Analytical Gas Systems Product Catalog

Bulletin AGS A

Parker is the world's leading diversified manufacturer of motion and control technologies and systems serving many markets.

Markets Parker serves:

- Commercial transport
- Military aircraft and missiles
- Regional transports
- General aviation
- Business aircraft
- Helicopters
- Engines
- Power plants/power generation
- Construction machinery
- Automotive
- Agriculture
- Transportation
- Mobile machinery
- Natural resources
- Machine tools
- Aerial lift
- Plastic machinery
- Mining equipment
- Hoists & cranes
- Lawn & garden
- Industrial machinery
- Conveyors
- Pulp & paper
- Metalworking
- Process control
- Printing
- Semiconductor manufacturing
- Packaging
- Mobile air conditioning
- Mobile & industrial generators
- Industrial refrigeration
- Supermarket refrigeration
- Commercial refrigeration
- Residential air conditioning
- Fuel dispensing
- Chemical processing
- Telecommunications
- Information technology
- Marine
- Environmental
- Oil & gas exploration
- Process analytical applications
- Medical & bio/pharmaceutical

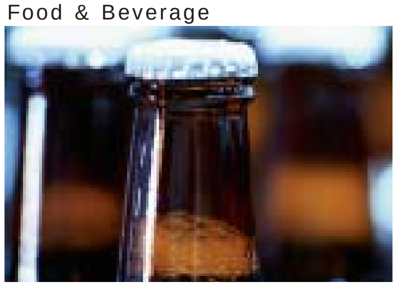
Marine

Hydraulic, fluid connector, seal, pneumatic, air conditioning and filtration components and systems.

Mobile Machinery

Hydraulic and fluid connector components and complete systems for mobile machinery.

Food & Beverage



Pneumatic, electromechanical and connector components plus filtration for automation systems.

Refrigeration & Air Conditioning

System-control and fluid-handling components and systems for refrigeration, air-conditioning and industrial equipment.

Machine Tool

Rigid and flexible connectors and associated products for pneumatic and fluid systems. Hydraulic & pneumatic components and systems.

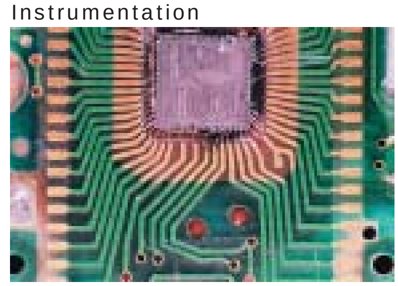
Electronics

Industrial and commercial sealing devices plus connector and related products.

Aerospace

Control systems and components for aerospace and related high-technology markets. Aviation fuel filtration products.

Instrumentation



High-quality critical flow components for process instrumentation, ultra-high-purity, medical and analytical applications.

Legal Notifications

⚠ **WARNING**

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Offer of Sale

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the "Offer of Sale".

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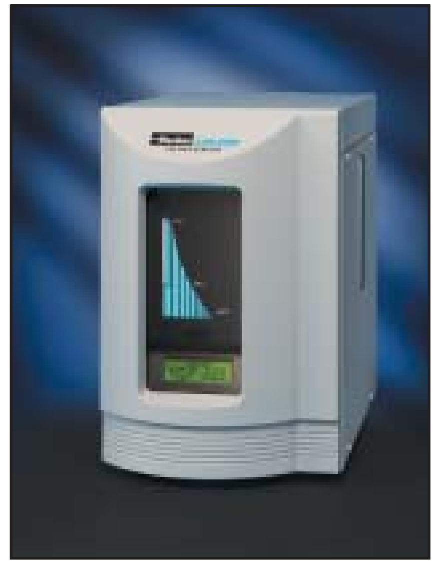
FID Gas Stations

- ▲ **Ideal for up to 5-6 FIDs**
- ▲ **Produces UHP zero air from house compressed air (<0.05 ppm THC) and 99.9995% pure hydrogen in one enclosure**
- ▲ **Eliminates inconvenient and dangerous zero air and hydrogen cylinders from the laboratory**
- ▲ **Increases the accuracy of analysis and reduces the cleaning requirement of the detector**
- ▲ **Recommended and used by many GC and column manufacturers**
- ▲ **Payback period of typically less than one year**
- ▲ **Automatic water fill as standard**
- ▲ **Silent operation and minimal operator attention required**



FID Gas Station

Parker Balston's FID-1000 and FID-2500 Gas Stations can provide both hydrogen gas and zero grade air to FID detectors on Gas Chromatographs. These systems are specifically designed to provide fuel gas and support air to 5-6 Flame Ionization Detectors, Flame Photometric Detectors or Total Hydrocarbon Analyzers.

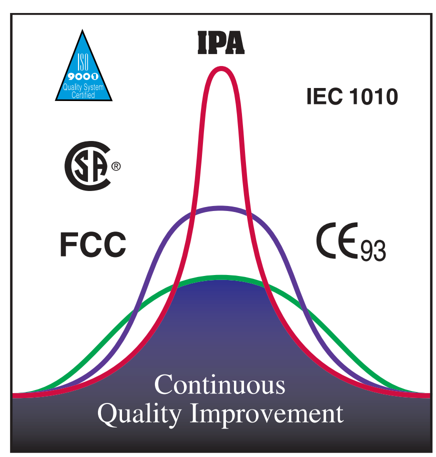
Hydrogen gas is produced from deionized water using a Proton Exchange Membrane Cell. The hydrogen generator compartment utilizes the principle of electrolytic dissociation of water and hydrogen proton conduction through the membrane. The hydrogen supply produces up to 250 cc/min of 99.9995% pure hydrogen with pressures to 60 psig.

Zero air is produced by purifying on-site compressed air to a total hydrocarbon concentration of < 0.05 ppm (measured as methane). The zero air compartment produces up to 2500 cc/min of Zero Grade Air.

The FID Gas Stations are complete systems with state-of-the-art, highly reliable components engineered for easy installation, operation, and long term performance. The Parker Balston® FID-1000 and FID-2500 eliminate all the inconveniences and cost of zero air and hydrogen cylinder gas supplies and dependence on outside vendors. Uncontrollable price increases, contract negotiations, long term commitments, and tank rentals are no longer a concern. With an FID Gas station, you control your gas supply.

All Parker Balston gas generators meet NFPA 50A and OSHA 1910.103 regulations governing the storage of hydrogen.

Produced and supported by an ISO 9001 registered organization, Parker Balston's hydrogen generators are the first built to meet the toughest laboratory standards in the world: CSA, UL, CE and IEC 1010.



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FID Gas Stations

Principal Specifications

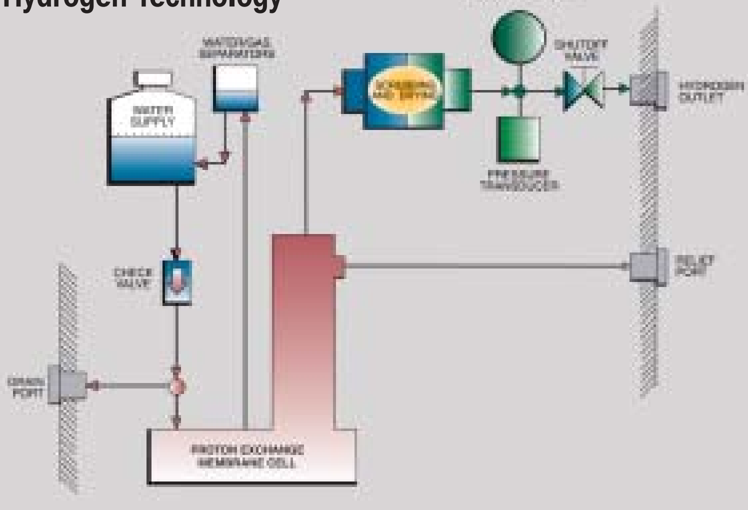
FID Gas Stations	
Hydrogen Purity	99.9995%
Zero Air Purity	<0.05 ppm (total hydrocarbon as methane)*
Maximum Hydrogen Flow Rate	FID-1000: 90 cc/min FID-2500: 250 cc/min
Maximum Zero Air Flow Rate	FID-1000: 1000 cc/min FID-2500: 2500 cc/min
Electrical Requirements	120 VAC, 60 Hz, 400 Watts
Hydrogen Outlet Pressure	60 psig
Zero Air Outlet Pressure	40-125 psig
Certifications	IEC 1010-1; CSA 1010; UL 3101; CE Mark
Dimensions	10.5"w x 17"d x 16.5"h (27cm x 43cm x 42cm)
Inlet Port	1/4" NPT (female) compressed air supply
Outlet Port	1/8" Compression
Shipping Weight	53 lbs/24 kg

*Purity of FID-1000 is <0.1 ppm (total hydrocarbons as methane)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

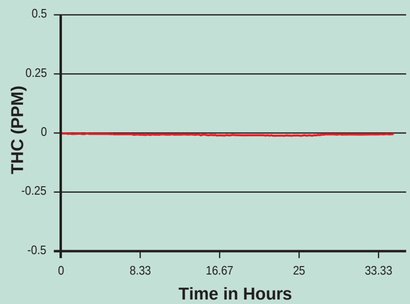
Model	Description
B02-0323	Resin Bed Cartridge
1647727	Desiccant Cartridge
FID-1000, FID-2500	FID Gas Station
MKFID1000	Maintenance Kit (Includes 1 each desiccant cartridge, 1 each resin bed cartridge, and 1 each filter cartridge)
Preventative Maintenance Contract	LFFIDGS-PM
Extended Support with 24 Month Warranty	FID-1000-DN2, FID-2500-DN2

Hydrogen Technology

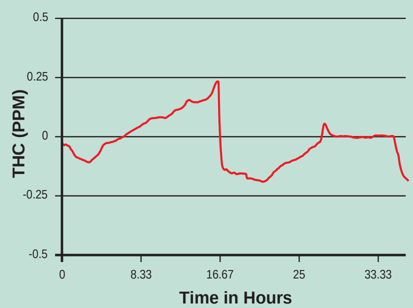


The Chromatograms (below) compare baselines produced by a Parker Balston Zero Air Generator and bottled fuel air. The baseline produced by the Parker Balston Generator is very flat, with no fluctuations or peaks, in comparison with the chromatogram of the bottled air fuel supply, which has many peaks ranging from .25 ppm to -.25 ppm.

Baseline FID-2500 Gas Station



Baseline Bottled Fuel Air



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Hydrogen Generators for Fuel Gas

- ▲ **Ideal for fuel gas, up to 14 FID's**
- ▲ **Eliminates dangerous and expensive hydrogen gas cylinders from the laboratory**
- ▲ **Certified for laboratory use by CSA, UL, IEC, 1010, and CE Mark**
- ▲ **Compact and reliable - only one square foot of bench space required**
- ▲ **Uses no liquid caustics**

Model 9400 Hydrogen Generator

Parker Balston's Proton Exchange Membrane (PEM) Cell eliminates the use of liquid electrolytes with hydrogen generators.

Proven in over 40,000 GC installations worldwide. Parker Balston's generators are the most reliable hydrogen generators on the market. Maintenance requires only a few moments per year - no inconvenient, extended downtime.

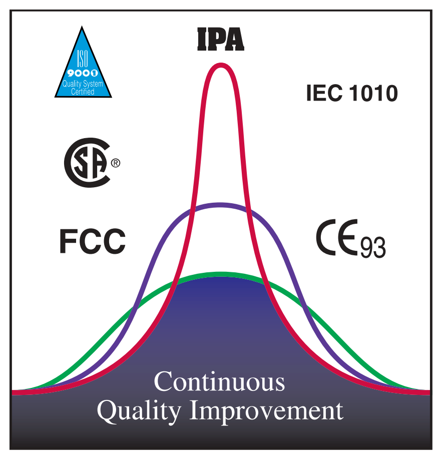
Simply change the deionizer bag every six months and the desiccant cartridge whenever it turns from light blue to grey.

Deionized water is all that is required to generate hydrogen for weeks of continuous operation.

With an output capacity of up to 500 cc/minute, one generator can supply 99.9995% pure hydrogen for up to several FID's. Based on cylinder gas savings alone, a Parker Balston® hydrogen generator pays for itself in less than a year.

All Parker Balston hydrogen generators meet NFPA requirements and OSHA 1910.103 regulations governing the storage of hydrogen.

Produced and supported by an ISO 9001 registered organization, Parker Balston's hydrogen generators are the first built to meet the toughest laboratory standards in the world: CSA, UL, CE and IEC 1010.



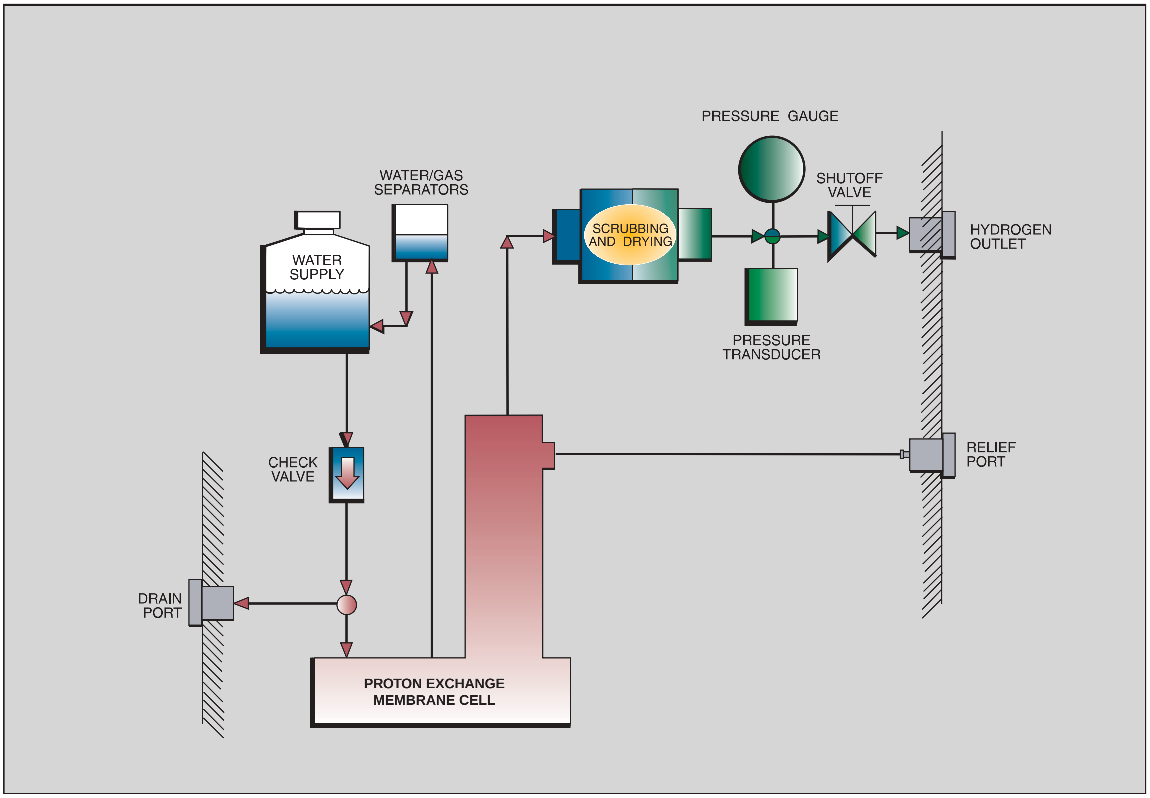
Hydrogen Generators for Fuel Gas

Principal Specifications

Model Number	H2-90NA	9150	9200	9400
Purity	99.9995%	99.9995%	99.9995%	99.9995%
Flow Rates	90 cc/min	160 cc/min	250 cc/min	500 cc/min
Outlet Port	1/8" compression	1/8" compression	1/8" compression	1/8" compression
Electrical	117 Vac/234 Vac	117 Vac/234 Vac	117 Vac/234 Vac	117 Vac/234 Vac
Pressure Control	5 to 20 psig±0.5% 20 to 90 psig±0.2%	5 to 20 psig±0.5% 20 to 90 psig±0.2%	5 to 20 psig±0.5% 20 to 90 psig±0.2%	5 to 20 psig±0.5% 20 to 90 psig±0.2%
Delivery Pressure	2 to 30 psig±0.3% 30 to 90 psig±0.2%	2 to 30 psig±0.3% 30 to 90 psig±0.2%	2 to 30 psig±0.3% 30 to 90 psig±0.2%	2 to 30 psig±0.3% 30 to 90 psig±0.2%
Shipping Weight	40 lb (18 kg) dry	40 lb (18 kg) dry	40 lb (18 kg) dry	40 lb (18 kg) dry
Dimensions	13"H x 15"W x 14"D (33cm x 38cm x 36cm)	13"H x 15"W x 14"D (33cm x 38cm x 36cm)	13"H x 15"W x 14"D (33cm x 38cm x 36cm)	13"H x 15"W x 14"D (33cm x 38cm x 36cm)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Model	Description
1647727	Dessicant cartridge (1 each)
7601132	Deionizer bags (2 each)
Preventative Maintenance Contract	SPEH2-PM
Extended Support with 24 Month Warranty	H2-90-DN2, 9150-DN2, 9200-DN2, 9400-DN2



Hydrogen Technology

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Hydrogen Generators for Fuel and Carrier Gas

Model H2-300 UHP Hydrogen Generator

- **Eliminates dangerous and expensive hydrogen gas cylinders from the laboratory**
- **Exceeds OSHA 1910.103 and NFPA 50A safety requirements**
- **Safe - produces only as much gas as you need**
- **Unique electron beam palladium cell technology**
- **Produces a continuous supply of 99.99999+% pure hydrogen gas, ideal for carrier and fuel gas applications**
- **Compact and reliable - only one square foot of bench space required and designed to run continuously 24 hours/day - includes automatic water fill**
- **Simple annual maintenance, without desiccants**
- **Certified for laboratory use by CSA, UL, IEC 1010, and CE Mark**

Parker Balston® Hydrogen Generators eliminate the need for expensive, dangerous, high pressure cylinders of hydrogen in the laboratory. It is no longer necessary to interrupt important analysis to change cylinders.

Generator flow capacities of up to 300 cc/min. of ultra high purity hydrogen are available.

The Parker Balston Hydrogen Generators are compact benchtop units designed for use in the laboratory or in the field.

Hydrogen gas is produced by electrolytic dissociation of water. The resultant hydrogen stream then passes through a palladium membrane to assure carrier grade purity.

Only hydrogen and its isotopes can penetrate the palladium membrane; therefore, the purity of the output gas is guaranteed to be 99.99999+% consistently. This technology produces hydrogen at a guaranteed purity two orders of magnitude greater than desiccant or silica gel technologies.

Parker Balston Hydrogen Generators offer many special features to ensure safe and convenient operation. These features include smart-display technology system status at a glance and automatic water fill for endless operation.

