Parker domnick hunter

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.

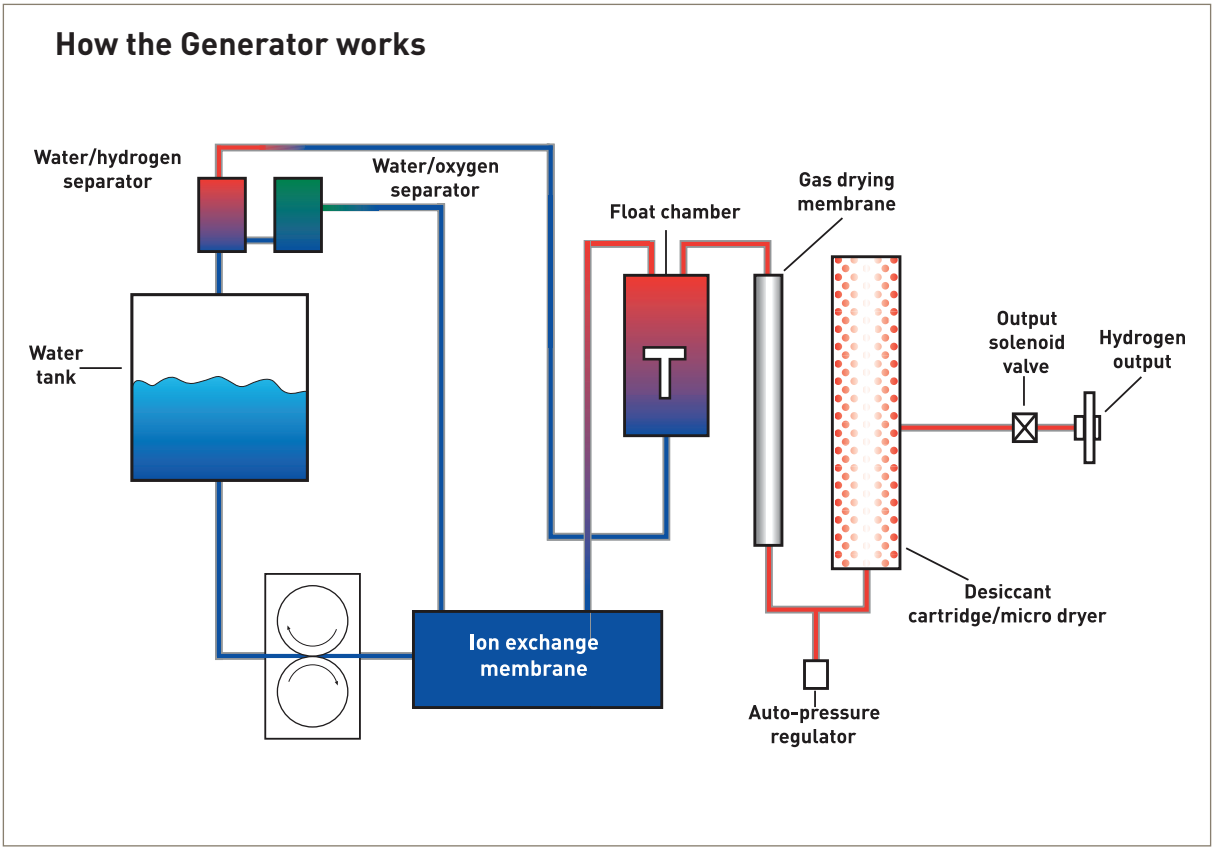

Figure 1: Hydrogen Technology

