transform standard compressed air in to a safe regulated supply of 99.9995% pure nitrogen, with <0.1ppm of hydrocarbons

Typical applications include GC make up gas and carrier gas, including ECD (Electron Capture Detector), DSC (Differential Scanning Calorimeter) and virtually any analytical instrument that requires a small flow of ultra high purity zero nitrogen.

Innovative design features include integral compressors with economy mode as standard. This extends compressor life and reduces ongoing running costs.

Contact Information:

Parker Hannifin Manufacturing Limited
Filtration and Separation Division
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England NE11 0PZ

Tel: +44 (0)191 402 9000
Fax: +44 (0)191 482 6296
Email: balstonukinfo@parker.com
www.parker.com/dhFNS

Product Features:

- **Produces a continuous supply of ultra high purity organic free nitrogen at 99.9995% purity**
- **Ideal for make-up and carrier gas applications including ECD**
- **Eliminate dangerous nitrogen cylinders from the laboratory**
- **Integral oil free compressors with noise reduction technology**
- **Economy mode: increasing compressor life and reducing ongoing running costs**
- **Designed to run 24 hours a day**

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Nitrogen is produced by utilising a combination of filtration and pressure swing adsorption (PSA) technology. Standard compressed air is filtered by high efficiency coalescing filters to remove all contaminants down to 0.01 micron. For ultra sensitive applications such as ECD, units also include the addition of a heated catalyst module to ensure hydrocarbons are removed to < 0.1ppm.

The air then passes through two columns filled with carbon molecular sieve (CMS) which adsorb O_2, CO_2, moisture and hydrocarbons. These are desorbed to atmosphere during the pressure swing cycle leaving a supply of ultra pure nitrogen.

Principal Specification

Model	UHPZN2-1100	UHPZN2-1100C	UHPZN2-3200	UHPZN2-3200C
Purity	99.9995%	99.9995%	99.9995%	99.9995%
Hydrocarbon concentration	<0.1ppm	<0.1ppm	<0.1ppm	<0.1ppm
CO Concentration	<1ppm	<1ppm	<1ppm	<1ppm
CO2 Concentration	<1ppm	<1ppm	<1ppm	<1ppm
H2O Concentration	<1ppm	<1ppm	<1ppm	<1ppm
Flow rates	1100ml/min	1100ml/min	3200ml/min	3200ml/min
Inlet pressure	8-9.9 bar	N/A	8-9.9 bar	N/A
Integral compressor	No	Yes	No	Yes
Outlet pressure	5 bar	5 bar	5 bar	5 bar
Inlet connection	1/4"	N/A	1/4"	N/A
Outlet connection	1/8" BSPP	1/8" BSPP	1/4" BSPP	1/4" BSPP
Ambient temperature	15 to 25°C	15 to 25°C	15 to 25°C	15 to 25°C
Electrical requirements	230VAC-50Hz	230VAC-50Hz	230VAC-50Hz	230VAC-50Hz
Power Consumption	720 Watts	1250 Watts	720 Watts	1250 Watts
Dimensions (HxWxD)	869x345x667mm	869x345x667mm	869x345x667mm	869x345x667mm
Weight	86	96	86	96

Ordering Information

Description	Model Number
1,100 ml/min Zero UHP Nitrogen Generator	UHPZN2-1100
1,100 ml/min Zero UHP Nitrogen Generator with integral compressor	UHPZN2-1100C
3,200 ml/min Zero UHP Nitrogen Generator	UHPZN2-3200
3,200 ml/min Zero UHP Nitrogen Generator with integral compressor	UHPZN2-3200C
Installation Kit	IK7694

Maintenance Items	Model Number	Change Frequency
Filter Kit - all non compressor models	MKUHPZN2-FK	12 months
Filter Kit - All compressor models	MKUHPZN2CL-FK	12 months
Compressor Kit 230V - All models	MKN2-CK230L	4,000 hours or 12 months (which ever comes sooner)

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Notes

Parker's Motion & Control Technologies

At Parker, we're guided by a relentless drive to help our customers become more productive and achieve higher levels of profitability by engineering the best systems for their requirements. It means looking at customer applications from many angles to find new ways to create value. Whatever the motion and control technology need, Parker has the experience, breadth of product and global reach to consistently deliver. No company knows more about motion and control technology than Parker. For further info call 00800 27 27 5374

Aerospace

Key Markets

Aftermarket services
Commercial transports
Engines
General & business aviation
Helicopters
Launch vehicles
Military aircraft
Missiles
Power generation
Regional transports
Unmanned aerial vehicles

Key Products

Control systems & actuation products
Engine systems & components
Fluid conveyance systems & components
Fluid metering, delivery & atomization devices
Fuel systems & components
Fuel tank inerting systems
Hydraulic systems & components
Thermal management
Wheels & brakes