Applications

Gas Chromatographs

Emmissions Test Equipment

Hydrogenation Reactors

ICP-MS Collision Gas

Fuel Cells

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Hydrogen Generators for Fuel and Carrier Gas

Principal Specifications

Hydrogen Generators	Models	Specifications
Hydrogen Purity		99.99999+%
Oxygen Content		<.01 ppm
Moisture Content		<1.0 ppm
Max Hydrogen Flow Rate	H2-150 H2-300	150 cc/min 300 cc/min
Electrical Requirements		120 VAC/60 Hz, 3.15 Amps
Hydrogen Outlet Pressure		Adjustable, 0 to 60 psig
Certifications		IEC 1010-1; CSA UL 3101; CE Mark
Dimensions		12"w x 12"d x 22"h (30cm x 33cm x 58cm)
Outlet Port		1/8" Compression
Shipping Weight		58 lbs (26 kg)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern

Description	Model Number
Hydrogen Gas Generator	H2-150, H2-300
Electrolyte Solution	920071
Pressure Regulator	W-425-4032-000
Installation Kit	IK7532
Preventative Maintenance Contract	PDH2-PM
Extended Support with 24 Month Warranty	H2-150-DN2, H2-300-DN2

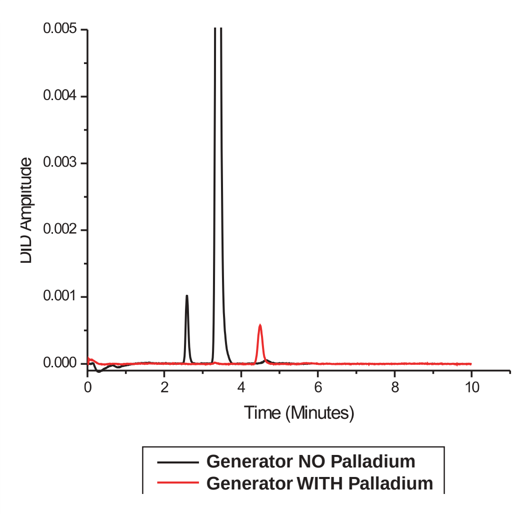
The Parker Balston® Hydrogen Generator is an excellent source of ultra pure, dry hydrogen for a wide range of laboratory uses. The generator is used extensively with Gas Chromatographs, as a fuel gas for Flame Ionization Detectors (FID), as a reaction gas for Hall Detectors, and as a carrier gas to ensure absolute repeatability of retention times. In high sensitivity Trace Hydrocarbon Analyzers and air pollution monitors, the hydrogen produced ensures the lowest possible background noise.

Other applications include using hydrogen for hydrogenation reactions and for FID's used in the analysis of engine gas emissions in the automobile industry.

In all applications the Parker Balston Hydrogen Generator sets the standard for safety, operational performance, and dependability.

Simple Experimental: The two merged baselines in the right chromatogram were created using a Gow-Mac Gas Chromatograph Series 590 equipped with a (DID) discharge ionization detector with hydrogen separator. In creating both baselines (black and red) the gas sample is hydrogen from a hydrogen generator. Both generators are the same - as hydrogen gas is produced from water via electrolytic disassociation, but differ slightly as one generator incorporates a desiccant drying tube as a final purifier while the second generator has a palladium membrane as the final purifier.

The large black peak represents a combined 12 ppm concentration of oxygen and nitrogen, suitable for hydrogen fuel gas while the corresponding point in the red baseline represents a combined 12 ppb concentration of oxygen and nitrogen, suitable for either fuel or carrier gas.



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Hydrogen Generators for Fuel and Carrier Gas

- ▲ Flow capacity up to 1,200 cc/min
- ▲ Ideal for high speed and fast GC applications
- ▲ Eliminates dangerous and expensive helium and hydrogen gas cylinders from the laboratory
- ▲ Safe — produces only as much gas as you need
- ▲ Produces a continuous supply of 99.99999% pure hydrogen gas at 100 psig, ideal for carrier and fuel gas applications
- ▲ Compact and reliable — only one square foot of bench space required and designed to run continuously 24 hours/day
- ▲ Smart display indicates system status at a glance
- ▲ Automatic water feed for continuous operation*
- ▲ Simple maintenance, without desiccants
- ▲ Certified for laboratory use by CSA, UL, IEC 1010, and CE Mark

Model H2-1200NA UHP Hydrogen Generator

The Parker Balston® Hydrogen Generator is designed as a hazard-free alternative to high pressure gas cylinders. The generator can be used with any instrumentation requiring high purity hydrogen - anywhere a standard electrical supply is available. Deionized water is all that is required to generate hydrogen for weeks of continuous operation.

With an output capacity of up to 1,200 cc/minute, one generator can supply 99.99999% pure carrier gas, at 100 psig, to multiple GCs, and fuel gas up to 40 FIDs. Based on cylinder gas savings alone, a Parker Balston hydrogen generator pays for itself in less than one year.

The Parker Balston H2-500NA, H2-800NA and H2-1200NA Hydrogen generators use a Proton Exchange Membrane (PEM) to produce UHP hydrogen on demand. Each generator incorporates a palladium purifier module to remove oxygen down to less than 0.01 ppm and moisture down to <1.0 ppm. Only 100 mL of hydrogen gas is stored in the system at any time and at a maximum of 140 psig. That's why the Parker Balston hydrogen generator meets the strict, safety guidelines of the National Fire Protection Agency (NFPA) and the regulations of the Occupational Safety and Health Association (OSHA - 1910.103). Most importantly, the Parker Balston hydrogen generator is certified for laboratory use by CSA, UL, IEC 1010, and CE. Proven in over 40,000 GC installations worldwide, Parker Balston's generators are the most reliable hydrogen generators on the market. Maintenance requires only a few moments per year - no inconvenient, extended downtime. Simply change the deionizer bag every six months. If contaminated water or low water level is detected, the system activates a warning light and shuts off the generator - avoiding harm to the system.

Hydrogen Generators for Fuel and Carrier Gas

Principal Specifications

Hydrogen Generators	
Purity	99.99999+% pure H2 Oxygen < .01 ppm Moisture < 1 ppm
Max Hydrogen Flow Rate	H2-500NA 500 cc/min* H2-800NA 800 cc/min H2-1200NA 1200 cc/min
Delivery Pressure	0 to 100 psig
Pressure Control	5 to 20 psig ± 0.5% 30 to 100 ± 0.2%
Electrical Requirement	60Hz, 100 - 130 VAC
Power Consumption	5.5 Amp @ 120 VAC
Certifications	IEC 1010-1; CSA; UL 3101, CE Mark
Dimensions, H2-800NA and H2-1200 NA	13"w x 17"d x 14.5"h
Dimensions, H2-500NA	15"w x 18"d x 13"h
Outlet Port	1/8" Compression
Shipping Weight	45 lbs (20.4 kg) dry (All)

Ordering Information **for assistance, call 800-343-4048, 8 to 5 Eastern Time**

Description	Model Number
UHP Hydrogen Gas Generator	H2-500NA*
UHP Hydrogen Gas Generator	H2-800NA
UHP Hydrogen Gas Generator	H2-1200NA
Deionizer Bags (2 each)	7601132
Preventative Maintenance Contract	SPEPDH2-PM
Extended Support with 24 Month Warranty	H2-500-DN2, H2-800-DN2, H2-1200-DN2

The Parker Balston® Hydrogen Generator is an excellent source of ultra pure, dry hydrogen for a wide range of laboratory uses. The generator is used extensively with Gas Chromatographs, as a fuel gas for Flame Ionization Detectors (FID), as a reaction gas for Hall Detectors, and as a carrier gas to ensure absolute repeatability of retention times. In high sensitivity Trace Hydrocarbon Analyzers and air pollution monitors, the hydrogen produced ensures the lowest possible background noise.

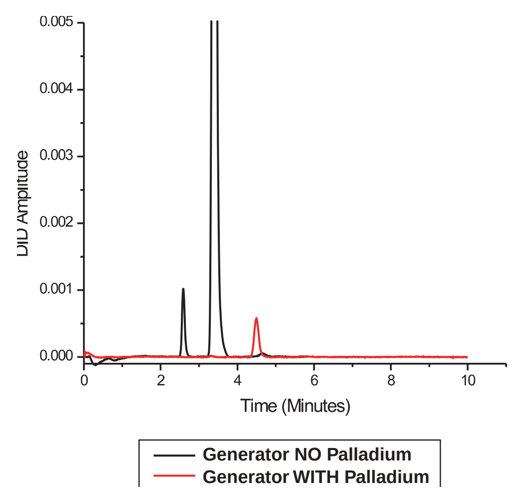
Other applications include using hydrogen for hydrogenation reactions and for FID's used in the analysis of engine gas emissions in the automobile industry.

In all applications the Parker Balston Hydrogen Generator sets the standard for safety, operational performance, and dependability.

*Does not include automatic waterfeed feature and has maximum pressure output of 90 psig.

Simple Experimental: The two merged baselines in the right chromatogram were created using a Gow-Mac Gas Chromatograph Series 590 equipped with a (DID) discharge ionization detector with hydrogen separator. In creating both baselines (black and red) the gas sample is hydrogen from a hydrogen generator. Both generators are the same - as hydrogen gas is produced from water via electrolytic disassociation, but differ slightly as one generator incorporates a desiccant drying tube as a final purifier while the second generator has a palladium membrane as the final purifier.

The large black peak represents a combined 12 ppm concentration of oxygen and nitrogen, suitable for hydrogen fuel gas while the corresponding point in the red baseline represents a combined 12 ppb concentration of oxygen and nitrogen, suitable for either fuel or carrier gas.



Analytical Gas Systems

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Zero Air Generators

- ▲ Produces UHP Zero Air from house compressed air (<0.05 ppm THC)
- ▲ Eliminates inconvenient and dangerous zero air cylinders from the laboratory
- ▲ Increases the accuracy of analysis and reduces the cleaning requirement of the detector
- ▲ Qualitative SMART-Display provides operational status at a glance
- ▲ Recommended and used by many GC and column manufacturers
- ▲ Payback period of typically less than 1 year
- ▲ Silent operation and minimal operator attention required
- ▲ Models available to service up to 66 FIDs

Model HPZA-3500

Parker Balston® Zero Air Generators are complete systems with state-of-the-art, highly reliable components engineered for easy installation, operation, and long term performance. Parker Balston Zero Air Generators are much easier to install than dangerous, high pressure gas cylinders, and only need to be installed once! All that is required is a standard compressed air line and an electrical outlet.

Parker Balston Zero Air Generators are easy to operate, there is no complicated operating procedure to learn or any labor intensive monitoring required.

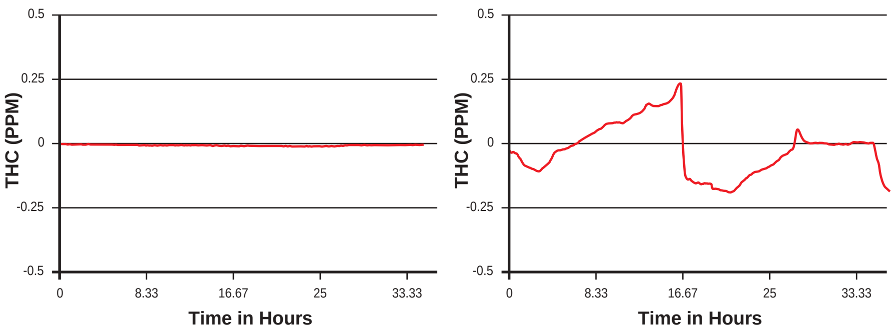
Parker Balston Zero Air Generators eliminate all the inconveniences and costs of cylinder gas supplies and dependence on outside vendors. Uncontrollable vendor price increases, contract negotiations, long term commitments and tank rentals are no longer a concern; Parker Balston Zero Air Generators offer long term cost stability.

There is no need to use valuable laboratory floor space to store excessive reserves to protect yourself from late deliveries, transportation interruptions, or periods of tight supplies. With a Parker Balston Zero Air Generator, you control your supply.

Model Number	Number of FIDs*
75-83NA	Up to 2
HPZA-3500	Up to 8
HPZA-7000	Up to 16
HPZA-18000	Up to 40
HPZA-30000	Up to 66

*Based on a 450 ccm fuel air rate.

Baseline Comparison



The Chromatograms (left) compare baselines produced by a Parker Balston® Zero Air Generator and bottled fuel air. The baseline produced by the Parker Balston Generator is very flat, with no fluctuations or peaks, in comparison with the chromatogram of the bottled air fuel supply, which has many peaks ranging from .25 ppm to -.25 ppm.

Principal Specifications

Parker Balston Models 75-83NA, HPZA-3500, HPZA-7000, HPZA-18000, HPZA-30000

Max Zero Air Flow Rate	75-83NA HPZA-3500 HPZA-7000 HPZA-18000 HPZA-30000	1 lpm 3.5 lpm 7 lpm 18 lpm 30 lpm
Outlet Hydrocarbon Concentration (as methane)*		<0 .05 ppm
Min/Max Inlet Air Pressure		40 psig/125 psig
Max Inlet Hydrocarbon Concentration (as methane)		100 ppm
Pressure Drop at Max Flow Rate		4 psig
Max Inlet Air Temperature		78°F (25°C)
Inlet/Outlet Ports		1/4" NPT (female)
Start-up Time for Specified Hydrocarbon Concentration (as methane)		45 minutes
Electrical Requirements	75-83NA HPZA-3500 HPZA-7000 HPZA-18000 HPZA-30000	120 VAC/60 Hz, 0.5 amps 120 VAC/60 Hz, 2.0amps 120 VAC/60 Hz, 2.0 amps 120 VAC/60 Hz, 4.0 amps 120 VAC/60 Hz, 4.0 amps
Dimensions	75-83NA Other Models	10"w x 3"d x 12"h (25cm x 8cm x 30cm) 11"w x 13"d x 16"h (27cm x 34cm x 42cm)
Shipping Weight	75-83NA Other Models	7 lbs.(3 kg) 41 lbs.(19 kg)

* Outlet hydrocarbon concentration (as methane) for models 75-83NA and HPZA-30000 is less than 0.1 ppm.

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description	Model Number
Zero Air Generator	75-83NA, HPZA-3500, HPZA-7000, HPZA-18000, HPZA-30000
Maintenance Kit for Model 75-83NA	MK7583
Maintenance Kit for All Other Models	MK7840
Installation kit for all models	IK76803
Preventative Maintenance Contract	LFZA-PM, MFZATOC-PM
Extended Support with 24 Month Warranty	75-83-DN2, HPZA-3500-DN2, HPZA-7000-DN2, HPZA-18000-DN2, HPZA-30000-DN2

Nitrogen Generators with Research Grade Purity

- ▲ **Produces a continuous supply of high purity nitrogen gas from existing compressed air**
- ▲ **Eliminates the need for costly, dangerous, inconvenient nitrogen cylinders in the laboratory**
- ▲ **Compact design frees up valuable laboratory floor space**
- ▲ **Offers long term cost stability - uncontrollable vendor price increases, contract negotiations, long term commitments and tank rentals are no longer a concern**
- ▲ **Ideal for carrier gas, make-up gas or solvent evaporation applications**

Model UHPN2-1100

The Parker Balston® Models HPN2 and UHPN2 Series Nitrogen Generators are completely engineered to transform standard compressed air into 99.99% or 99.9999% nitrogen, exceeding the specification of UHP cylinder gas. These systems can produce up to 1.1 lpm of UHP nitrogen gas and up to 2.0 lpm of research grade purity nitrogen gas. Nitrogen is produced by utilizing a combination of state-of-the art purification technologies and high efficiency filtration.

Pressure swing adsorption removes O_2, CO_2, and water vapor. A catalyst module is incorporated in the UHPN2 Series to oxidize hydrocarbons from the inlet air supply. High efficiency coalescing prefilters and a 0.01 micron (absolute) membrane filter is also incorporated into the design of the generators.

The Parker Balston UHPN2 and HPN2 Series Nitrogen Generators are engineered and packaged in a small cabinet to fit on or under any benchtop. The systems eliminate the need for costly, inconvenient high pressure nitrogen cylinders. Typical applications include GC carrier and make-up gas and low flow sample concentrators.

Flow Table

Inlet Air Pressure (psig)	**Max Outlet Flow** (cc/min.)	**Max Outlet Pressure** (psig)
Models HPN2-1100 and UHPN2-1100		
125	1100	85
110	1000	75
100	900	65
90	800	60
80	700	50
70	600	45
60	500	35
Model HPN2-2000		
75-120	2000	90

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Nitrogen Generators with Research Grade Purity

Principal Specifications

Model	HPN2-1100, UHPN2-1100	HPN2-2000
Max Nitrogen flow rate	See Flow Table	2 lpm
Nitrogen Purity	99.9999%	99.99%
Max Nitrogen output pressure	See Table	90 psig
CO_2 concentration	< 1 ppm	< 1 ppm
O_2 concentration	< 1 ppm	< 100 ppm
H_2O Concentration	< 1 ppm	< 2 ppm
Hydrocarbon concentration (1)	< 0.1 ppm	NA
Argon concentration (2)	0.9%	0.9%
Min/Max inlet pressure	60 psig/125 psig	75 psig/120 psig
Recommended inlet temperature	78°F (25°C)	78°F (25°C)
Ambient operating temperature	60°F-100°F (16°C-38°C)	60°F-100°F (16°C-38°C)
Max air consumption	42 lpm (1.5 scfm)	42 lpm (1.5 scfm)
Inlet connection	1/4" NPT (female)	1/4" NPT (female)
Outlet connection	1/8" compression	1/8" NPT compression
Electrical requirements (3)	120 VAC/60 Hz	120 VAC/60 Hz
Dimensions	12" w x 16" d x 35" h (30cm x 41cm x 89cm)	12" w x 16" d x 35" h (30cm x 41cm x 89cm)
Shipping Weight	110 lbs. (50 kg)	110 lbs. (50 kg)

Notes:

1 Models HPN2-1100 and HPN2-2000 do not remove hydrocarbons.

2 Purity specification for Nitrogen does not include Argon concentration.

3 Power Consumption is as follows: Model HPN2-1100 = 25 Watts, Model UHPN2-1100 = 700 Watts, Model HPN2-1100 = 25 Watts.

Ordering Information call 800-343-4048, 8 to 5 EST

Description	Model Numbers
High Purity Nitrogen Generator	HPN2-2000
Ultra High Purity Nitrogen Generator	HPN2-1100 and UHPN2-1100
Purity Indicator/Scrubber	72092
Optional Prefilter Assembly	72-100NA
Pressure Regulator	W-425-4032-000
Maintenance Kit	MK7692*, MK7694
Installation Kit for all models	IK7694
Preventative Maintenance Contract	LFHPN2-PM*, LFUHPN2-PM
Extended Support with 24 Month Warranty	HPN2-1100-DN2, UHPN2-1100-DN2, HPN2-2000-DN2

* For use with Generator Model HPN2-1100.

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Explosion-Proof Zero Air Generator

- ▲ **Eliminates dangerous, expensive, and inconvenient gas cylinders from the laboratory**
- ▲ **Safe, even in explosive environments**
- ▲ **Low maintenance**
- ▲ **Produces a continuous supply of ultra high purity zero grade air**
- ▲ **Compact and reliable**
- ▲ **Designed to mount on Unistrut® framing or directly on the wall**
- ▲ **Certified by CSA (CSA NRTL/C)**

Model 75-82S

The Parker Balston® Model 75-82S Zero Air Generator produces up to 1,000 cc/min. of high purity zero grade air from a standard compressed air supply. The generator utilizes state-of-the-art catalytic technology to convert compressed air into zero-grade air, at safe regulated pressures, on a continuous basis without the need of operator attention.