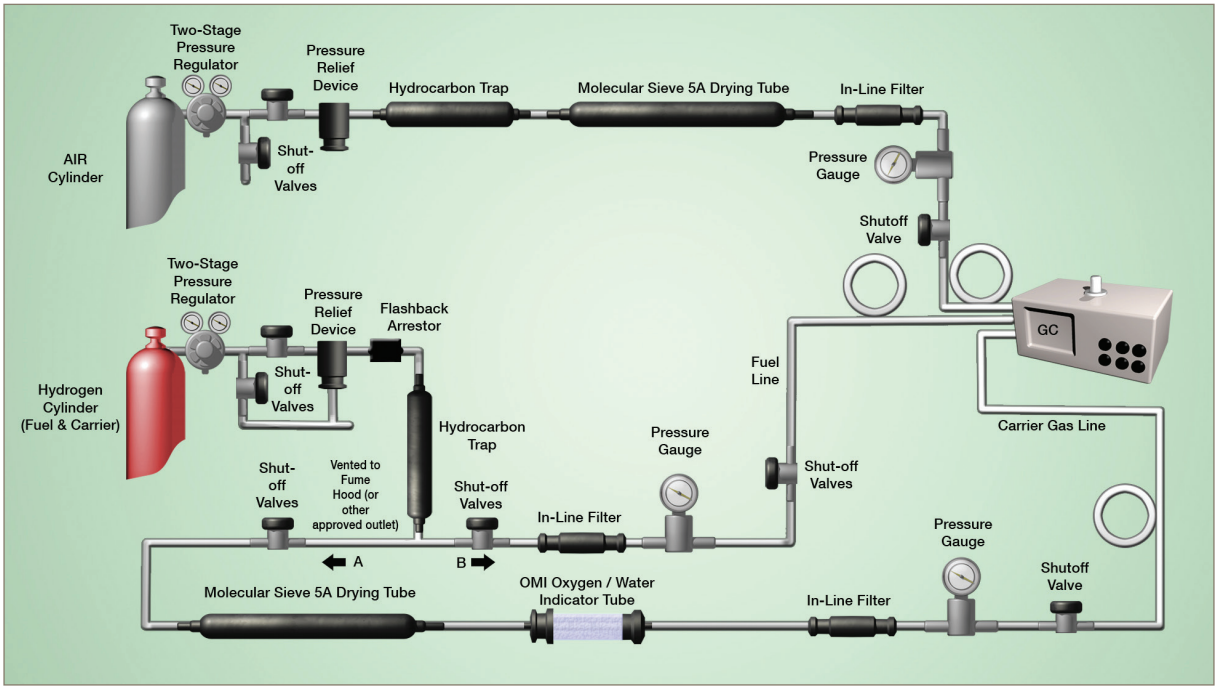

Figure 2: Ideal Configurations for a Single-GC System: Hydrogen Used as Carrier and Fuel Gas

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.