Climate Control

Key Markets

Agriculture
Air conditioning
Construction Machinery
Food & beverage
Industrial machinery
Life sciences
Oil & gas
Precision cooling
Process
Refrigeration
Transportation

Key Products

Accumulators
Advanced actuators
CO_2 controls
Electronic controllers
Filter driers
Hand shut-off valves
Heat exchangers
Hose & fittings
Pressure regulating valves
Refrigerant distributors
Safety relief valves
Smart pumps
Solenoid valves
Thermostatic expansion valves

Electromechanical

Key Markets

Aerospace
Factory automation
Life science & medical
Machine tools
Packaging machinery
Paper machinery
Plastics machinery & converting
Primary metals
Semiconductor & electronics
Textile
Wire & cable

Key Products

AC/DC drives & systems
Electric actuators, gantry robots & slides
Electrohydrostatic actuation systems
Electromechanical actuation systems
Human machine interface
Linear motors
Stepper motors, servo motors, drives & controls
Structural extrusions

Filtration

Key Markets

Aerospace
Food & beverage
Industrial plant & equipment
Life sciences
Marine
Mobile equipment
Oil & gas
Power generation & renewable energy
Process
Transportation
Water Purification

Key Products

Analytical gas generators
Compressed air filters & dryers
Engine air, coolant, fuel & oil filtration systems
Fluid condition monitoring systems
Hydraulic & lubrication filters
Hydrogen, nitrogen & zero air generators
Instrumentation filters
Membrane & fiber filters
Microfiltration
Sterile air filtration
Water desalination & purification filters & systems

Fluid & Gas Handling

Key Markets

Aerial lift
Agriculture
Bulk chemical handling
Construction machinery
Food & beverage
Fuel & gas delivery
Industrial machinery
Life sciences
Marine
Mining
Mobile
Oil & gas
Renewable energy
Transportation

Key Products

Check valves
Connectors for low pressure fluid conveyance
Deep sea umbilicals
Diagnostic equipment
Hose couplings
Industrial hose
Mooring systems & power cables
PTFE hose & tubing
Quick couplings
Rubber & thermoplastic hose
Tube fittings & adapters
Tubing & plastic fittings

Hydraulics

Key Markets

Aerial lift
Agriculture
Alternative energy
Construction machinery
Forestry
Industrial machinery
Machine tools
Marine
Material handling
Mining
Oil & gas
Power generation
Refuse vehicles
Renewable energy
Truck hydraulics
Turf equipment

Key Products

Accumulators
Cartridge valves
Electrohydraulic actuators
Human machine interfaces
Hybrid drives
Hydraulic cylinders
Hydraulic motors & pumps
Hydraulic systems
Hydraulic valves & controls
Hydrostatic steering
Integrated hydraulic circuits
Power take-offs
Power units
Rotary actuators
Sensors

Pneumatics

Key Markets

Aerospace
Conveyor & material handling
Factory automation
Life science & medical
Machine tools
Packaging machinery
Transportation & automotive

Key Products

Air preparation
Brass fittings & valves
Manifolds
Pneumatic accessories
Pneumatic actuators & grippers
Pneumatic valves & controls
Quick disconnects
Rotary actuators
Rubber & thermoplastic hose & couplings
Structural extrusions
Thermoplastic tubing & fittings
Vacuum generators, cups & sensors

Process Control

Key Markets

Alternative fuels
Biopharmaceuticals
Chemical & refining
Food & beverage
Marine & shipbuilding
Medical & dental
Microelectronics
Nuclear Power
Offshore oil exploration
Oil & gas
Pharmaceuticals
Power generation
Pulp & paper
Steel
Water/wastewater

Key Products

Analytical Instruments
Analytical sample conditioning products & systems
Chemical injection fittings & valves
Fluoropolymer chemical delivery fittings, valves & pumps
High purity gas delivery fittings, valves, regulators & digital flow controllers
Industrial mass flow meters/ controllers
Permanent no-weld tube fittings
Precision industrial regulators & flow controllers
Process control double block & bleeds
Process control fittings, valves, regulators & manifold valves

Sealing & Shielding

Key Markets

Aerospace
Chemical processing
Consumer
Fluid power
General industrial
Information technology
Life sciences
Microelectronics
Military
Oil & gas
Power generation
Renewable energy
Telecommunications
Transportation

Key Products

Dynamic seals
Elastomeric o-rings
Electro-medical instrument design & assembly
EMI shielding
Extruded & precision-cut, fabricated elastomeric seals
High temperature metal seals
Homogeneous & inserted elastomeric shapes
Medical device fabrication & assembly
Metal & plastic retained composite seals
Shielded optical windows
Silicone tubing & extrusions
Thermal management
Vibration dampening

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