The housing is a standard Crouse-Hinds® explosion-proof enclosure designed to operate in a class 1, division 1, groups B, C, D environments. The internals are all stainless steel. This generator completely eliminates the need for expensive, inconvenient and dangerous gas cylinders. It is a turnkey system, ready to install on Unistrut frames or directly to the wall.

The Parker Balston® Model 75-82S Zero Air Generator can be used as: a fuel air supply to process GC-FIDs, and zero grade gas supply/zero reference for process analytical instruments.

Zero grade air is produced from compressed air by means of catalytic oxidation. The compressed air is channeled into a heated catalyst bed where the hydrocarbons are converted to carbon dioxide and water vapor, producing zero-grade air with less than 0.1 ppm hydrocarbon content (measured as methane). The use of a Parker Balston 75-82S Zero Air Generator has advantages over the conventional sources of fuel air for GC analysis. For example, a lower and more stable baseline signal can be obtained. Lower baseline noise means higher signal-to-noise ratio, giving rise to higher sensitivity or larger peak areas. The result is increased accuracy and reduced cleaning requirement of the detector.

Principal Specifications

Model 75-82S Zero Air Generator	
Explosion Proof Certification (CSA NRTL/C)	Class 1, Division1, Groups B, C, and D
Maximum Flow Rate	1000 cc/min.
Total Hydrocarbon Concentration	< 0.1 ppm (measured as methane)
Min./Max. Inlet Pressure	40 psig/125 psig
Maximum Inlet Hydrocarbon Content	100 ppm
Maximum Inlet Air Dewpoint	10°F (5°C) above ambient
Pressure Drop at Max. Flow Rate	< 8 psid
Outlet Air Temperature	Ambient +20°F (+11°C)
Start-up Time	45 min.
Electrical Requirements	120 VAC/60 Hz, 0.5 amps
Shipping Weight	28 lbs. (13 kg)
Dimensions	11"w X 7"h X 6"d (28 cm X 18 cm X 15 cm)

Principal Specifications

Description	**Model Number**
Zero Air Generator	75-82S
Replacement Catalyst Module	75398
Final Filter Cartridge	75820
Optional Prefilter Assemblies	2002N-1B1-DX, 2002N-1B1-BX
Installation Kit	IK76803
Preventative Maintenance Contract	EXZA-PM
Extended Support with 24 Month Warranty	75-82S-DN2

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FT-IR Purge Gas Generators

- ▲ **Eliminates the need for costly, dangerous, inconvenient nitrogen cylinders in the laboratory**
- ▲ **Compact design frees up valuable laboratory floor space**
- ▲ **Improves signal-to-noise ratio even on non-purge systems**
- ▲ **Increases FT-IR sample thru-put and maximizes up-time**
- ▲ **Recommended and used by all major FT-IR manufacturers**

Models 75-52NA, 75-62NA, and 75-45NA

The Parker Balston® FT-IR Purge Gas Generator is specifically designed for use with FT-IR Spectrometers to provide a purified purge and air bearing gas from compressed air. The generator supplies carbon dioxide-free air at less than -100°F (-73°C) dew point with no suspended impurities larger than 0.01 µm. The unit is designed to operate continuously 24 hours/day, 7 days/week. The Parker Balston Purge Gas Generator completely eliminates the inconvenience and the high costs of nitrogen cylinders and dewars, and significantly reduces the costs of operating FT-IR instrumentation. The Parker Balston unit offers cleaner background spectra in a shorter period of time and more accurate analysis by improving the signal-to-noise ratio. The typical payback period is less than one year. The generator is also ideally suited for use with CO_2 Analyzers and Matrix GC's in addition to supplying gas to other laboratory instruments.

The generators are quiet, reliable, and easy to install - simply attach the inlet and outlet air lines (at least 60 psig and 1/4 inch pipe), plug the power cord into a wall outlet, and enjoy trouble-free operation.

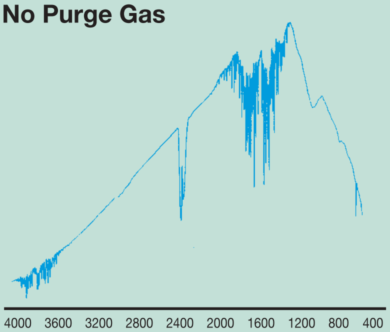
Here's what your colleagues say:

"A Parker Balston® FT-IR Purge Gas Generator and Self Contained Lab Gas Generator were used in conjunction with the Society for Applied Spectroscopy Fourier Transform Infrared Spectrometry Workshop at the University of Georgia, June 2000 (organized by Dr. James A de Haseth and Dr. Peter R. Griffiths). The Self-Contained Lab Gas Generator provided excellent purge for six spectrometers. The organizers were so pleased with the performance of the Parker Balston® systems, they have requested that Parker Hannifin Corporation, Inc. participate in future workshops."

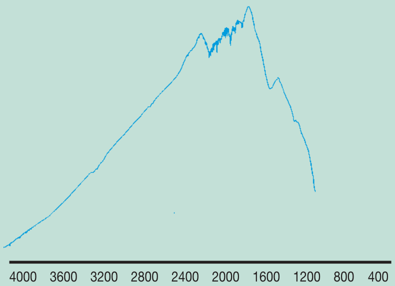
- Dr. James A. de Haseth and Dr. Peter R. Griffiths

Comparative Spectral Analysis in Purging an FT-IR Sample Chamber

No Purge Gas



2 Minutes Parker Balston®



This spectra comparison illustrates that a Parker Balston® FT-IR Purge Gas Generator allows an FT-IR to be purged at a much higher flow rate than is practical with nitrogen.

The sample chamber purged by the Parker Balston unit if free of CO_2 and water faster than the sample chamber purged by nitrogen.

Principal Specifications

Flow Rate for Specified Dew Point		
Inlet Pressure 125 psig	75-45NA	36 scfh (17 lpm)
Inlet Pressure 60 psig		18 scfh (9 lpm)
Inlet Pressure 125 psig	75-52NA	72 scfh (34 lpm)
Inlet Pressure 60 psig		36 scfh (17 lpm)
Inlet Pressure 125 psig	75-62NA	216 scfh (102 lpm)
Inlet Pressure 60 psig		120 scfh (57 lpm)
CO_2 Concentration		< 1 ppm
Dew Point		-100°F (-73°C)
Min/Max Inlet Air Pressure		60 psig/125 psig
Max Inlet Air Temperature (1)		78°F (25°C)
Air Consumption for regeneration (2)	75-45NA	30 scfh (14 lpm)
	75-52NA	60 scfh (28 lpm)
	75-62NA	120 scfh (57 lpm)
Inlet/Outlet Port Size		1/4" NPT (female)
Electrical Requirements		120 VAC/60 Hz/10 watts
Dimensions	75-45NA	7"w x 13"h x 6"d (18cm x 33cm x 15cm)
	75-52NA	13"w x 28"h x 9"d (32cm x 71cm x 23cm)
	75-62NA	13"w x 42"h x 9"d (32cm x 102cm x 23cm)
Shipping Weight	75-45NA	25 lbs (11 kg)
	75-52NA	40 lbs (20 kg)
	75-62NA	80 lbs (36 kg)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description		Model Number
FT-IR Purge Gas Generator		75-45NA, 75-52NA, 75-62NA
Annual Maintenance Kit	75-45NA	MK7505
	75-52NA	MK7552
	75-62NA	MK7520
Installation Kit for all models		IK7572
Preventative Maintenance Contract	75-45NA	LFFTIR-PM
	75-52NA	MFFTIR-PM
	75-62NA	HFFTIR-PM
Extended Support with 24 Month Warranty		75-45-DN2, 75-52-DN2, 75-62-DN2

Notes
1 Outlet dew point will increase at higher inlet compressed air temperatures.
2 Total air consumption = regeneration flow + flow demand.

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Self-Contained FT-IR Purge Gas Generator

- ▲ **Less expensive and more convenient than nitrogen cylinders and dewars**
- ▲ **Includes state-of-the-art, oil-less compressor**
- ▲ **Compact, portable design is ideal for mobile labs**
- ▲ **Improves signal-to-noise ratio even on non-purge systems**
- ▲ **Increases FT-IR sample thru-put and maximizes up-time**
- ▲ **Special sound insulation design ensures quiet operation**

Model 74-5041NA

The Parker Balston® Model 74-5041NA FT-IR Purge Gas Generator is specifically designed for use with FT-IR spectrometers to provide a purified purge and air bearing gas supply from compressed air. The Parker Balston model 74-5041NA provides instruments with CO_2-free compressed air at less than -100°F (-73°C) dew point with no suspended impurities larger than 0.01 micron 24 hours/day, 7 days/week. The Parker Balston Self-Contained FT-IR Purge Gas Generator completely eliminates the inconvenience and the high costs of nitrogen cylinders and Dewars, and significantly reduces the costs of operating FT-IR instruments.

The Parker Balston unit generates cleaner background spectra in a shorter period of time and more accurate analysis by improving the signal-to-noise ratio. The typical payback period is less than one year.

The generator is quiet, very reliable, and easy to install - simply attach the outlet air line, plug the electrical cord into a wall outlet, and the unit is ready for trouble-free operation.

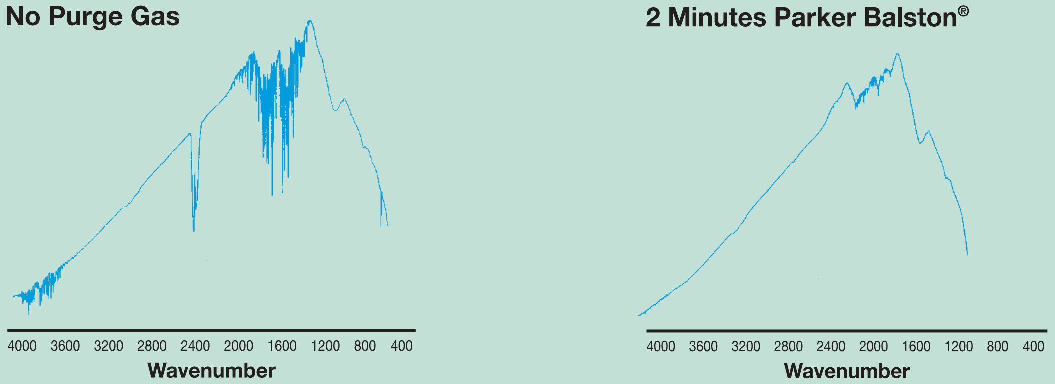
Here's what your colleagues say:

"A Parker Balston® FT-IR Purge Gas Generator and Self Contained Lab Gas Generator were used in conjunction with the Society for Applied Spectroscopy Fourier Transform Infrared Spectrometry Workshop at the University of Georgia, June 2000 (organized by Dr. James A de Haseth and Dr. Peter R. Griffiths). The Self-Contained Lab Gas Generator provided excellent purge for six spectrometers. The organizers were so pleased with the performance of the Parker Balston® systems, they have requested that Parker Hannifin Corporation, Inc. participate in future workshops."

- Dr. James A. de Haseth and Dr. Peter R. Griffiths

Self-Contained FT-IR Purge Gas Generator

Comparative Spectral Analysis in Purging an FT-IR Sample Chamber



This spectra comparison illustrates that a Parker Balston FT-IR Purge Gas Generator allows an FT-IR to be purged at a much higher flow rate than is practical with nitrogen. The sample chamber purged by the Parker Balston unit if free of CO_2 and water faster than the sample chamber purged by nitrogen.

Principal Specifications

Self-Contained FT-IR Purge Gas Generator	**74-5041NA**
Maximum Flow Rate (at 80 psig)	60 SCFH (28 lpm)
Maximum Output Pressure	80 psig
CO_2 Concentration	< 1 ppm
Dew Point	-100°F (-73°C)
Outlet Port Size	1/4" NPT (female)
Min/Max Ambient Temperature	30°F/90°F (-1°C/32°C)
Electrical Requirements (single phase)	120 VAC/60 Hz, 20 amps
Compressor	3/4 hp
Dimensions	18"w x 31"h x 32"d (46 cm x 76 cm x 81 cm)
Shipping Weight	250 lbs. (114 kg)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description	Model Number
FT-IR Purge Gas Generator	74-5041NA
Annual Maintenance Kit	74065
Preventative Maintenance Contract	SCFTIR-PM
Extended Support with 24 Month Warranty	74-5041-DN2

Ultra Dry Air Gas Generator

- ▲ **Supplies ultra-dry, purified compressed air to NMR Spectrometers and other analytical instruments**
- ▲ **Ideal gas supply for spindle and automatic sample changer**
- ▲ **Completely eliminates costly, inconvenient nitrogen dewars - never pay for or change out another dewar again**
- ▲ **Compact design frees up valuable laboratory floor space**
- ▲ **Completely automatic - plug it in and forget about it.**

Model 64-20

The Parker Balston® NMR Model 64-20 Dry Gas Generator supplies ultra-dry, purified compressed air with a dew point below -100°F without operator attention. The generator is delivered complete and ready for easy installation. A high efficiency prefiltration system, automatic drains, a 0.01 µm particulate final filter, a dewpoint indicator, and pretested controls are integral to the design of the generator. To install, simply connect the house compressed air supply (60 psig, minimum) to the generator inlet port, and connect the outlet to the NMR. Plug the electrical cord into a wall outlet - no electrician required- and the unit is ready for trouble-free operation. Designed specifically for NMR Instrumentation, the generator is completely automatic, and virtually maintenance-free. It is ideal for ejecting, spinning, and lifting operations. The Parker Balston Gas Generator is recommended and used by major NMR instrument manufacturers, and is currently installed in several thousand locations.

Principal Specifications

Model 64-20 NMR Gas Generator	
Dew Point	-100°F (-73°C)
Max Dry Air Flow Rate for Specified Dew Point (3)	12 scfm (340 lpm) at 125 psig
Min/Max Inlet Air Pressure	60 psig/125 psig
Max Inlet Air Temperature (1)	78°F (25°C)
Air Consumption for Regeneration	2.5 scfm (71 lpm)
Inlet/Outlet Port Size	1/4" NPT (female)
Electrical Requirements	120 Vac, 60 Hz, 10 watts
Dimensions	41"h x 15"w x 8"d (104cm x 38cm x 20cm)
Shipping Weight	50 lbs (23 kg)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description	Model Number
NMR Gas Generator	64-20
Receiving Tank	72-012
Installation Kit	IK7572
Maintenance Kit	MK7525
Preventative Maintenance Contract	NMRDRY-PM
Extended Support with 24 Month Warranty	64-20-DN2

Notes:
1 Outlet dew point will increase at higher inlet compressed air temperatures.

ICP Spectrometer Nitrogen Generator

- ▲ **Produces a continuous supply of ultra high purity nitrogen gas from existing compressed air**
- ▲ **Eliminates the need for costly, dangerous, inconvenient nitrogen cylinders or dewars in the laboratory**
- ▲ **Extends ICP Analysis into far-UV range below 170 (nm)**
- ▲ **Compact design frees up valuable laboratory floor space**
- ▲ **Offers long term cost stability - uncontrollable vendor price increases, contract negotiations, long term commitments and tank rentals are no longer a concern**

Model 76-98NA
Nitrogen Generator

The Parker Balston® 76-97NA and 76-98NA UHP Nitrogen Generators can produce 5-12 lpm of ultra high purity nitrogen gas. These systems are completely engineered to transform standard compressed air into 99.9999% of 99.995% pure nitrogen, exceeding the specification of UHP cylinder gas and dewars. Nitrogen is produced by utilizing a combination of state-of-the-art purification technologies and high efficiency filtration. Pressure swing absorption is utilized for the removal of 02, CO_2, and water vapor. A catalyst module is incorporated in the 76-98NA to oxidize hydrocarbons from the inlet air supply. The generators also have a combination of high efficiency prefilters and a 0.01 micron (absolute) membrane filter incorporated into their design. The Parker Balston UHP Nitrogen Generators are engineered and packaged in a laboratory cabinet to fit nearly any laboratory. The systems eliminate the needs for costly, inconvenient high pressure nitrogen cylinders or dewars. The 76-97NA and 76-98NA are ideal for ICP Purge gas applications.

Applications

Other applications include high flow GC carrier gas needs, DNA Synthesis and Sequencing Equipment, Mocon Moisture Analyzers, Circular Dichroism and Gel Permeation needs.

ICP Spectrometer Nitrogen Generator

Flow Table@ 99.9999% Purity

Inlet Air Pressure (psig) **Models 76-97NA and 76-98NA**	**Max Outlet Flow** (lpm)	**Max Outlet Pressure** (psig)
120	5	83
110	5	73
100	5	63
90	4	62
80	4	51
70	2	50
60	2	42

Flow Table@ 99.995% Purity

Inlet Air Pressure (psig) **Models 76-97NA and 76-98NA**	**Max Outlet Flow** (lpm)	**Max Outlet Pressure** (psig)
120	12	60
110	12	55
100	12	45
90	10	45
80	8	40
70	8	35
60	6	33

Principal Specifications

Model	**76-97NA/76-98NA**
Nitrogen Purity	99.995% and 99.9999%
Max Nitrogen Output Pressure	See Table
CO Concentration	< 1 ppm
CO_2 Concentration	< 1 ppm
O_2 Concentration	< 1 ppm
H_2O Concentration	< 2 ppm
Hydrocarbon Concentration (1)	< 0.1 ppm
Argon Concentration (2)	0.9%
Min/Max Inlet Pressure	60 psig/120 psig
Recommended Inlet Temperature	- 78°F (25°C)
Ambient Operating Temperature	60°F-100°F (16°C-38°C)
Average Air Consumption	3.0 scfm
Inlet Connection	1/4" NPT
Outlet Connection	1/8" NPT, convertible to 1/4" NPT
Electrical Requirements (3)	120 VAC/60 Hz
Dimensions	41"h x 25"w x 25"d (104cm x 64cm x 64cm)
Shipping Weight	500 lbs (227 kg)

Ordering Information

Description	**Model Numbers**
Ultra High Purity Nitrogen Generator	76-97NA and 76-98NA
Preventative Maintenance Contract	HFUHP-PM
Extended Support with 24 Month Warranty	76-97-DN2, 76-98-DN2

Notes:

1 Model 76-97NA does not remove hydrocarbons.

2 Purity specification for Nitrogen does not include Argon concentration.

3 Power Consumption is as follows:
Model 76-97NA = 10 Watts, Model 76-98NA = 1 KW

Parker BALSTON
Analytical Gas Systems

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Self-Contained Membrane Nitrogen Generator

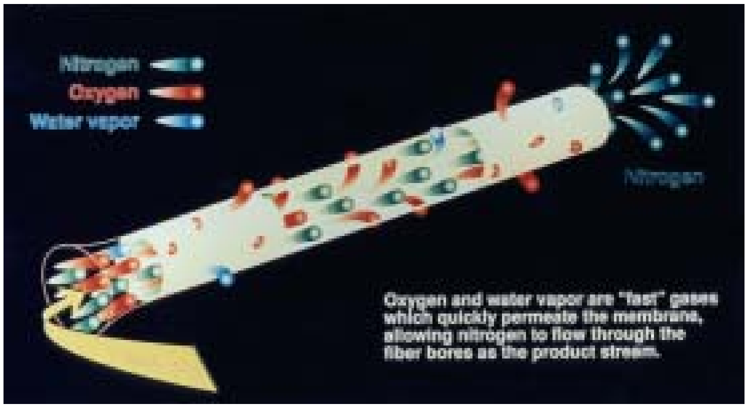
- **Less expensive and more convenient than nitrogen cylinders and Dewars**
- **Ideal for all derivatives of ESi and APCi Modes of LC/MS**
- **Includes special vortex extended life, oil-less compressor**
- **Unlike PSA and Hosmer technologies, membrane will not suppress Corona needle discharge**
- **Recommended and used by all major LC/MS manufacturers**
- **Special sound insulation design ensures quiet operation**

Model N2-30NA

The Parker Balston® N2-30NA is a self-contained membrane nitrogen generator that produces phthalate-free pure LC/MS grade nitrogen with pressures above 100 psig. Nitrogen is produced by utilizing a combination of compressor, filtration, and membrane separation technologies. A single reliable vortex compressor filtered by high efficiency coalescing filters remove all contaminants down to 0.01 micron. Hollow fiber membranes subsequently separate the clean air into a concentrated nitrogen stream and an oxygen enriched permeate stream, which is vented from the system. The combination of these technologies produces a continuous on-demand supply of pure nitrogen. Additional applications include: nebulizer gas, chemical and solvent evaporation, instrument purge and supply, evaporative light scattering detector use (HPLC), and sparging.