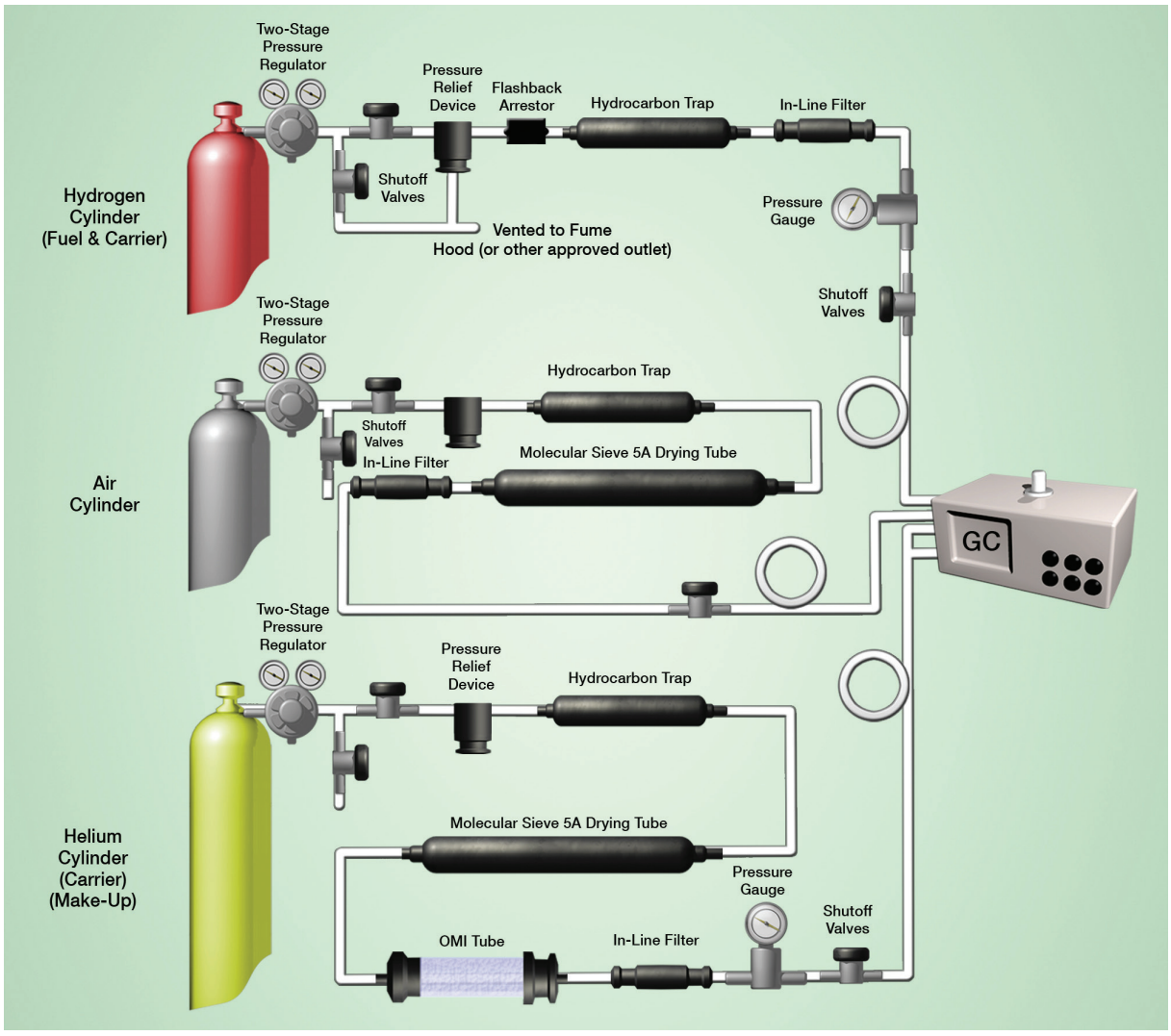

Figure 3: Standard Configuration for a Single GC System: Gas Delivered from Cylinders