Principal Specifications

Model	**N2-30NA**
Nitrogen Purity	99.9%
Nitrogen Product	30 lpm
Phthalates	None
Maximum Outlet Pressure	100 psig (7 barg)
Hydrocarbon Content	<2 ppm (excluding Methane)
Atmospheric Dewpoint	-58° F (-50° C)
Outlet Port	Female 1/4" NPT
Min/Max Ambient Temperature	60°F/90°F (16° C/32°C)
Electrical Requirements	120 Vac, 60 Hz, 20 Amp
Dimensions	31"h x 18"w x 32"d (76cm x 46cm x 81cm)
Shipping Weight	285 lbs. (130 kg)
Warranty	1 year
Annual Preventative Maintenance Contract	SCLCMS-PMPLUS
Extended Support with 24 Month Warranty	N2-30-DN2



Membrane Technology

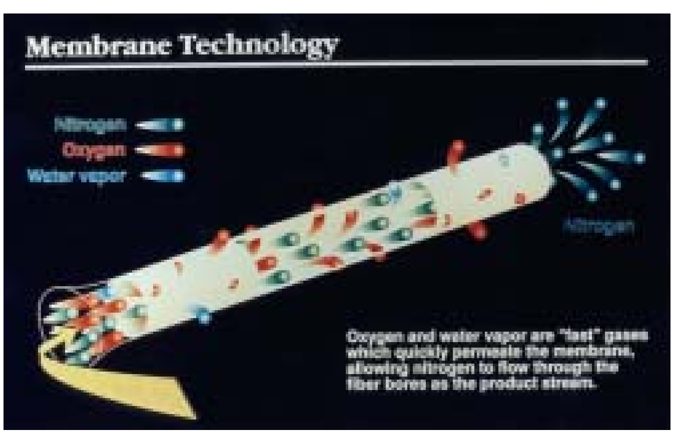
Low and Mid Flow Nitrogen Generators

- **Recommended and used by all major LC/MS manufacturers**
- **Eliminates the need for costly, dangerous, inconvenient nitrogen cylinders in the laboratory**
- **Models N2-04, N2-14, N2-22, N2-35 require no electricity**
- **Compact design frees up valuable laboratory floor space**
- **Phthalate-free, no organic vapors**
- **Unlike PSA technology, membrane will not suppress corona needle discharge.**

Model N2-14 Low Flow Membrane Nitrogen Generator

Parker Balston® Low Flow Nitrogen Generators include models N2-04, N2-14, N2-14A that produce up to 61 SLPM of compressed nitrogen, on-site. **The Parker Balston® Mid-Flow Nitrogen Generators** include models N2-22, N2-22ANA, N2-35, and N2-35ANA that produce 132 SLPM of compressed nitrogen, on-site. The purity level of the nitrogen stream is defined by the user, for the application, and may range from 95% to 99.5%.

Low Flow Model N2-14ANA and Mid Flow Models N2-22ANA and N2-35ANA Nitrogen Generators include an oxygen analyzer which monitors the oxygen concentration of the nitrogen stream. An audible alarm signals high or low oxygen concentrations. Parker Balston Nitrogen Generators are complete systems engineered to transform standard compressed air into nitrogen at safe, regulated pressures, on demand, without the need for operator attention. The systems eliminate the need for costly, dangerous dewars and cylinders in the laboratory.



Nitrogen is produced by utilizing a combination of filtration and membrane separation technologies. A high efficiency prefiltration system pretreats the compressed air to remove all contaminants down to 0.01 micron. Hollow fiber membranes subsequently separate the clean air into a concentrated nitrogen output stream and an oxygen enriched permeate stream, which is vented from the system. The combination of these technologies produces a continuous on demand supply of pure nitrogen.

This Technology Features Advanced HiFluxx Fiber!

Typical applications include: LC/MS, nebulizer gas, chemical and solvent evaporation, instrument purge and supply, evaporative light scattering detector use (ELSD), and sparging.

Low and Mid Flow Nitrogen Generators

Nitrogen Purity / Flow Chart

Flow measured in SLPM at indicated Operating Pressure, psig. Flows for Model N2-04 printed in black, flows for Models N2-14 and N2-14A in red.

	145		125		110		100		90		80		70		60	
99.5	–	11	–	10	–	9	–	8	–	7	–	6	–	5	–	4
99	6	18	5	16	5	15	4	13	4	11	3	10	3	8	2	7
98	11	29	10	25	9	25	8	20	7	18	6	16	5	13	4	11
97	15	40	13	34	13	33	10	27	9	25	8	21	7	18	6	15
96	20	50	17	43	16	42	13	34	12	31	10	26	9	22	7	19
95	24	60	21	52	20	51	17	42	15	37	13	32	11	28	9	24

Nitrogen Purity / Flow Chart

Flow measured in SLPM at indicated Operating Pressure, psig. Flows for Model N2-22, N2-22A printed in black, flows for Models N2-35, N2-35A in red.

	145		125		110		100		90		80		70		60	
99.5	19	29	16	25	14	22	13	20	12	18	10	16	9	13	17	11
99	29	44	25	37	22	33	20	30	18	27	15	23	13	20	11	17
98	44	66	38	57	34	51	30	46	27	41	24	36	20	30	17	26
97	59	83	50	74	45	65	40	57	36	52	31	46	26	40	23	35
96	73	109	63	94	56	84	50	75	45	67	39	59	32	50	27	42
95	88	131	177	114	69	102	61	90	55	81	48	71	41	60	35	52

Principal Specifications

Model		**N2-04, N2-14, N2-14ANA, N2-22, N2-22ANA, N2-35 and N2-35ANA**
Nitrogen Purity		95.0% - 99.5%
Atmospheric Dewpoint		-58°F (-50°C)
Suspended Liquids		None
Particles > 0.01µm		None
Commercially Sterile		Yes
Phthalate-free		Yes
Hydrocarbon-free		Yes
Min./Max. Operating Pressure		60/145 psig
Max. Press. Drop @ 99% N_2 Purity, 125 psig		10 psig
Recommended Ambient Operating Temperature		68°F (20°C)
Max. Inlet Air Temperature		110°F (43°C)
Inlet/Outlet Ports		1/4" NPT
Electrical Requirements	N2-04, N2-14, N2-22, N2-35	None
	N2-14ANA, N2-22ANA, N2-35ANA	120 VAC/60 Hz/25 Watts
Shipping Weight	N2-04	42.5 lbs (19 kg)
	N2-14	75 lbs (34 kg)
	N2-14ANA, N2-22, N2-22ANA	80 lbs (36 kg)
	N2-35, N2-35ANA	90 lbs (41 kg)
Oxygen Analyzer		Included with Model N2-14ANA, N2-22ANA, N2-35ANA
Dimensions, N2-04		16.1"h x 10.7"w x 13.4"d (40.9cm x 27.2cm x 34cm)
Dimensions, N2-14, N2-14ANA, N2-22, N2-22ANA, N2-35, N2-35ANA		51.5"h x 18"w x 16.2"d (130.8cm x 45.7cm x 41.1cm)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern

Description	Galvanic Cell	Annual Maintenance Kit	Installation Kit	Preventative Maintenance Contract	Extended Support with 24 Month Warranty
N2-04	N/A	MK7840	IK7572	MFZATOC -PM	N2-04-DN2
N2-14	N/A	MK7572C	IK7572	LFMEMN2-PM	N2-14-DN2
N2-14ANA	72695	MK7572C	IK7572	LFMEMN202-PM	N2-14ANA-DN2
N2-22, N2-35	N/A	MK7572C	IK7572	LFMEMN2-PM	N2-22-DN2, N2-35-DN2
N2-22ANA, N2-35ANA	72695	MK7572C	IK7572	LFMEMN202-PM	N2-22ANA-DN2, N2-35ANA-DN2

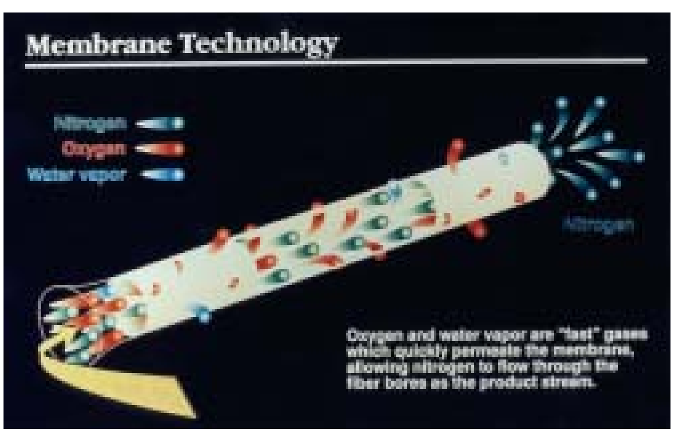
High Flow Nitrogen Generators

- ▲ **Recommended and used by all major LC/MS manufacturers**
- ▲ **Eliminates the need for costly, dangerous, inconvenient nitrogen cylinders in the laboratory**
- ▲ **Models N2-45, N2-80, and N2-135 require no electricity**
- ▲ **Compact design frees up valuable laboratory floor space**
- ▲ **Phthalate-free, no organic vapors**
- ▲ **Unlike PSA technology, membrane will not suppress corona needle discharge.**

Model N2-135 High Flow Membrane Nitrogen Generator

Parker Balston® High Flow Nitrogen Generators include models N2-45, N2-80, N2-135 that produce up to 467 SLPM of compressed nitrogen, on-site. The purity level of the nitrogen stream is defined by the user, for the application, and may range from 95% to 99.5%.

High Flow Model N2-45ANA, N2-80ANA, and N2-135ANA Nitrogen Generators include an oxygen analyzer which monitors the oxygen concentration of the nitrogen stream. An audible alarm signals high or low oxygen concentrations. Parker Balston Nitrogen Generators are complete systems engineered to transform standard compressed air into nitrogen at safe, regulated pressures, on demand, without the need for operator attention. The systems eliminate the need for costly, dangerous dewars and cylinders in the laboratory.



Nitrogen is produced by utilizing a combination of filtration and membrane separation technologies. A high efficiency prefiltration system pretreats the compressed air to remove all contaminants down to 0.01 micron. Hollow fiber membranes subsequently separate the clean air into a concentrated nitrogen output stream and an oxygen enriched permeate stream, which is vented from the system. The combination of these technologies produces a continuous on demand supply of pure nitrogen.

Typical applications include: LC/MS, nebulizer gas, chemical and solvent evaporation, instrument purge and supply, evaporative light scattering detector use (ELSD), and sparging.

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Nitrogen Purity / Flow Chart

Flow LPM (liters per minute), at 68°F (25°C) inlet air temperature and operating pressure, PSIG.
Flows printed in black are for Models N2-45 and N2-45A
Flows printed in red are for Models N2-80 and N2-80A
Flows printed in green are for Models N2-135 and N2-135A

	145			125			110			100			90			80		
99.5	67	100	133	55	83	110	47	71	94	39	59	78	33	50	66	27	41	54
99	92	138	183	74	112	149	63	95	127	53	79	106	44	66	89	35	53	71
98	129	194	258	106	159	212	89	134	179	73	110	147	62	93	124	50	75	101
97	163	244	325	132	198	264	113	169	226	94	141	187	79	119	159	65	97	130
96	200	300	400	160	240	320	137	205	274	114	171	228	97	145	194	80	119	159
95	233	350	467	187	281	374	160	241	321	134	201	268	111	167	222	90	135	180

Principal Specifications

Model		**N2-45, N2-80, N2-135, N2-45ANA, N2-80ANA, and N2-135ANA**
Nitrogen Purity		95.0% - 99.5%
Atmospheric Dewpoint		-58°F (-50°C)
Suspended Liquids		None
Particles > 0.01µm		None
Commercially Sterile		Yes
Phthalate-free		Yes
Hydrocarbon-free		Yes
Min./Max. Operating Pressure		60/145 psig
Max. Press. Drop @ 99% N_2 Purity, 125 psig		10 psig
Recommended Ambient Operating Temperature		72°F (22°C)
Max. Inlet Air Temperature		110°F (43°C)
Inlet/Outlet Ports		1/2" NPT
Electrical Requirements	N2-45, N2-80, N2-135	None
	N2-45ANA, N2-80ANA, N2-135ANA	120 VAC/60 Hz/25 Watts
Shipping Weight	N2-45, N2-80, N2-135	250 lbs (114 kg)
	N2-45ANA, N2-80ANA, N2-135ANA	250 lbs (114 kg)
Oxygen Analyzer		Included with Model N2-45ANA, N2-80ANA, N2-135ANA
Dimensions		67"h x 24"w x 20"d (140cm x 61cm x 50cm)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description	Galvanic Cell	Carbon Tower	Installation Kit	Preventative Maintenance Contract	Extended Support with 24 Month Warranty
N2-45	N/A	75344	IK75880	MFMEMN2-PM	N2-45-DN2
N2-45ANA	72695	75344	IK75880	MFMEMN202-PM	N2-45ANA-DN2
N2-80	N/A	75344	IK75880	MFMEMN2-PM	N2-80-DN2
N2-80ANA	72695	75344	IK75880	MFMEMN202-PM	N2-80ANA-DN2
N2-135	N/A	75344	IK75880	MFMEMN2-PM	N2-135-DN2
N2-135ANA	72695	75344	IK75880	MFMEMN202-PM	N2-135ANA-DN2

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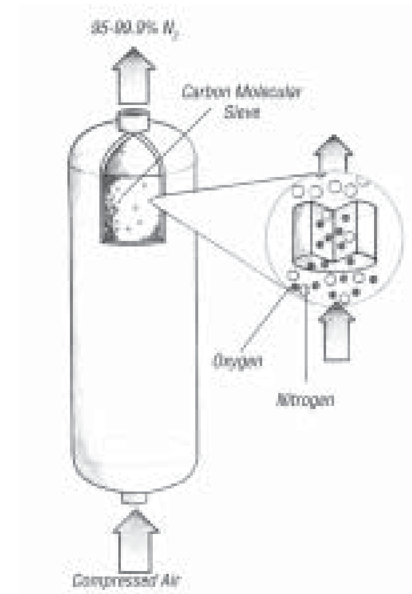
High Flow Nitrogen Generators

- Lower cost…eliminates the need for costly gas cylinders
- Complete package with prefilters, final filters, and receiving tank
- Compact - frees up valuable floor space
- Eliminates unexpected shutdowns due to a “bad” or empty cylinder
- Hassle-free, easy to install, easy to operate
- Safe and reliable

Parker Balston
Dual Bed Nitrogen Generators

Parker Balston® Monobed Nitrogen Generators produce up to 99.95% pure, compressed nitrogen at dewpoints to -70°F (-21°C) from nearly any compressed air supply. The generators are designed to continually transform standard compressed air into nitrogen at safe, regulated pressures without operator attention.

Parker Balston PSA Nitrogen Generators utilize a combination of filtration and pressure swing adsorption technologies. High efficiency prefiltration pretreats the compressed air to remove all contaminants down to 0.1 micron. Air entering the generator consists of 21% oxygen and 78% nitrogen. The gas separation process preferentially adsorbs oxygen over nitrogen using carbon molecular sieve (CMS). At high pressures the CMS has a greater affinity for oxygen, carbon dioxide, and water vapor than it does at low pressures. By raising and lowering the pressure within the CMS bed, all contaminants are captured and released, leaving the CMS unchanged. This process allows the nitrogen to pass through as a product gas at pressure. The depressurization phase of the CMS releases the absorbed oxygen and other contaminant gases to the atmosphere.



Parker BALSTON
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High Flow Nitrogen Generators

The Parker Balston PSA Nitrogen Generators completely eliminate the inconvenience and the high costs of nitrogen Dewars and cylinders. There is no need to depend on outside vendors for your nitrogen gas supplies. The hassles of changing dangerous, high pressure cylinders, and interruption of gas supplies are completely eliminated. **The Balston PSA Nitrogen Generators** offer long term cost stability eliminating uncontrollable vendor price increases, contract negotiations, long term commitments, and tank rentals. Once the generator is installed, a continuous nitrogen supply of consistent purity is available within minutes from start-up.

Installation consists of simply connecting a standard compressed air line to the inlet and connecting the outlet to a nitrogen line. Plug the electrical cord into a wall outlet, and the unit is ready for trouble-free operation. This system is designed to operate 24 hours per day, 7 days per week.

Once the system is operating, it requires little monitoring. The only maintenance involves changing the coalescing prefilter cartridges and final sterile air filter periodically. The PSA towers do not require any maintenance.

An oxygen monitor to measure the oxygen concentration of the nitrogen stream is available as an option. An audible alarm signals high or low oxygen concentrations (determined by the application). The oxygen analyzer is supplied with alarm relay outputs which may be used to signal a remote alarm, open a backup supply or the process stream, or close the process flow for protection of downstream equipment or processes.

Principal Specifications

Model	**AGS200, AGS400**
Nominal Conditions	
Feed Pressure	140 psig
Temperature	80°F
Ambient Pressure	1 Atm.
Compressed Air Specifications	
Maximum Pressure	140 psig
Temperature Range	60°F - 105°F
Dewpoint	40°F pressure dewpoint or better
Residual Oil Content	Trace
Particles	<.01 micron
Ambient Conditions	
Temperature	45°F-90°F
Ambient Pressure	Atmospheric
Air Quality	Clean air without contaminants
Dimensions	28.5”L x 32.25”D x 76.25”H
Weight	520 lbs (AGS200), 738 lbs (AGS400)
Inlet	1/2” NPT
Outlet	1/2” NPT

Nitrogen Purity Flow Chart

	Models AGS200 and AGS400	
Model	**Flow Rate (SCFH) 99.9%, 140 psig**	**Flow Rate (SCFH) 99.99%, 140 psig**
AGS200	235	47
AGS400	470	94

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High Flow Nitrogen Generators

- Lower cost…eliminates the need for costly gas cylinders
- Complete package with prefilters, carbon filter, and membrane filter
- Compact - frees up valuable floor space
- Eliminates unexpected shutdowns due to a "bad" or empty cylinder
- Hassle-free, easy to install, easy to operate
- Safe and reliable
- Expandable modular design

Parker Balston N2-300
Nitrosource Nitrogen Generator

Parker Balston® High Flow Nitrosource Nitrogen Generators produce up to 99.5% pure, commercially sterile nitrogen at dewpoints to -58°F (-50°C) from a compressed air supply. All Membrane Nitrogen Generators include a 0.01 micron membrane filter which ensures the nitrogen is completely free of suspended impurities.

Parker Balston High Flow Nitrosource Nitrogen Generators are one of the most effecient membrane systems available with higher recovery rates and lower operating costs than many other membrane systems.

The generators utilize proprietary membrane separation technology. The membrane divides the air into two separate streams: one is 95%-99.5% pure nitrogen, and the other is oxygen rich with carbon dioxide and other trace gases.

The generator separates air into its component gases by passing inexpensive, conventional compressed air through bundles of individual hollow fiber, semi-permeable membranes. Each fiber has a perfectly circular cross section and a uniform bore through its center. Because the fibers are so small, a great many can be packed into a limited space, providing an extremely large membrane surface area that can produce a relatively high volume product stream.

Compressed air is introduced to the center of the fibers at one end of the module and contacts the membrane as it flows through the fiber bores. While oxygen, water vapor and other trace gases permeate the membrane fiber and are discharged through a permeate port, the nitrogen is contained within the hollow fiber membrane, and flows through the outlet port of the module.

Water vapor also permeates through the membrane; therefore, the nitrogen product gas is very dry.

Applications

High thru-put LC/MS contract labs
Sample concentrators
Nitrogen supply to analytical lab

Custom Systems Available

Flow rates to 2,265 lpm
Delivery presssures to customer's specifications
Skid mounted systems with compressor, receiving tank and controls are available

High Flow Nitrogen Generators

The Parker Balston Nitrosource Nitrogen Generators completely eliminate and inconvenient and the high costs of nitrogen Dewars and cylinders. There is no need to depend on outside vendors for nitrogen gas supplies. The hassles of changing dangerous, high pressure cylinders and interruption of gas supplies are completely eliminated. The Balston Systems offer long term cost stability by eliminating uncontrollable vendor price increases, contract negotiation, long term commitments and tank rentals. Once the generator is installed, a continuous nitrogen supply of consistent purity is available within minutes from start-up.

The Parker Balston Nitrosource Nitrogen Generators are complete systems ready to operate as delivered with carefully matched components engineered for easy installation, operation and long term reliability.

The generators are free-standing and housed in an attractive cabinet. Standard features include: high efficiency coalescing prefilters with automatic drains, an activated carbon filter, and a 0.01 micron membrane final filter. Installation consists of simply connecting a standard compressed air line to the inlet and connecting the outlet to a nitrogen line.

There is no complicated operating procedure to learn or labor intensive monitoring involved. Simply select the purity your process requires, set the flow and pressure, and within minutes high purity, dry nitrogen is available for use!

Once the system is operating, it requires little monitoring. The only maintenance involves changing the coalescing filter cartridges and activated carbon filter periodically. This is a simple ten minute procedure.

All models also include an oxygen monitor which offers LCD readouts and remote alarm or chart recorder capabilities. An audible alarm signals high or low oxygen concentrations (determined by the application). The oxygen monitor is supplies with alarm relay outputs which may be used to signal a remote alarm, open a backup supply or the process stream, or close the process flow.

Flow Rates (lpm) @ 100 psig, 68°F

Model	99.5%	99%	98%	97%	96%	95%
N2-300	200	311	538	736	935	1133
N2-400	297	467	807	1104	1402	1699
N2-600	396	623	3962.5	1473	1869	2266

Principal Specifications - Nitrosource Series

Model	N2-300	N2-400	N2-600
Atmospheric Dewpoint	-58°F (-50°C)	-58°F (-50°C)	-58°F (-50°C)
Commercially Sterile	Yes	Yes	Yes
Particles >0.01 micron	None	None	None
Suspended Liquids	None	None	None
Min/Min Operating Pressure (1)	60 psig/145 psig	60 psig/145 psig	60 psig/145 psig
Max Pressure Drop			
(at 95% N2, 125 psig)	15 psig	15 psig	15 psig
Recommended Ambient			
Operating Temperature	70°F (21°C)	70°F (21°C)	70°F (21°C)
Min/Max Inlet Air Temp.	50°F /104°F (10°F /40°F)	50°F /104°F (10°F /40°F)	50°F /104°F (10°F /40°F)
Recommended Inlet Air Temp.	70°F (21°C)	70°F (21°C)	70°F (21°C)
Electrical Requirements	90-250 VAC 50-60 Hz	90-250 VAC 50-60 Hz	90-250 VAC 50-60 Hz
Dimensions	29"W x 31"D x 76"H	29"W x 42"D x 76"H	29"W x 53"D x 76"H
	(74cm x 51cm x 193cm)	(74cm x 79cm x 193cm)	(74cm x 107cm x 193cm)
Shipping Weight	660 lbs.	870 lbs.	1,290 lbs.

Laboratory Membrane Air Dryers

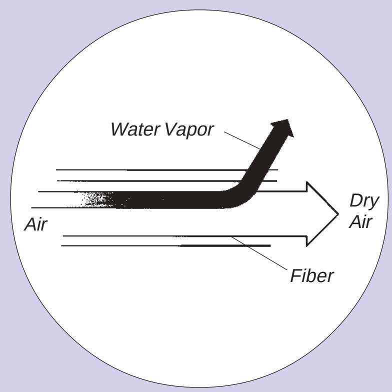
- **Low dewpoint instrument air - prevents analytical instrument contamination**
- **Dry air for hazardous areas**
- **No electricity required - low operating costs**
- **No refrigerants or freons - environmentally sound**
- **Explosion proof**
- **No moving parts or motors - silent operation**

Model 64-02

The Parker Balston® 64-01, 64-02, 64-10, and Membrane Air Dryers will supply oil and particulate free dry compressed air to atmospheric dewpoints as low as -40°F (-40°C), and at flow rates of up to 25 SCFM. Parker Balston Membrane Air Dryers are engineered for easy installation, operation, and long term reliability. The dryers incorporate the highest efficiency membrane available, offering low cost operation and minimal maintenance.

Parker Balston Membrane Air Dryers are designed to operate continuously, 24 hours per day, 7 days per week. The only maintenance required is changing the prefilter cartridge once each year. This annual maintenance takes approximately 5 minutes.

The dryers are lightweight, compact, and can be easily installed on an existing air line. In a vertical or horizontal orientation (depending upon model), a high efficiency coalescing prefilter is installed directly upstream from the dryer module to protect the membrane from potential contamination caused by pipe scale, liquids, or other solids. Parker Balston Membrane Air Dryers require no electrical connections, making them ideal for remote and point-of-use installations or for installation in hazardous areas.



Water vapor quickly permeates the membrane, and is released harmlessly to atmosphere. Air flows along the membrane fiber as a separate product stream.

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Laboratory Membrane Air Dryers

Principal Specifications

Membrane Air Dryers	Model	At -40°F Dewpoint (-40°C)	At 32°F Dewpoint (0°C)
Max. Flow Rate (1)	64-01	47 LPM	113 LPM
	64-02	125 LPM	307 LPM
	64-10	517 LPM	1,203 LPM
Min/Max Inlet Air Temp. (2)		40°F/140°F (4°C/60°C)	
Recommended Operating Temp. Range		60°F-100°F (16°C-38°C)	
Min/Max Inlet Pressure		60 psig/150 psig	
Maximum Pressure Drop		<4 psig	
Wall Mountable		Yes	
Inlet/Outlet Port Size	64-01	1/4" NPT (female)	
	64-02	1/4" NPT (female)	
	64-10	1/2" NPT (female)	
Electrical Requirements	None		
Shipping Weight	64-01	9 lbs. (4 kg)	
	64-02	10 lbs. (5 kg)	
	64-10	18 lbs. (9 kg)	
Dimensions	64-01	6"w x 22"h x 5"d (15cm x 57cm x 13cm)	
	64-02	6"w x 23"h x 5"d (15cm x 112cm x 13cm)	
	64-10	6"w x 37"h x 5"d (15cm x 93cm x 13cm)	

Notes:

1 Dewpoint specified with inlet air at 100°F (38°C) saturated at 100 psig.

2 Inlet compressed air dewpoint must not exceed the ambient air temperature.

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description		Model Number
Parker Balston Membrane Dryer		64-01, 64-02, 64-10
Inlet Compressed Air Conditioner	All	72-100NA
Annual Maintenance Kit	64-01	MK7601
	64-02	MK7601
	64-10	MK7610
Installation Kit	64-01	IK7572
	64-02	IK7572
	64-10	IK75880
Pressure Regulator	All	72-130-V883
Preventative Maintenance Contract	64-01	LFMEMDRY-PM
	64-02	LFMEMDRY-PM
	64-10	HFMEMDRY-PM
Extended Support with 24 Month Warranty	64-01	64-01-DN2
	64-02	64-02-DN2
	64-10	64-10-DN2

Compressed Air Dryers for Analytical Instruments

- ▲ **Produces ultra-dry, purified compressed air for analytical instruments**
- ▲ **Provides analytical grade compressed air to the whole laboratory**
- ▲ **Compact design frees up valuable laboratory floor space**
- ▲ **Automates your laboratory - eliminates costly, inconvenient air or nitrogen gas cylinders**

Model 64-20

The Parker Balston® Model 64-20 Compressed Air Dryer provides ultra-dry, purified compressed air to analytical instruments. The model 64-20 reduces the dewpoint to -100°F (-73°C) without operator attention.

Each system is delivered complete, and ready for easy installation. A high efficiency prefiltration system, automatic drains, a 0.01µm final filter, a moisture indicator, and pretested controls are integral to the design of each dryer.

To install, simply connect your house compressed air supply (at least 60 psig and 1/4 inch pipe) to the dryer inlet port, and connect the dryer outlet port to your instruments. Plug the electrical cord into a wall outlet - no electrician required - and the unit is ready for trouble-free operation.

If oxygen is not a concern, a Parker Balston Air Dryer is ideal for all laboratory applications requiring ultra-dry, purified compressed gas. The user can eliminate costly, inconvenient cylinders of nitrogen and other inert gases from your laboratory with a Parker Balston Air Dryer.

Principal Specifications

Model 64-20 Compressed Air Dryer	
Dew Point	-100°F (-73°C)
Flow Rate at 60 psig	390 scfh (184 lpm)
Flow Rate at 125 psig	720 scfh (340 lpm)
Min/Max Inlet Air Pressure	60 psig/125 psig
Max Inlet Air Temperature (1)	78°F (25°C)
Inlet/Outlet Port Size	1/4" NPT (female)
Electrical Requirements	120 VAC/60 Hz, 10 Watts
Dimensions	41"h x 15"w x 8"d (104cm x 38cm x 20cm)
Shipping Weight	50 lbs (23 kg)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description	Model Number
Compressed Air Dryer	64-20
Inlet Pressure Regulator	72-130-V883
Annual Maintenance Kit	MK7525
Annual Preventative Maintenance Contract	NMRDRY-PM
Extended Support with 24 Month Warranty	64-20-DN2

Notes:
1 Outlet dew point will increase at higher inlet compresses air temperatures

2 Power consumption - less than 10 watts; dryer is supplied with a 12 VDC transformer to connect to the local power supply

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TOC Gas Generator

- Replaces high pressure oxygen or nitrogen gas cylinders with hydrocarbon-free, CO_2-free compressed gas for TOC Analyzers
- Ensures consistent, reliable, TOC operation and reduces instrument service and maintenance costs
- Compact design frees up valuable laboratory floor space
- Purity meets or exceeds all TOC manufacturers' gas purity requirements
- Unique display shows qualitative gas purity at a glance

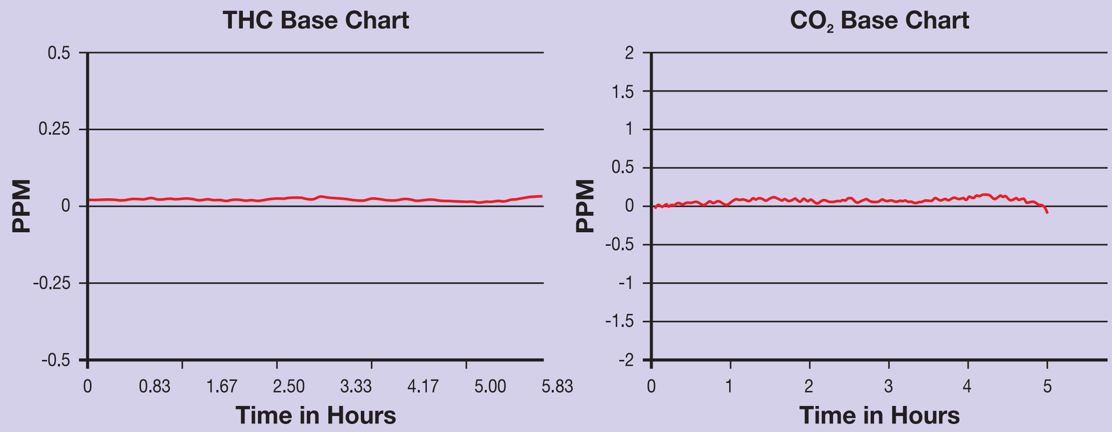
Model TOC-1250

The Parker Balston® TOC-1250 Gas Generator produces carrier/combustion gas, from an existing compressed air supply, for TOC instruments, eliminating the need to purchase expensive, inconvenient, high pressure cylinders of air, nitrogen, or oxygen. The Parker Balston TOC-1250 utilizes catalytic oxidation and pressure swing adsorption technologies to remove hydrocarbons to 0.1 ppm (measured as methane), CO_2 to 1 ppm, and water vapor to 1 ppm (-100°F/-73°C dewpoint).

The Parker Balston TOC Gas Generator eliminates all the inconveniences and costs of cylinder gas supplies and dependence on outside vendors. Uncontrollable vendor price increases, contract negotiations, long term commitments and tank rentals are no longer a concern. The Parker Balston TOC Gas Generator offers long-term cost stability.

The Parker Balston TOC-1250 is a complete system with carefully matched components engineered for easy installation, operation, and long term reliability. Installation consists of connecting a standard compressed air line to the inlet and connecting the outlet to the TOC gas supply line. Plug the generator into a standard electrical wall outlet and within minutes high purity carrier/combustion gas is supplied!

Baseline Supplied by a Parker Balston TOC Gas Generator



Baselines of THC Analyzer (above) and CO_2 Content Analyzer (right) after 5 hours supplied by a Parker Balston® TOC Gas Generator.

Principal Specifications

Model TOC-1250 TOC Gas Generator	
Max. TOC Gas Flow Rate (outlet) at 100 psig	1.25 lpm (1,250 cc/min)
Outlet Hydrocarbon Concentration (as methane)	0.1 ppm
Outlet CO_2 Concentration	< 1 ppm
Dewpoint	< -100°F (-73°C)
Inlet and Outlet Port Connections	1/4" NPT (female)
Min/Max Inlet Air Pressure	65 psig/125 psig
Max Inlet Air Temperature	78°F (25°C)
Min Required Inlet Air Flow at 100 psig	2.5 lpm (2,500 cc/min)
Max Inlet Hydrocarbon Concentration (as methane)	100 ppm
Pressure Drop at Maximum Flow Rate	7 psig
Warm-up Time	45 minutes
Electrical Requirements	120VAC/60 Hz, 2.0 Amps.
Dimensions	11"w x 17"h x 17"d (28 cm x 43 cm x 43 cm)
Shipping Weight	48 lbs. (22 kg)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description	Model Number
TOC Gas Generator	TOC-1250
Annual Maintenance Kit	MK7840
Installation Kit	IK76803
Preventative Maintenance Contract	MFZATOC-PM
Extended Support with 24 Month Warranty	TOC-1250-DN2

Nitrogen Generators for TOC

- ▲ **Produces a continuous supply of high purity nitrogen gas from existing compressed air**
- ▲ **Eliminates the need for costly, dangerous, inconvenient nitrogen cylinders in the laboratory**
- ▲ **Ideal for all combustion, UV persulfate, and wet oxidation sampling techniques**
- ▲ **Compact design frees up valuable laboratory floor space**
- ▲ **Offers long term cost stability - uncontrollable vendor price increases, contract negotiations, long term commitments and tank rentals are**

Model HPN2-1100

The Parker Balston® Models HPN2-1100 and UHPN2-1100 Nitrogen Generators can produce up to 1.1 lpm of ultra high purity nitrogen gas. These systems are completely engineered to transform standard compressed air into 99.9999% nitrogen, exceeding the specification of UHP cylinder gas.

Nitrogen is produced by utilizing a combination of state-of-the art purification technologies and high efficiency filtration. The Model HPN2-2000 can produce up to 2 lpm of 99.99% pure nitrogen gas from standard compressed air.

Pressure swing adsorption removes O_2, CO_2, and water vapor. A catalyst module is incorporated in the UHPN2-1100 to oxidize hydrocarbons from the inlet air supply. The generators also have high efficiency coalescing prefilters and a 0.01 micron (absolute) membrane filter incorporated into their design.

The Parker Balston UHP Nitrogen Generators are engineered and packaged in a small cabinet to fit nearly any benchtop. The systems eliminate the need for costly, inconvenient high pressure nitrogen cylinders. The HPN2-1100 and UHPN2-1100 are ideal for TOC carrier gas and purge applications.