All gas generator system flow schematic

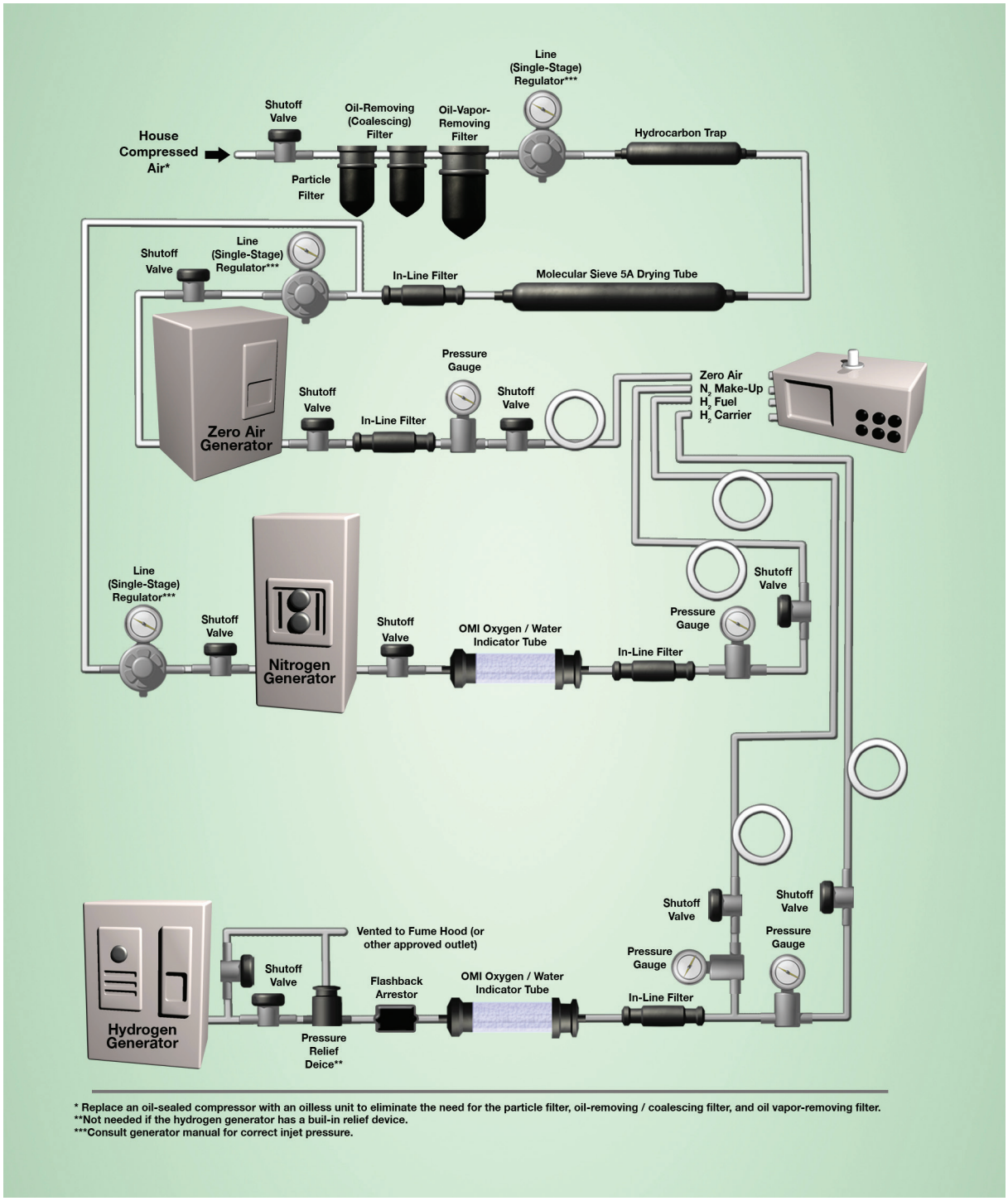

Figure 4: Ideal Configurations for a Single-GC System: All Generator System

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

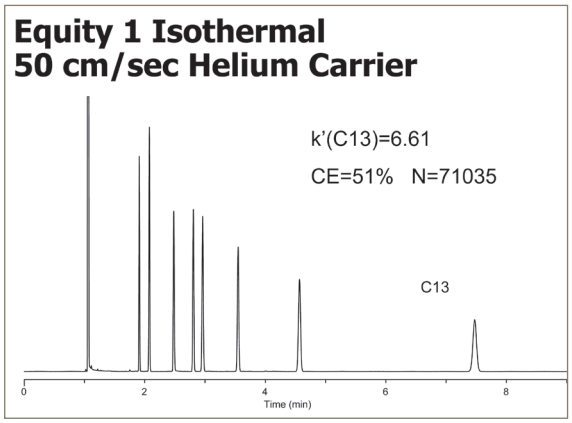

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Figure 5: Equity 1 Isothermal 50cm/sec Helium Carrier

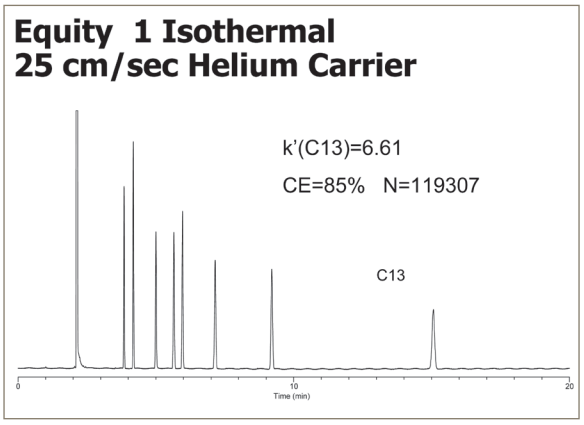

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Figure 6: Equity 1 Isothermal 25cm/sec Helium Carrier

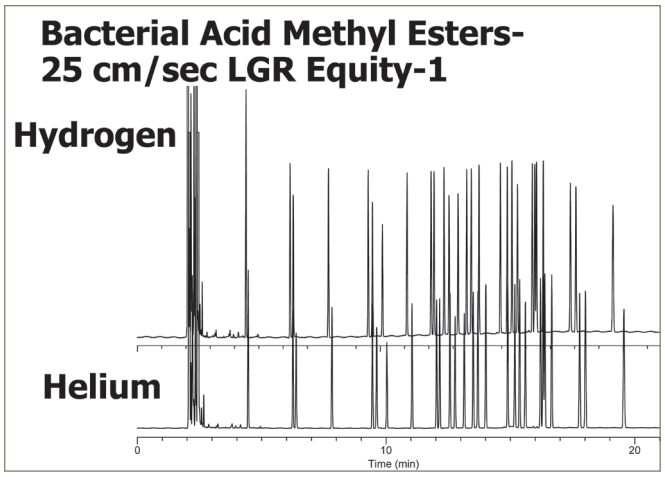

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Figure 7: Bacterial Acid Methyl Esters - 25cm/sec LGR Equity-1

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 accurs, 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

Hydrogen Generators

for GC and GC/MS carrier gas applications

The Parker domnick hunter H-MD ultra high purity hydrogen gas generators offer the optimum combination of safe operation, reliability, performance and low cost of ownership.

Utilising field proven PEM cell technology, hydrogen is produced on demand from deionised water and electricity, at low pressure and with minimal stored volume. Innovative control software allows unrivalled operational safety and reliability.

The H-MD generators ideally supply GC and GC/MS carrier gas, in addition to all known combustion detectors that are routinely used in today's laboratory workflows. Four models operate at flow rates; 160 ml/min, 250 ml/min, 500 ml/min and 1100 ml/min.

Hydrogen generators are available with Remote Networking software. Remote Networking software allows up to 27 hydrogen generators to be actively controlled from one central PC, and facilitates true cascading capabilities.

Contact Information:

Parker Hannifin Manufacturing Limited
domnick hunter 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: gasgen@parker.com
www.parker.com/dhfns

Product Features:

- **Eliminate dangerous hydrogen cylinders from the work place**
- **Simple to install and operate**
- **Compact, reliable with minimal maintenance**
- **Produces a continuous supply of 99.99995% pure hydrogen up to 1,100ml/min and 6.9 bar**
- **2 year standard cell warranty**
- **Optional automatic water fill and remote networking capability**

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Product Selection

Model	Flow Rate	Purity*	Water Consumption (24/7, full flow)	Delivery Pressure		Optional Auto Water Fill (AWF)
	ml/min	%	L/week	bar g	psi g	
20H-MD	160	>99.99995	1.69	0.69-6.89	10-100	YES
40H-MD	250	>99.99995	2.41	0.69-6.89	10-100	YES
60H-MD	500	>99.99995	4.82	0.69-6.89	10-100	YES
110H-MD	1100	>99.99995	10.60	0.69-6.89	10-100	Standard

*With respect to oxygen

Note: For auto water fill option add suffix AWF ie 20H-MD-AWF

Technical Data

Ambient Temperature Range		5 - 40°C 41 - 104°F
Water Supply Pressure*		0.1 bar g 1.45 psi g
Water Supply Flow Rate*		1 L/min
Water Quality		Deionised. ASTM II, >1MΩ, <1µs, filtered to <100µm
Supply Voltage Range		90V - 264V 50/60Hz
Port Connections	Hydrogen Outlet Water Drain Water Fill*	1/8" Compression Fitting Quick Release Push in Fitting Quick Release Push in Fitting

*With optional AWF

Weights and Dimensions

Model	Height (H)		Width (W)		Depth (D)		Weight (Empty)		Weight (Full of Water)	
	mm	in	mm	in	mm	in	kg	lb	kg	lb
20H-MD	456	17.9	342	13.5	470	18.5	20.5	45.2	25	55.1
40H-MD	456	17.9	342	13.5	470	18.5	20.5	45.2	25	55.1
60H-MD	456	17.9	342	13.5	470	18.5	20.5	45.2	25	55.1
110H-MD	456	17.9	342	13.5	470	18.5	23.6	51.8	28	61.7