Flow Chart

Inlet Air Pressure (psig)	**Max Outlet Flow** (cc/min.)	**Max Outlet Pressure** (psig)
Models HPN2-1100, UHPN2-1100		
125	1100	85
110	1000	75
100	900	65
90	800	60
80	700	50
70	600	45
60	500	35

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Principal Specifications

Model	HPN2-1100, UHPN2-1100	HPN2-2000
Max Nitrogen flow rate	See Flow Table	2 lpm
Nitrogen Purity	99.9999%	99.99%
Max Nitrogen output pressure	See Table	90 psig
CO_2 concentration	< 1 ppm	< 1 ppm
O_2 concentration	< 1 ppm	< 100 ppm
H_2O Concentration	< 1 ppm	< 1 ppm
Hydrocarbon concentration (1)	< 0.1 ppm	NA
Argon concentration (2)	0.9%	0.9%
Min/Max inlet pressure	60 psig/125 psig	75 psig/120 psig
Recommended inlet temperature	- 78°F (25°C)	- 78°F (25°C)
Ambient operating temperature	60°F-100°F (16°C-38°C)	60°F-100°F (16°C-38°C)
Max air consumption	42 lpm (1.5 scfm)	42 lpm (1.5 scfm)
Inlet connection	1/4" NPT (female)	1/4" NPT (female)
Outlet connection	1/8" NPT (female)	1/8" NPT (female)
Electrical requirements (3)	120 VAC/60 Hz	120 VAC/60 Hz
Dimensions (31cm x 41cm x 89cm)	12" w x 16" d x 35" h (31cm x 41cm x 89cm)	12" w x 16" d x 35" h
Shipping Weight	110 lbs. (50 kg)	110 lbs. (50 kg)

Notes:

1 Model HPN2-1100 does not remove hydrocarbons.

2 Purity specification for Nitrogen does not include Argon concentration.

3 Power Consumption is as follows:
Model HPN2-1100 = 25 Watts,
Model UHPN2-1100 = 700 Watts,
Model HPN2-2000 = 25 Watts.

Ordering Information call 800-343-4048, 8 to 5 EST

Description	Model Numbers
High Purity Nitrogen Generator	HPN2-1100, HPN2-2000
Ultra High Purity Nitrogen Generator	UHPN2-1100
Purity Indicator/Scrubber	72092
Optional Prefilter System	2002N-1B1-DX
Maintenance Kit	MK7692*, MK7694
Installation Kit for all Models	IK7694
Annual Preventative Maintenance Contract	LFHPN2-PM*, LFUHPN2-PM
Extended Support with 24 Month Warranty	HPN2-1100-DN2, UHPN2-1100-DN2, HPN2-2000-DN2

* For Model HPN2-1100

Atomic Absorption Gas Purifier

- ▲ **Designed specifically for AA Instrumentation**
- ▲ **Protects microcomputer gas controls and burner system**
- ▲ **Ensures a clean, contaminant-free flame**
- ▲ **Ensures consistent quality of compressed air oxidant and fuel gas**
- ▲ **Convenient, turnkey system**
- ▲ **Services a single AA**

Model 73-100 AA Gas Purifier

The Parker Balston® AA Gas Purifier is a completely engineered, wall mountable system designed to purify gases commonly used with Atomic Absorption Spectrophotometers. The Purifier consists of two independent filtration systems. The first system is designed to purify the compressed air (oxidant) with two stages of high efficiency coalescing filtration. These filters will remove all oil, water, and particulate matter down to 0.01 micron.

The second filtration system is designed to purify the acetylene gas. This system removes liquid acetone and solid particulate from the gas. The 73-100 protects the microcomputer gas controls and AA burner assembly from contamination and corrosion. In addition, the acetylene filter has an integral flashback arrestor, meeting all OSHA requirements, to enhance the safe operation of the spectrophotometer.

Principal Specifications

Model 73-100 Atomic Absorption Gas Purifier	
Compressed Air Inlet/Outlet	1/4" NPT (female)
Recommended Inlet Air Temperature	< 78°F (26°C)
Min/Max Inlet Pressure (compressed air)	15 psig/125 psig
Acetylene Inlet/Outlet	9/16 - 18 LH (“B” size)
Max Inlet Pressure (acetylene)	15 psig max. working pressure
Ambient Operating Temperature	40°F - 100°F (4°C - 38°C)
Dimensions	11" w x 8" d x 10" h (28cm x20cm x 25cm)
Shipping Weight	10 lbs (4.5 kg)

Ordering Information for assistance, call 800-343-4048, 8 to 5 Eastern Time

Description	Model Number
Atomic Absorption Gas Purifier	73-100
73-100 Service Kit (contains one year supply of all replacement filter cartridges)	73065
Acetylene Hose Assembly (6 feet in length)	19257

Recommended Gas Generators for Analytical Instruments

Instrument	Gas Requirements	Gas Purity Requirements	Flow Rates	Generator Recommendation/ Model
Atomic Absorption (AA) with Flame	Air for Oxidant Gas	Clean, Dry	1-7 SCFM	**AA Gas Purifier** Model
Atomic Thermal Desorber	Zero Air	Clean, Dry, Hydrocarbon-free	Up to 1600 ml/min.	**Zero Air or TOC Gas Generator** TOC-1250 HPZA-3500
	Hydrogen for FID	Clean, Dry, Ultra-High Purity	Up to 40 ml/min. per FID	**Hydrogen Generator** H2-90, H2-150 H2-300, H2-500
Atmospheric Pressure Ionization (API-MS)	Air for Nebulizer Gas	Clean, Dry, Hydrocarbon-free	< 18 LPM	**Zero Air** HPZA-18000
	Nitrogen for Curtain, Sheath, and Shield gas	99% or higher	< 20 LPM	**Nitrogen Generator** N2-14, N2-22, N2-35, N2-30
Autosamplers for Various Instruments	Air for Pneumatic Controls	Clean, Dry	< 1 SCFM	**Air Dryer** 64-20 74-5041NA
	Nitrogen for Sample Injector	Ultra High Purity	< 550 cc/min	**UHP Nitrogen** HPN2-1100 UHPN2-1100
CO_2 Analyzers	Calibration Air	CO_2-free	0.5-1.0 SLPM	**FT-IR Purge Gas Generator** 75-45NA, 75-52NA
Continuous Emissions Monitoring (CEM)	Calibration Air Dilution Air	Dry, CO_2, SO_2, NO_x, CO, Hydrocarbon-free	10-15 SLPM	75-45(M744) 75-45(M798)
Emissions Analyzers	Zero Air	Hydrocarbon-free	2-15 SLPM	**Zero Air Generator** HPZA-18000, VEM 2000, VEM 6000
Fourier Transform Infrared Spectrometer (FT-IR)	Air for Sample Compartment, Optics, and/or Air-Bearing Components	Clean, Dry, CO_2-free	0.3-3 SCFM	**FT-IR Purge Gas Generator** 75-62NA 75-52NA 75-45NA **Lab Gas Generator** 74-5041NA
Gas Chromatograph (GC)				
GC-FID	Zero Air as Flame Support Air	Clean, Hydrocarbon-free	150-600 cc/min.	**Zero Air Generator**
	Hydrogen as Flame Fuel Gas	Ultra High Purity	30-40 cc/min.	**Hydrogen Generator**
	Hydrogen as Capillary Carrier Gas	Ultra High Purity	Varies	**Hydrogen Generator**
	Nitrogen as Packed Carrier Gas	Ultra High Purity, Zero Grade	Varies	**UHP Nitrogen Generator**
	Nitrogen as Make up Gas	Ultra High Purity, Zero Grade	<100 cc/min	**UHP Nitrogen Generator**
GC-FPD	Zero Air as Flame Support Air	Clean, Hydrocarbon-free	<200 cc/min	**Zero Air Generator**
	Hydrogen as Flame Fuel Gas	Ultra High Purity	50-70 cc/min	**Hydrogen Generator**
	Hydrogen as Capillary Carrier Gas	Ultra High Purity	Varies	**Hydrogen Generator**
	Nitrogen as Packed Carrier Gas	Ultra High Purity	Varies	**UHP Nitrogen Generator**
GC-NPD	Zero Air to Rubidium/Thermonic Bead	Dry, Clean, Hydrocarbon-Free	60-200 cc/min.	**Zero Air Generator** **Membrane Air Dryer**
	Hydrogen as Detector Support Gas	Ultra High Purity	<10 cc/min	**Hydrogen Generator**
	Hydrogen as Capillary Carrier Gas	Ultra High Purity	Varies	**Hydrogen Generator**
	Nitrogen as Packed Carrier Gas	Ultra High Purity	Varies	**UHP Nitrogen Generator**

Recommended Gas Generators for Analytical Instruments

Instrument	Gas Requirements	Gas Purity Requirements	Flow Rates	Generator Recommendation/ Model
GC-ECD	Nitrogen as Carrier Gas Nitrogen as Make up Gas	Ultra High Purity, Zero Grade Ultra High Purity, Zero Grade	Varies <100 cc/min	**UHP Nitrogen Generator** **UHP Nitrogen Generator**
GC-ELCD, HALL	Hydrogen as Reaction Gas	Ultra High Purity	70-200 cc/min	**Hydrogen Generator**
GC-TCD	Hydrogen as Carrier & Reference Gas	Ultra High Purity	Varies	**Hydrogen Generator**
LC/MS	Nitrogen as a Curtain Gas	LC/MS Grade	3-30 lpm	**Nitrogen Generator** N2-14, N2-14A, N2-30NA N2-35, N2-35ANA
ICP Spectrometer	Nitrogen as Optic/Camera Purge	Ultra High Purity	<1-51 lpm	**Nitrogen Generator** 76-97NA, 76-98NA
Nuclear Magnetic Resonance (NMR)	Air for Lifting, Spinning	Clean, Dry	<10 SCFM	**Air Dryer** 64-20 **Lab Gas Generator** 74-5041NA
Ozone Generator	Supply Air	Clean, Dry	.3-20 SCFM	**Air Dryer** 64-01, 64-02, 64-10, 64-20
Protein Analyzer	Dry Air, Nitrogen	Clean, Dry	40 psig	**Nitrogen Generator** N2-14, N2-30NA, N2-35
Solvent Evaporators (Sample Concentrators)	Nitrogen	Clean, Dry Nitrogen	Up to 5 SCFM	**Nitrogen Generator** N2-14, N2-14ANA N2-22, N2-22ANA N2-35, N2-35ANA 72-45, N2-80, N2-135
Stack Gas Sampler	Dilution Air	Clean, Dry	<1.0 SCFM	**Air Dryers** 75-45-M744 75-45-M798 74-5041NA
Total Oxygen Demand (TOD)	Nitrogen Carrier Gas	Ultra High Purity	300 cc/min	**Nitrogen Generator** UHPN2-1100
Thermal Gravametric Analyzer (TGA)	Nitrogen as Furnace Purge	Clean, Dry, Inert	<100 cc/min	**Nitrogen Generator** UHPN2-1100
Differential Scanning Calorimeter (DSC)	Air for Air Shield	Clean, Dry	<100 cc/min	**Dry Air Generator** 64-20
Total Hydrocarbon Analyzer (THA)	Zero Air for FID Hydrogen as Flame Fuel Gas	Clean, Hydrocarbon-Free Ultra High Purity	50-500 cc/min 5-50 cc/min	**Zero Air Generator** 75-82S, 75-83NA **Hydrogen Generator** H2-90
Total Organic Carbon Analyzer (TOC)	Dry Air or Nitrogen for Carrier Gas or Combustion Gas	Clean, Dry, Hydrocarbon-Free CO2-Free Ultra High Purity	100-500 SLPM 50-700 cc/min	**TOC Gas Generator** TOC-1250 **UHP Nitrogen Generator** UHPN2-1100
Additional Laboratory Application		**Recommendation**		**Accessories**
Reference Gas to Calibrate Analytical Instruments		Zero Air Generator		W-FM Series Flow Controllers

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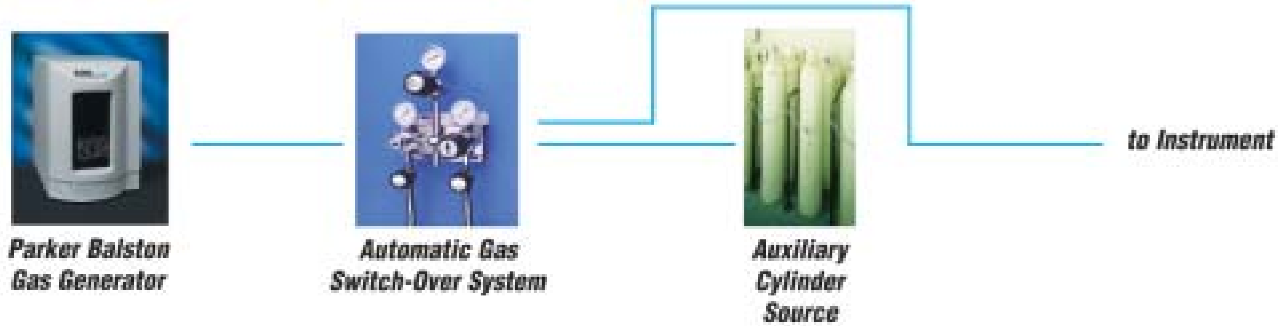
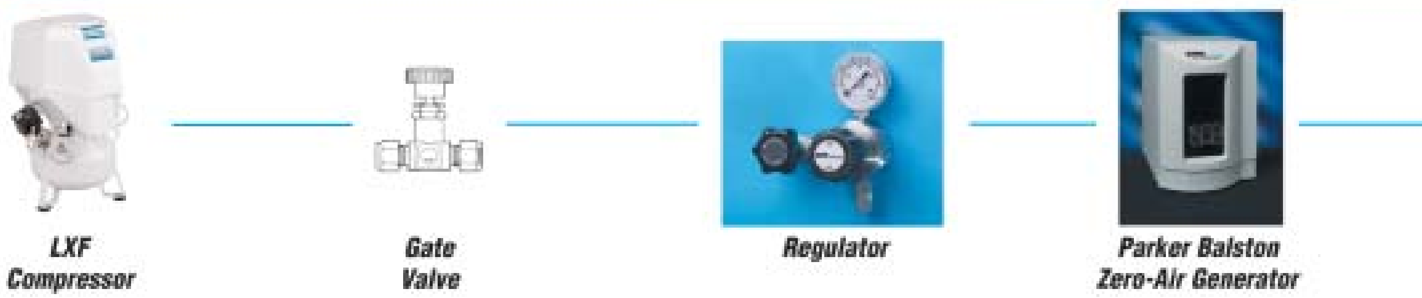
Installation Schematic

TOC Gas Generator

Automatic Gas Switch-Over System

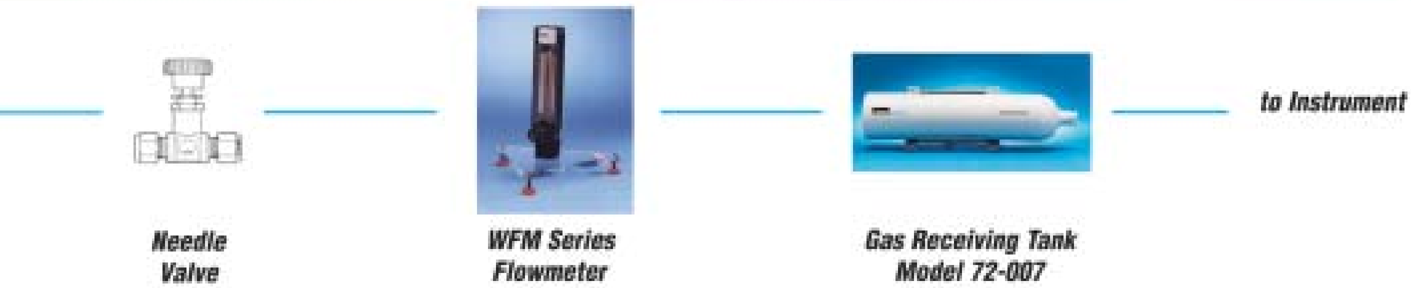


Zero Air Generator



Ultra High Purity Nitrogen Generator

Installation Schematic



Hydrogen Generator

Basic Lab Compressor

- Ideal for Parker Balston® Gas Generators
- Pressure Switch
- Manual Drain
- Pressure Safety Valve (ASME)
- Pressure Gauge
- Unloading Capability
- Globe Valve
- 100% Oil-less Operation
- Only Minutes to Install

Gast® Model 2HAH-92T-M200X Compressor

The Gast® Compressor is for locations without a compressed air supply or low pressure supply. This quality product is in stock and available for immediate delivery along with your Parker Balston Gas Generator. This product is fully warranteed and serviced exclusively by Gast® Manufacturing Corporation. It is ideal for use with smaller Parker Balston Gas Generators only.

Principal Specifications

Model 2HAH-92T-M200X	
Tank Size	2 Gallons (7.5 liters)
Output Pressure	Output Flow
@ 0 psig	1.65 CFM
@ 10 psig	1.55 CFM
@ 30 psig	1.30 CFM
@ 50 psig	1.15 CFM
@ 70 psig	1.00 CFM
@ 90 psig	.90 CFM
Noise Level @ Full Flow	65 dBa @ 3 ft.
Standard Pressure Settings - ON/OFF	70 psig / 90 psig
Pressurization Time (0 psig to set pressure)	1min. 30 sec.
Recovery Time (to set pressure)	24 sec.
Motor Specifications	115 VAC/60 Hz, 1/4 hp
Dimensions	18"w x 18"h x 5"d (46 cm x 46 cm x 13 cm)
Shipping Weight	56 lbs. (25 kg)

Ordering Information

Description	Model Number
Gast Compressor	2HAH-92T-M200X
Automatic Drain Valve	20-440

High Output Oil-Free Piston Compressor

- ▲ **100% Oil-Free Air**
- ▲ **Air to Air Heat Exchanger**
- ▲ **Integral 50 Litre Receiver Tank & Electronic Tank Drain**
- ▲ **Single Stage Motor**
- ▲ **Power Cord Included**
- ▲ **Quiet Operation**
- ▲ **24-hour Continuous Duty Applications**
- ▲ **Approved for smaller Parker Hannifin Gas Generators**

LXF Series Compressor

Parker Hannifin Corporation has teamed with Atlas Copco to offer the latest innovation in high output piston compression technology. The **LXF Series** compressor offers a quiet, compact, high quality source of oil-free compressed air. Each **LXF Series** compressor is totally pre-piped and wired for easy and economical installation. Along with quiet operation, each compressor is simple to use, low-vibration and requires virtually no preventative maintenance. **Full service and warranty are provided exclusively from Atlas Copco. Each compressor includes Atlas Copco "Certified Start-up Assistance Service" as standard.**

Principal Specifications

Model LXF12D-8	
Motor HP (3)	1.29
Flow and Pressure (1)	up to 5 CFM and 100 psi
Sound Level (dBA) (2)	60
Standard Voltage	115VAC, 60Hz, 20 Amp
Dimensions	24"w x 42"h x 24"d (56 cm x 86 cm x 58 cm)
Net Weight	125 lbs. (57 kg)

1 Unit performance measured according to Pneurop/CAGIPN2CPTC2
2 Maximum noise level measured at a distance of 3 ft. according to Pneurop/CAGIPN8NTC2 test code
3 Unit includes 3' power cord with NEMA class plug

Ordering Information

Model/Series	Use on Gas Generators
LXF12D-8	64-01, 75-45, 75-52, N2-04, HPN2-1100, UHPN2-1100, HPN2-2000, TOC-1250, HPZA-3500, HPZA-7000, HPZA-18000, HPZA-30000

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Rotary Scroll & Rotary Screw Compressors

- ▲ **100% Oil Free Air**
- ▲ **35°F-39°F Integral Refrigerant Air Dryer**
- ▲ **Air Cooled, Fully Packaged**
- ▲ **Single Stage Motor**
- ▲ **High Efficiency**
- ▲ **Whisper Quiet Operation**
- ▲ **24-hour Continuous Duty Applications**
- ▲ **Approved for all Parker Hannifin Gas Generators**

SF & GA Series

Parker Hannifin Corporation has teamed with Atlas Copco to offer the latest innovation in small rotary compressor technology. The SF Series compressors offer a lubrication free compression chamber that eliminates the possibility of oil carryover into the compressed air. The GA Series is oil-sealed and packaged with full-features providing oil-free output to less than 2 ppm. Each compressor configuration is totally pre-piped and wired for easy installation. Simply select your desired compressor from the table below and order from Parker Hannifin Corporation. **Full service and warranty are provided exclusively from Atlas Copco. Each compressor includes Atlas Copco "Certified Start-up Assistance Service*" as standard.**

Principal Specifications

	L330 (3)	L189-150 (4)	L189 (4)	L196 (4)	L199 (5)
Motor HP	3	5	5	10	15
Capacity ACFM (1)					
100	9.0	14.7	14.7	27.9	57.2
125	6.8	10.5	na	na	51.7
150	6.0	9.1	na	na	47.0
Sound Level (dBA) (2)	58	59	59	57	68
Net Weight (lbs.)	260	289	289	1,052	582

1 Unit performance measured according to Pneurop/CAGIPN2CPTC2
2 Maximum noise level measured at a distance of 3 ft. according to Pneurop/CAGIPN8NTC2 test code
3 Unit includes comprehensive full-featured epoxy coated external 30-gallon receiver tank
4 Unit includes comprehensive full-featured epoxy coated external 60-gallon receiver tank
5 Unit horizontally pre-mounted on steel 120-gallon receiver tank, GA series not to be installed in laboratory

Ordering Information

Model/ Series	Dimensions	Specify Desired Voltage**	Use on Gas Generator
L330	23"W x 24"D x 34"H	200VAC, 230VAC or 460VAC	76-97, 76-98, 75-62, N2-14, N2-14ANA
L189-150	23"W x 24"D x 34"H	200VAC, 230VAC or 460VAC	N2-22, N2-22ANA
L189	23"W x 24"D x 34"H	200VAC, 230VAC or 460VAC	N2-35, N2-35ANA, N2-45, N2-45ANA (Output Limited to 100 psig)
L196	38"W x 48"D x 66"H	200VAC, 230VAC or 460VAC	N2-80, N2-80ANA (Output Limited to 100 psig)
L199	68"W x 36"D x 72"H	200VAC, 230VAC or 460VAC	N2-45, N2-45ANA, N2-80, N2-80ANA N2-135, N2-135ANA

* "Certified Start-up Assistance" excludes electrical supply work, due to local code restrictions. Electrician may be required.
** Contact Parker Technical Services or your local representative for exact part number suffix prior to ordering. 800-343-4048.