Preventative Maintenance

Preventative Maintenance Kit	Part Number	Change Frequency
6 Month Kit	604971500	6 Months
24 Month Kit	604970720	24 Months

Optional Extra's

Description	Part Number	Required for
Remote Networking User Software	604971530	Allows cascading of two generators or more
Remote User Expansion Module	604971540	Each additional generator (604971530 required)
Installation kit	IK7532	Suitable for all hydrogen generators

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Zero Air Generators

for GC combustion detector applications

The Parker domnick hunter UHP-ZA zero air generators produce a continuous stream of organic impurity free air from an external dry compressed air source and offer superior limits of detection over and above other modes of supply. Flow rates range from 1 L/min to 30 L/min.

The UHP-ZA generators feature an interchangeable top panel facilitating the direct mounting of any Parker domnick hunter hydrogen generator. The stackable system forms an innovative, modular FID gas station suitable for all known GC combustion detectors such as FID, FPD and NPD.

UHP-ZA generators may also be used in many other chemical analysis and life science applications, including LC/MS source gas, zero and combustion gas for total hydrocarbon analysers and as a gas sensing calibration and dilution gas.

Contact Information:

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Dukesway, Team Valley Trading Estate
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England NE11 0PZ

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

Product Features:

- **Ultra high purity, organic free, air for GC combustion detectors**
- **Increase resolution and detection limits of analysis**
- **Compact, reliable with minimal operator attention and maintenance**
- **Eliminate inconvenient and potentially dangerous air cylinders**
- **Payback period typically less than 24 months**
- **Models available to supply up to 75 FID's**

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Product Selection

Model	Flow Rate	Organic Impurity	Air Inlet @ 4 -10 bar g (58-145 psi g)	Delivery Pressure		Integral Compressor
	L/min	ppm	L/min	bar g	psi g	
UHP-10ZA-S	1	<0.1	1.2	4-10	58-145	NO
UHP-35ZA-S	3.5	<0.1	4.2	4-10	58-145	NO
UHP-50ZA-S	5.0	<0.1	6.0	4-10	58-145	NO
UHP-75ZA-S	7.5	<0.1	9.0	4-10	58-145	NO
UHP-150ZA-S	15	<0.1	18	4-10	58-145	NO
UHP-200ZA-S	20	<0.1	24	4-10	58-145	NO
UHP-300ZA-S	30	<0.1	35	4-10	58-145	NO

Note: Add suffix 'E' for 207-253V 50/60Hz ie. UHP-10ZA-S-E
Add suffix 'W' for 103 -126V 60Hz ie. UHP-10ZA-S-W

Technical Data

Ambient Temperature Range		5 - 40°C 41 - 104°F
Inlet Air Quality		Clean dry compressed air ISO8573-1:2001 Class 3.2.1
Supply Voltage Range		103 - 126V 60Hz 207 - 253V 50/60Hz
Port Connections	Outlet (UHP-10ZA-S & UHP-35ZA-S) Inlet (UHP-10ZA-S & UHP-35ZA-S) Outlet (UHP-50ZA-S - UHP-300ZA-S) Inlet (UHP-50ZA-S - UHP-300ZA-S)	1/8" Compression Fitting 1/8" Compression Fitting 1/4" Compression Fitting 1/4" Compression Fitting

Weights and Dimensions

Model	Height (H)		Width (W)		Depth (D)		Weight	
	mm	in	mm	in	mm	in	kg	lb
UHP-10ZA-S	325	12.8	340	13.4	425	16.7	10.2	22.5
UHP-35ZA-S	455	17.9	340	13.4	425	16.7	14.2	31.3
UHP-50ZA-S	455	17.9	340	13.4	425	16.7	14.2	31.3
UHP-75ZA-S	455	17.9	340	13.4	425	16.7	14.2	31.3
UHP-150ZA-S	455	17.9	340	13.4	425	16.7	15.2	33.5
UHP-200ZA-S	455	17.9	340	13.4	425	16.7	15.2	33.5
UHP-300ZA-S	455	17.9	340	13.4	425	16.7	15.2	33.5

Preventative Maintenance

Preventative Maintenance Kit	Part Number	Change Frequency
Inlet Filter PM Kit - all models	005A0	12 Months
Outlet Filter PM Kit - all models	005AA	12 Months
Fan PM Kit, 230V - all models	606272525	24 Months
Fan PM Kit, 120V - all models	606272526	24 Months

Optional Extra's

Description	Part Number	Required for
Installation kit	IK76803	Suitable for all zero air generators

Ultra High Purity Zero Nitrogen Generators

for GC makeup gas and carrier gas applications

The Parker domnick hunter zero nitrogen generators employ robust, field proven technology to produce ultra high purity nitrogen for GC makeup and carrier gas applications. An integral heated platinum catalyst ensures carrier grade nitrogen free from organic impurities to <0.1ppm.

The generators provide a continuous stream of ultra high purity nitrogen from a single 'plug & play' unit. Models are available with and without an integral oil free compressor, are extremely quiet in operation and are fully approved for use by major instrumentation manufacturers.

Innovative design features include economy mode as standard which extends compressor life and significantly reduces on going running costs.

Contact Information:

Parker Hannifin Manufacturing Limited
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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: gasgen@parker.com
www.parker.com/dhfns

Product Features:

- **Ultra high purity, organic free, nitrogen**
- **Economy mode as standard, increases compressor life**
- **Ideal for GC make-up and carrier gas applications including ECD**
- **Integral oil free compressor, with advanced noise reduction technology**
- **Eliminate inconvenient and potentially dangerous nitrogen cylinders**
- **Compact, reliable with minimal operator attention and maintenance**

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Product Selection

Model	Flow Rate	Purity*		Inlet Air @ 9 bar (130psi g)	Delivery Pressure		Integral Compressor
	L/min	ppm organic impurity	%	L/min	bar g	psi g	
UHPZN2-1000	1	<0.1 Total Hydrocarbons	>99.9995%	42	5	72.5	NO
UHPZN2-1000C	1	<0.1 Total Hydrocarbons	>99.9995%	n/a	5	72.5	YES
UHPZN2-3000	3	<0.1 Total Hydrocarbons	>99.9995%	52	5	72.5	NO
UHPZN2-3000C	3	<0.1 Total Hydrocarbons	>99.9995%	n/a	5	72.5	YES

*Purity with respect to oxygen

Note: Add suffix 'E' for 207-253V 50/60Hz ie. UHPZN2-1000-E
Add suffix 'W' for 103 -126V 60Hz ie. UHPZN2-1000-W

Technical Data

Ambient Temperature Range		15 - 25°C 59 - 77°F
Inlet Air Quality†		Clean dry compressed air ISO8573-1:2001 Class 2.-.1
Supply Voltage Range		103 - 126V 60Hz 207 - 253V 50/60Hz
Port Connections	Inlet† Outlet	1/4" Compression Fitting 1/8" Compression Fitting

†Non compressor models only

Weights and Dimensions

Model	Height (H)		Width (W)		Depth (D)		Weight (with compressor)		Weight (without compressor)	
	mm	in	mm	in	mm	in	kg	lb	kg	lb
UHPZN2 range	869	34.2	345	13.6	667	26.3	96	211.6	86	189.5

Preventative Maintenance

Preventative Maintenance Kit	Part Number	Change Frequency
Filter Kit - non compressor option	606272561	12 months
Filter Kit - compressor option	606272563	12 months
Compressor Kit 230V	606272581	4,000 hours or 12 months (which ever comes first)
Compressor Kit 120V	606272583	4,000 hours or 12 months (which ever comes first)

Optional Extra's

Description	Part Number	Required for
Installation kit	IK7694	Suitable for all zero nitrogen generators

Catalogue: 174004742_03_EN 06/12

Notes

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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