HydroGen Mate™ DI Water System

- ▲ **Economical means of providing deionized water to hydrogen generators**
- ▲ **Minimal maintenance**
- ▲ **Visual indication for cartridge changes**
- ▲ **Easy fill dispensing gun**
- ▲ **Removal of organics, phosphates, chlorine, and essentially all ionizable constituents from water supply**
- ▲ **No electrical requirements**

Parker Balston® Model 72-230
HydroGen Mate™ DI Water System

The Parker Balston® HydroGen Mate™ DI Water System is specifically designed to provide high purity deionized water to all models of Parker Balston hydrogen generators. The system is ready to install and is shipped complete with prefiltration, two DI resin exchange cartridges, dispensing gun, and a final filter.

The only required maintenance on the system is to change out the resin exchange cartridges and to replace the filter cartridges as needed.

Principal Specifications

Model 72-230 and 72-231 DI Water Systems**	
Maximum Flow Rate	1 lpm
Water Inlet	1/4" "Push to connect"
Maximum Water Supply Pressure	50 psig
Maximum Water Supply Temperature	80°F (27°C)
Physical Dimensions	12"w x 18"h x 3"d (30 cm x 46 cm x 8 cm)
Shipping Weight	12 lbs. (5.5 kg)

Ordering Information

Description	Model Number
Complete DI Water System	72-230, 72-231
Cartridge Kit*	72236

* Includes 2 each resin exchange cartridges, 1 each prefilter and 1 each final filter.

**Model 72-231 does not include dispensing gun and connects directly to generator automatic water feed port.

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Gas Receiving Tanks

- ▲ **External powder-coat finish eliminates rust and contamination**
- ▲ **Internal primer eliminates particle shedding and vapor out-gassing**
- ▲ **Convenient mounting brackets for floor or wall placement**
- ▲ **Smoothes out gas pressure fluctuations**
- ▲ **Reduces duty cycle on compressors**

Parker Balston® Models 72-007 and 72-012 Receiving Tanks

The Parker Balston® Gas Receiving tanks are highly recommended for supplying gas to pressure sensitive instrumentation, for the storage of compressed nitrogen from nitrogen generators, and for other instruments requiring an occasional high flow burst of compressed gas in excess of the normal capacity of a Parker Balston Gas Generator.

Three models of gas receivers are available. The Model 72-007 has a maximum pressure rating of 240 psig. At 240 psig, the 72-007 will hold approximately 1.7 scf (50 liters) of compressed gas. The model 72-012 has a maximum pressure rating of 125 psig. At 125 psig, the 72-012 will hold approximately 15 SCF (430 liters) of compressed gas. The IK7698C model will hold over (1,075 liters) of compressed gas.

Principal Specifications

	Model 72-007	**Model 72-012**	**Model IK7698C**
Material of Construction	3003 Aluminum	Carbon steel	Carbon steel
Capacity at Atmospheric Pressure	0.75 gallons (2.8 liters)	12 gallons (45 liters)	30 gallons (136 liters)
Max. Temperature	130°F (54°C)	130°F (54°C)	130°F (54°C)
Max. Pressure at Max. Temperature	240 psig	125 psig	125 psig
Inlet/Outlet Ports	1/8" NPT (female)	1/4" NPT (female)	3/8" Tubing Included
Dimensions	18" w x 5" h (45 cm x 12 cm)	26"w X 13"h (66 cm x 33 cm)	16"w X 40"h (41 cm x 102 cm)
Shipping Weight	4 lbs (1.8 kg)	42 lbs (19 kg)	109 lbs (49.4 kg)

Ordering Information

Description	**Model Number**		
Gas Receiving Tank	72-007	72-012	IK7698C

Parker BALSTON
Analytical Gas Systems

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- Unique patented compression member loads the seal to the body without requiring a threaded nozzle or additional seals to atmosphere
- Internally threadless seat design to promote long seat life
- Positive upward and downward diaphragm stops increasing cycle life by preventing over stroking of the diaphragm
- Captured bonnet allows for safety venting
- Unique carrier design disperses gas uniformly through the regulator to improve purging

Parker Balston® Models 402 and 422 Gas Cylinder Regulators

Parker Balston® has expanded its range of pressure control accessories to include high-pressure cylinder gas regulators. Use stainless steel for critical detection limits and brass for less demanding applications. These regulators provide stable flow over wide temperature ranges and are suited as primary pressure control. Select the 402 series for noncorrosive, less demanding applications or the 422 series for ultra high purity (UHP) requirements.

Principal Specifications

	Model 402	Model 422
Maximum Inlet Pressure	3000 psig (210 bar)	3000 psig (210 bar)
Temperature Range	-40°F to 140°F (-40°C to 60°C)	-40°F to 140°F (-40°C to 60°C)
Pressure Control Range	0-250 psig (0-17bar)	0-250 psig (0-17bar)
Material of Construction		
Body	Brass barstock	316L SS barstock
Bonnet	Brass barstock	Chromplated brass barstock
Seat	PTFE Teflon®	PTFE Teflon®
Filter	10 μm sintered bronze	10 μm sintered SS
Diaphragm	316L SS	316L SS
Internal Seals	PTFE Teflon®	PTFE Teflon®
Gages	2" dia. brass	2" dia. SS
Ports	1/8" Tube fitting	1/8" Tube fitting
Helium Leak Integrity	$1*10^{-9}$ scc/sec	$1*10^{-9}$ scc/sec
CV	0.1 (50 psig)	0.1 (50 psig)

Ordering Information

Less Demanding Applications

W-402-4332-350 Hydrogen Cylinders

W-402-4332-580 Argon, Helium, Nitrogen Cylinders

W-402-4332-590 All Air Cylinders

Critical Applications (UHP)

W-422-4332-350 Hydrogen Cylinders

W-422-4332-580 Argon, Helium, Nitrogen Cylinders

W-422-4332-590 All Air Cylinders

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In-Line Gas Regulators

- **Unique patented compression member loads the seal to the body without requiring a threaded nozzle or additional seals to atmosphere**
- **Internally threadless seat design to promote long seat life**
- **Positive upward and downward diaphragm stops increases cycle life by preventing over stroking of the diaphragm**
- **Captured bonnet allows for safety venting**
- **Unique carrier design disperses gas uniformly through the regulator to improve purging**

Parker Balston® Models 405 and 425 In-Line Gas Regulators

Parker Balston® In-Line Gas Regulators are suitable for pressure control with all Parker Balston gas generators and as secondary control for high-pressure gas cylinders and bulk gas systems. Use stainless steel for critical detection limits and brass for less demanding applications. Parker Balston regulators provide stable flow over wide temperature ranges. Select the 405 series for noncorrosive, less demanding applications and the 425 series for ultra high purity (UHP) requirements.

Principal Specifications

	Model 405	Model 425
Maximum Inlet Pressure	3000 psig (210 bar)	3000 psig (210 bar)
Temperature Range	-40°F to 140°F (-40°C to 60°C)	-40°F to 140°F (-40°C to 60°C)
Pressure Control Range	0-250 psig (0-17 bar)	0-250 psig (0-17 bar)
Material of Construction		
Body	Brass barstock	316 SS barstock
Bonnet	Brass barstock	Chromplated brass barstock
Seat	PTFE Teflon®	PTFE Teflon®
Filter	10 µm sintered bronze	10 µm sintered SS
Diaphragm	316L SS	316SS
Internal Seals	PTFE Teflon®	PTFE Teflon®
Gages	2" dia. brass	2" dia. SS
Ports	1/4" FNPT to 1/8" Tube fitting	1/4" FNPT to 1/8" Tube fitting
Helium Leak Integrity	$1*10^{-9}$ scc/sec	$1*10^{-9}$ scc/sec
CV	0.1 (50 psig)	0.1 (50 psig)
Shipping Weight	2.25 lbs. (1.05 kg)	2.25 lbs. (1.05 kg)

Ordering Information

Less Demanding Applications
W-405-4032-000 Air, Argon, Helium, Hydrogen, Nitrogen

Critical Applications (UHP)
W-425-4032-000 Air, Argon, Helium, Hydrogen, Nitrogen

In-Line Gas Regulators

- ▲ **Oversized connection ports minimize pressure settings**
- ▲ **Convenient user-friendly pressure control range from 10 to 130 psig**
- ▲ **Bolt down regulator adjustment handle locks pressure settings, maximizes tampering**
- ▲ **Ideal for regulating inlet compressed air pressure to Parker Balston Gas Generators**

Parker Balston® Model 72-130-V883 In-Line Regulator

Parker Balston® High Flow Rate In-Line Gas Regulators are suitable as primary inlet pressure control to all compressed air supplied gas generators. They are ideal for use with high-output nitrogen generators as models N2-45, N2-45ANA, N2-80, N2-80ANA, N2-135 and N2-135ANA. Parker Balston High Flow Rate In-Line Gas Regulators are not suitable for use with hydrogen generators, cylinder gases, corrosive gases, or gases that are flammable. Minimal assembly required.

Principal Specifications

Model 72-130-V883	
Maximum Inlet Pressure	150 psig
Maximum Temperature	220°F (104°F)
Pressure Control Range	10-130 psig
Material of Construction	Aluminum, Brass, Buna
Ports (Inlet/Outlet)	1/2" FNPT
Flow Rate Limitation	65 SCFM

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Oxygen Analyzer

- ▲ **Protects instruments against undesirable oxygen concentrations**
- ▲ **Low maintenance**
- ▲ **LED display**
- ▲ **One year warranty**
- ▲ **Shipped ready to install from local stock**

A Parker Balston Model 72-02730 Oxygen Analyzer

The Parker Balston 72-02730 Oxygen Analyzer is a self-contained wall-mountable or benchtop unit designed to monitor the oxygen concentration in a process stream, display the concentration in digital form, and provide appropriate alarms and controls for protecting a process against undesirable oxygen concentrations. The Parker Balston 72-02730 Oxygen Analyzer is offered as an integral accessory to Balston Nitrogen Generation Systems. The Analyzer is also designed to be used on existing house nitrogen systems. The Analyzer has all the controls necessary to assure safe and accurate monitoring of oxygen concentration in a nitrogen process stream.

Features include:

Alarm Set Points: The high and low limits of the integral alarm may each be set anywhere between .1% and 23% oxygen, depending on the process limitations and requirements.

Alarm Output: The oxygen analyzer, through the use of the alarm relay outputs, may be used to control the process stream. For example, a high or low oxygen concentration could signal a remote alarm, open a backup supply for the process stream, or close the process down for protection of downstream equipment or processes.

Easy Installation and Maintenance: A convenient power selection switch affords quick adaptation to available power supplies of 120 VAC/60 Hz or 240 VAC/50 Hz. The Analyzer requires very little maintenance other than timely calibration and sensor replacement.

Principal Specifications

72-02730 Oxygen Analyzer	
Accuracy	± 1% full scale calibrated span, after 30 min. stabilization
Sensitivity range	0 to 100% oxygen
Digital display limits	00.0 to 99.9% oxygen
Span concentration	0 to 23% oxygen
Response time	12 seconds
Min/Max Sample inlet pressure	2 psig/145 psig (0.1 barg/10 barg)
Min/Max sample flow rate range	25/850 ccm
Min/Max operating temperatures	59°F/95°F (15°C/35°C)
Alarm outputs	DPDT relay contacts 5 amp, 250 VAC rating, 1/8 HP resistive
Power requirement	120 VAC/60 Hz., 240 VAC/50 Hz.
Dimensions	11"w x 5"h x 5"d (28 cm x 13 cm x 13 cm)
Shipping Weight	6 lbs (3 kg)

Ordering Information

Description	Model Number
Oxygen Analyzer	72-02730
Galvanic Cell (sensor)	72695

Automatic Gas Switch-Over Systems

- ▲ **Metal to metal diaphragm seal assures gas purity integrity**
- ▲ **Capsule® seat mechanism promotes increased serviceability and long life**
- ▲ **One knob switches gas generator or cylinder priority**
- ▲ **Total user control**
- ▲ **Check valves at inlet gland prevent contamination and backflow**

Parker Balston® Model 527 Automatic Gas Switch-Over System

Parker Balston® automatic gas switch-over systems provide primary control to switch from gas generator to cylinder or from cylinder to cylinder. Uninterrupted gas is provided regardless of source. Use stainless steel for critical applications and brass for less demanding applications. Switch-over systems provide stable flow over wide temperature ranges and are suited as a primary gas control. Select the 526 series for noncorrosive, less demanding applications, and the 527 series for ultra high purity (UHP) requirements.

Principal Specifications

	Model 526	Model 527
Maximum Inlet Pressure	3000 psig (210 bar)	3000 psig (210 bar)
Switchover Pressure	50 or 70 psig	50 or 70 psig
Temperature Range	-40°F to 140°F (-40°C to 60°C)	-40°F to 140°F (-40°C to 60°C)
Material of Construction		
Body	Brass barstock	316 SS barstock
Bonnet	Brass barstock	Chromplated brass barstock
Seat	PTFE Teflon®	PTFE Teflon®
Filter	10 µm sintered bronze	10 µm sintered SS
Diaphragm	316L SS	316L SS
Internal Seals	PTFE Teflon®	PTFE Teflon®
Gages	2" dia. brass	2" dia. SS
Ports	1/4" to CGA Pigtails	1/4" to CGA Pigtails
Helium Leak Integrity	$1*10^{-8}$ scc/sec	$1*10^{-8}$ scc/sec
CV	0.1 (50 psig)	0.1 (50 psig)
Shipping Weight	8.25 lbs. (3.71 kg)	8.25 lbs. (3.71 kg)

Ordering Information

Less Demanding Applications

W-526-2532-350 Hydrogen

W-526-2532-580 Argon, Helium, Nitrogen

W-526-2532-590 Air, Dry Air, Hydrocarbon-Free Air, Zero Air

Critical Applications (UHP)

W-527-2532-350 Hydrogen

W-527-2532-580 Argon, Helium, Nitrogen

W-527-2532-590 Air, Dry Air, Hydrocarbon-Free Air, Zero Air

Flow Controllers

- Conveniently regulates and distributes clean air output and pressure
- Easy installation and operation
- Manifold and single flow versions available
- Immediate delivery from stock

Parker Balston® Manifold Flow Controller

Parker Balston® Flow Controllers provide a convenient means for regulating and distributing the clean air output from a Parker Balston compressed Air Dryer, FT-IR Purge Gas Generator, or Self-Contained Lab Gas Generator. Two styles of flow Controllers are available: manifolded flow controllers or single flow controllers.

Manifold models 72-398, 72-400, 72-401, and 72-402 accept clean gas, at the regulated pressure, into the manifold where independently adjustable flow controls may be set to serve three separate instruments. Single Flow Models 72-428, 72-430, 72-431, and 72-432 include a pressure regulator and a single flow controller.

Each flow controller is equipped with a triple scale pressure gauge (psig, bar, kg/cm^2), a pressure regulator, and a flow meter mounted on a convenient bracket for wall or panel mount installations.

Principal Specifications

Manifold Models	Single Flow Models 72-398, 400, 401, 402	72-428, 430, 431, 432
Inlet Ports	1/4" NPT (female)	1/8" NPT (female)
Max. Pressure	125 psig	125 psig
Pressure Gauge Range	0-60 psig	0-100 psig
Outlet Ports	1/8" tube fitting	1/8" tube fitting
Dimensions	8"w x 7"h x 6"d (20cm x 18cm x 15cm)	4"w x 7"h x 2"h (10cm x 18cm x 5 cm)
Shipping Weight	5 lbs (2 kg)	5 lbs (2 kg)

Ordering Information

Description	Flow Range
Manifold Models	
72-398	1-5 scfh (.5-2.5 lpm)
72-400	10-100 scfh (5-50 lpm)
72-401	5-50 scfh (2.5-25 lpm)
72-402	20-200 scfh (10-100 lpm)
Single Flow Models	
72-428	1-5 scfh (.5-2.5 lpm)
72-430	10-100 scfh (5-50 lpm)
72-431	5-50 scfh (2.5-25 lpm)
72-432	20-200 scfh (10-100 lpm)

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www.parker.com/ags

Precision Control Flow Meters

- ▲ **Rib-guided metering tubes assure accurate stable readings**
- ▲ **Magnifier lens in front shield enhances reading resolution**
- ▲ **Non-rotating feature prevents turning of flow tube**
- ▲ **Interchangeable flow tubes provide simple upgrade for use with other applications as required**
- ▲ **Flow calculations and conversions eliminated by matching the bottom table**

Parker Balston WFM Series Flowmeters

Parker Balston® Precision Control Flow Meters are suitable with all Parker Balston Gas Generators. These flowmeters incorporate traditional variable area flow technology and are ideal for trace low flow and high flow control requirements. Leak integrity is tested using a state-of-the-art mass spectrometer and helium. The flowmeters are constructed of rugged, inert materials. Low flow series meters include a flat surface tripod.

Principal Specifications

Maximum Inlet Pressure	200 psig (13.8 bar)
Maximum Temperature	250°F (121°C)
Material of Construction	
Float (gas specific)	Glass, Sapphire, or 316 SS
Flow Tube	Heavy walled Borosilicate glass
Side Panels	Aluminum, black anodized
Front Shields	Lexan® with magnifier lens
Back Plates	1/8" White acrylic
Calibrated Accuracy	±1% FS
Ports	1/8" convertible to 1/4" compression
Helium Leak Integrity	$1*10^{-7}$ scc/sec
Repeatability	± 0.25% FS
Flat Surface Tripod	Acrylic with level adjust
Shipping Weight	5 lbs. (2kg)

Ordering Information

FT-IR Purge Gas Generators	
75-45NA	W-FM76807
75-52NA	W-FM76830
75-62NA	W-FM7562
Membrane Air Dryers @ min. flow rate	
64-01	W-FM76830
64-02	W-FM7562
64-10	W-FM6410
Membrane Air Dryers @ max. flow rate	
64-01	W-FM7562
64-02	W-FM7562
64-10	W-FM6410HF
NMR Gas Generator	
64-20NA	W-FM6410
TOC Gas Generator	
TOC-1250	W-FM7583

Halogenated Hydrocarbon Scrubber

- ▲ **Ideal for removing halogenated hydrocarbons from compessed air**
- ▲ **Extended-life adsorbent requiring minimal maintenance**
- ▲ **Protects equipment from chlorinated solvent vapors**
- ▲ **Purifies bulk inert non-corrosive gases**

Parker Balston® Model 76080 Halogenated Hydrocarbon Scrubber

Parker Balston® Halogenated Hydrocarbon Scrubbers effectively remove halogenated hydrocarbons from an existing compressed air supply. The scrubber can be used with any Parker Balston Zero Air Generator or UHP Nitrogen Generator if the compressed air supply contains halogenated hydrocarbons. Halogenated hydrocarbons can corrode piping, filters, valves, and other components.

Principal Specifications

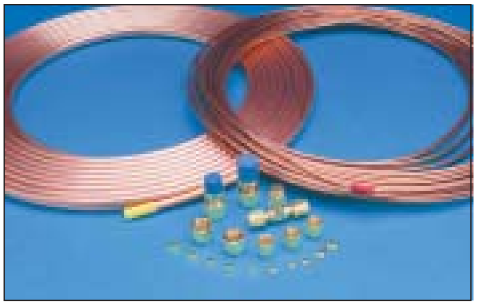
Model 76080 Halogenated Hydrocarbon Scrubber	
Min/Max Pressure Rating	60 psig to 125 psig (4 barg - 8.6 barg)
Inlet/Outlet Ports	1/4" NPT (female)
Change Frequency @ 17 LPM	18 Months
Dimensions	41"h x 15"w x 8"d (104 cm x 38 cm x 20 cm)
Shipping Weight	29 lbs. (13 kg)

Ordering Information

Description	Model Number
Halogenated Hydrocarbon Scrubber (New)	76080

Installation Kits

- Provides clean tubing for commissioning of new gas generators
- Eliminates the wait for materials to install new gas generators
- Logical complement to gas generator purchases



Installation Kit Contents

Each Installation Kit combines all of the basic fittings and tubing required to connect your Parker Balston® gas generator to a compressed air source (where applicable) and up to two instruments. Parker Balston Installation Kits are designed specifically for each model of gas generator. All Installation Kits use Parker fittings and refrigerant grade copper tubing. Parker fittings provide a leakproof, torque-free seal at all tubing connections, and eliminate leaks in instrumentation tubing. Additional valves, pressure regulators, scrubbers, and other vital components are available for each gas generator.

Principal Specifications

Installation Kit Part Number	Used On
IK75880	N2-45, N2-45ANA, N2-80, N2-80ANA, N2-135, N2-135ANA
IK76803	75-83NA, HPZA-3500, HPA-7000, HPZA-18000 HPZA-30000, HPZA-30000, TOC-1250, N2-04
IK7694	HPN2-1100, UHPN2-1100, HPN2-2000
IK7532	H2-90NA, 9150, H2-150NA, 9200, H2-300NA, 9400, H2-500NA, H2-800NA, H2-1200NA
IK7572	N2-14, N2-14ANA, N2-22, N2-22ANA, N2-30NANA, N2-35, N2-35ANA
IK7698	76-97NA, 76-98NA

Parker Hannifin Corporation
Filtration and Separation Division
Haverhill, MA • 1-800-343-4048
www.parker.com/ags

Compressor Aftercooler System

- Complete system to condition compressed air by removing oil, water, and solids prior to the inlet of gas generators
- Simple turn-key solution for gas generator users questioning the quality of building and laboratory supply compressed air
- Easy wall-mounting design requires no laboratory or bench space
- Protects generator systm and will assure long-term reliable operation in event of compressed air system upset
- Ideal for areas of high humidity
- Minimal annual maintenance

Compressor Aftercooler System

The Parker Balston compressor aftercooler and inlet compressed air conditioner is a point-of-use compressed air cleaner. It should be used on any substandard compressed air line that supplies air to instrumentation.

It is especially useful when used with a Parker Balston brand gas generator in areas with high humidity levels and with compressor systems which do not have a heat exchange device.

Specifications

System Specifications	
Model Number	72-100NA
Maximum Inlet Air Pressure	250 psig (17 barg)
Maximum Flow Rate	6 SCFM (170 lpm)
Maximum Ambient Temperature	120°F (49°C)
Inlet Port Fitting	1/8" NPT convertable to 1/4" NPT
Outlet Port Fitting	1/4" NPT (female)
Electrical Requirements	120 VAC/60 Hz
Physical Dimensions	15"w x 21.5"h x 10"d (39cm x 54cm x 25cm)
Product Weight	26 lbs. (12 kg)
Shipping Weight	32 lbs. (14 kg)

Replacement Parts

Description	P/N	Frequency
Maintenance Kit	MK76080	Annual

Extended Support Programs

UHP Nitrogen Generators produce 99.9999% pure N_2 for GC's or ICP Spectrometers

Hydrogen Generators produce 99.99999% pure hydrogen for GC's

FT-IR Gas Generators produce dry, CO_2-free purge gas for FT-IR Spectrometers

Zero Air Generators produce zero grade air for GC's

Pure Air and Nitrogen Generators produce dry, ultra pure compressed gas for laboratory instruments including LC/MS

Accessories for Gas Generators

Parker Balston Analytical Gas Generators, Filtration and Separation equipment are world renowned for their reliability, dependability, and long life. Since commercializing our first laboratory scale analytical gas generator in the 1980s, we now serve an installed customer base of over 40,000 gas generator users globally.

Our experience shows that with regularly scheduled maintenance, generators and analytical instruments continue to consistently produce precise results, and precise purity for decades.

Parker Balston is pleased to offer a variety of Extended Support Plans to assure this standard of performance is possible with your new gas generator purchase. At the fraction of the cost of a new gas generator, Parker Balston Extended Support Plans are truly affordable to purchase.

Our plans range from the standard Depot class of support to our exclusive Express class of support. Both types of plans are convenient and are designed to match your needs and budget. Derivatives or each class are offered, which includes automatic shipment of maintenance items as required by your gas generator when needed. It's a simple reminder for periodic maintenance.

Lastly, Parker Balston Extended Support Plans are smart to select when you depend upon high performance analytical equipment. Our exclusive Express support program offers the piece-of-mind of a new or like new replacement generator arriving at your door the very next business morning.

Included with Extended Support Program	Express (EC2)	Express (EN2)	Depot (DC2)	Depot (DN2)
Next Day Delivery of New or Like New Temporary Replacement Unit	X	X	NA	NA
Extends Warranty Coverage to 24 Months	X	X	X	X
Covers Replacement Parts for Repair	X	X	X	X
Covers Labor Charges for Repair	X	X	X	X
Covers Packaging Materials for Repair	X	X	X	X
Covers Freight Charges for Repair	X	X	X	X
Autoshipment of Consumables (Scheduled Maintenance)	X	NA	X	NA

Benefits Summary/Overview:

- Next business morning delivery of a replacement gas generator
- Extension of standard gas generator warranty to 24 months
- Responsive turn-around time for service center repairs
- Complete coverage of freight charges, to and from service center
- Complete expense coverage regarding labor, parts, and packaging materials
- Dedicated technical support hot-line
- Automatic delivery of preventative maintenance items as required by the generator

The Effect of Fuel Air Purity on FID Sensitivity

Dorothea J. Jeffery, Gregory C. Slack and Harold M. McNair, Dept. of Chemistry,
Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

Poster Session Report

Presented by Virginia Polytechnic Institute and State University and Parker Hannifin Corporation

Abstract

In the field of capillary gas chromatography, the presence of sensitive detectors and trace analyte samples increases the need for dry, clean fuel gases. Laboratories in an industrial setting often maintain several gas chromatographs in continuous operation. Since large volumes of fuel gases are consumed daily, gas cylinders are changed almost as frequently. Usually the fuel air is of breathing quality and is introduced either directly or after drying via a molecular sieve trap. The objective of this study is to compare flame ionization detector sensitivity vs. air purity under isothermal conditions. This study included air sources as follows: the Parker Balston® Type HPZA-3500 Zero Air Generator, breathing air (cylinder without scrubbers), ultra zero air (cylinder), and filtered house air.

The study proceeded as follows:

1. compared baseline runs taken at 10 minutes, 60 minutes, and 12 hours
2. compared runs of a 50 ppm trace alkane sample, and
3. compared runs of a 1 ppm trace alkane sample for the air sources with the exception of the house air. Finally, both breathing and generated air studies were repeated under optimized conditions and without air scrubbers. This final study also included the filtered house air.

A comparison of the chromatograms for the baseline and the trace component runs showed that both the Parker Balston® Type HPZA-3500 Zero Air Generator and the ultra pure air produced lower signals and better sensitivity: as shown by increased peak area counts. These baseline were also more stable than either the breathing air or the house air. In addition to the lower and stable baseline, the air generator had the advantage of providing a continuous source of air.

Table 1: Chromatographic Conditions

Column	HP-1, 12 m x 0.2 mm, 0.33 µm df
Oven Temperature	110½C
Inlet Temperature	250½C
Detector Temperature	300½C
Split Ratio	28:1
Carrier Gas	0.8 ml/min He
Fuel Gases	30 ml/min H and 300 ml/min Air
Samples	50 ppm and 1 ppm decane, undecane

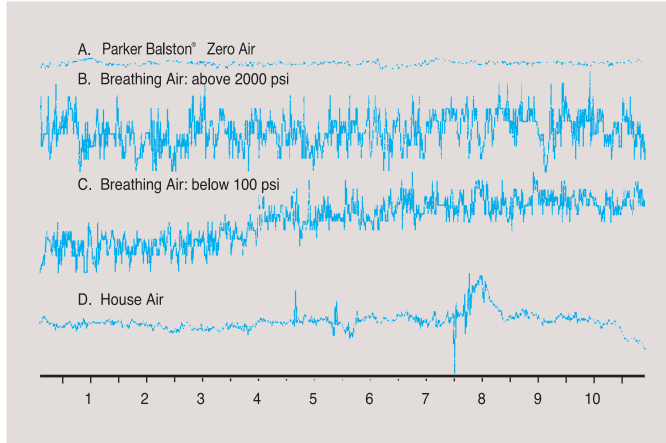


Figure 1: *Baseline Signals – Random spike at 6 min. for Zero Air (A). Baselines are raw data (mA) on equivalent scales*

Introduction

In a previous study, baseline and trace alkane sample data was obtained utilizing a HP 5890 gas chromatograph (GC) equipped with a flame ionization detector (FID) and a 12 meter methyl silicone column (Hewlett-Packard, Avondale, PA). The air sources in that study were the Parker Balston® Type HPZA-3500 Zero Air Generator, an ultra pure air cylinder, and a breathing air cylinder. An improvement in both the baseline and the peak areas was noted for the Parker Balston® zero air, in comparison with the breathing air. In this study, the Zero Air was compared with breathing air at the two specified cylinder pressures of above 2000 psi and below 100 psi and with filtered house air.

For each air source, this study proceeded from a 30 minute baseline run to triplicate runs of each standard:
1 ppm and 50 ppm decane, undecane, and dodecane in iso-octane. Between each air supply, the system was allowed to equilibrate several hours before the baselines were run. Chromatograms showing area counts were generated by a HP 3396A integrator for each run. This peak area data was statistically compared using Statview, a Macintosh statistics software package.

Experimental

A 30 minute baseline and triplicate runs of the 1 ppm and the 50 ppm alkane standard of the air supply were obtained under the conditions listed in *Table 1* for the following air sources:

1. Parker Balston® Type HPZA-3500 Zero Air Generator
2. Breathing Air Cylinder (at pressures above 2000 psi and below 100 psi)
3. House Air via Parker Balston® DXE and BXE filters

The house air was filtered before introduction to the GC due to its potential to damage or contaminate the system by introducing particulate.

Results

Optimized carrier gas flow rate and split ratio were used in order to produce better quantitation. Similar to previous baseline runs, the zero air signal (average signal during blank runs) was lower than either of the other air sources (*Figure 1 and Table 2*). In addition, the zero air undecane peak area counts for both the 50 ppm and 1 ppm standards were significantly larger than those of either the breathing or house air (*Table 2*). Tables 3 and 4 contain the statistical comparisons of the average peak area counts for both the 50 ppm and 1 ppm standards respectively.

Parker Balston® zero air was used as the reference in the paired t value and 2-tail probability determinations. The paired t value critical values at the 97.5 confidence level were 3.18 for 3 degrees of freedom and 4.30 for 2 degrees of freedom. The calculated values in both the 50 ppm and the 1 ppm runs were larger than the respective critical values; therefore, the differences in area counts were not due to random fluctuations. In addition, the 2-tail probabilities were below the absolute critical value of 0.05. This occupance supports the theory of non random differences in area counts as determined by the paired t test. Since both the paired t values and 2-tail probability values were outside their respective critical ranges, the differences in peak areas were not due to random fluctuations[1]. These differences were due to the flame purity.

Table 2: Baseline Data

Air Source	Parker Balston®	Breathing Air > 2000 psi	Breathing Air < 100 psi	House Air
Signal	12	22	18	22

Table 3: Undecane Peak Area Data 50 ppm Standard Data

Mean Area Counts	10878	9784	9181	8206
Standard Deviation	426	194	179	89
Paired t Values	–	3.8	8.75	14.82
Probability (2-Tailed)	–	0.032	0.003	0.001
Degrees of Freedom	3	3	3	3

[1] *Abacus Concepts, Statview II, Abacus Concepts, Inc.: California 1987*

Table 4: Undecane Peak Area Data 1 ppm Standard Data

Mean Area Counts	1744	1629	1531	1404
Standard Deviation	2.1	35.2	20.8	21.1
Paired t Values	–	4.77	19.57	27.06
Probability (2-Tailed)	–	0.041	0.003	0.001
Degrees of Freedom	2	2	2	2

Conclusion

The Parker Balston® Type HPZA-3500 Zero Air Generator has advantages over the conventional sources of air for GC analysis. A lower and more stable baseline signal can be obtained. Due to lower baseline noise, the signal-to-noise ratio is larger, giving rise to higher sensitivity or larger peak areas. A comparison of peak areas for the alkane standards gave similar results. The air generator produced peak areas which were more than 12% of the breathing air peak areas. Not only does the air generator give better baselines. In addition, the air generator also removes the need for frequent cylinder changes, thus saving time.

[1] Abacus Concepts, Statview II, Abacus Concepts, Inc.: California 1987.

Dr. Harold M. McNair is Chairperson of the Chemistry Department at Virginia Polytechnic Institute and State University. Dorothea J. Jeffery and Gregory C. Slack are currently undergraduate students at VPI & SU.

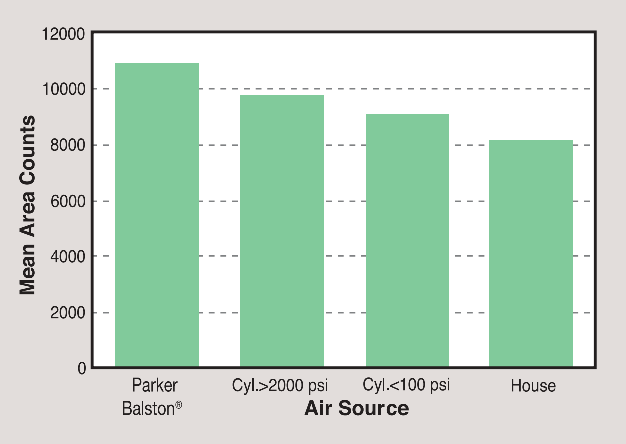


Figure 2: *Average Area Counts – 50 ppm Undecane.*

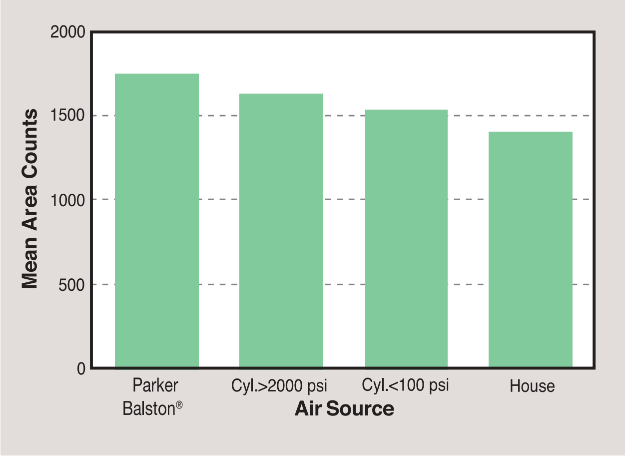


Figure 3: *Average Area Counts – 1 ppm Undecane.*

The Effect of Detector Gas Purity on FID Baseline Stability By Eugene Barry

American Laboratory

Reprinted from American Laboratory April 1993

It is well accepted in the field of gas chromatography that the purity of gases utilized for the operation of the gas chromatograph will affect the accuracy of analyses, consistency of results, detector sensitivity, and column life as well as column performance. As a result, it is important that sources of gas used by the chromatographer meet the highest possible purity standards affordable in order to meet the demand to achieve higher sensitivities required for environmental analysis, quality control procedures, government regulations, as so forth. Traditionally, this source has been a high-pressure gas cylinder specified to a wide range of purities (99.99% to 99.9999%). More recently, gas generators have become available as a source of high-purity hydrogen (for carrier and fuel gas) and high-purity nitrogen (for make-up gas).

This paper describes the results of a performance study using the Parker Balston® Model H2-300 Hydrogen Gas Generator (*Fig. 1*) and the Parker Balston® Model UHPN2-1100 Ultra High Purity Nitrogen Generator (*Fig. 2*) (Parker Hannifin Corporation, Haverhill, MA) to provide make-up gas and detector fuel for a GC flame ionization detector. The objective of the study was to demonstrate any effect of using hydrogen and nitrogen from the generators on the performance of the gas chromatograph. The results of the instrument operation using the generators as a source were compared to the results using the highest purity grade of cylinder gas (research grade) available. Baseline stability was the primary basis for comparison of the gases in the study.

igure 1: Model H2-300 hydrogen gas generatorÿ

Dr. Barry is a Professor of Chemistry and Graduate Coordinate at the University of Massachusetts at Lowell, Dept of Chemistry, One University Ave., Lowell, MA 01854, U.S.A.

Table 1

Gases used to establish baselines shown in Figure 3

Gas function	Gas source	Specified purity	Flow rate (cm³/min)	Pressure (psig)
Fuel air	Parker Balston® Zero Air Generator	< 0.05 ppm total hydrocarbons	300	35
Fuel Gas (H_2)	Parker Balston® H2-300 H_2 generator	99.99999%	40	22
	Research-grade cylinder	99.9995%		
Carrier gas (He)	Research-grade helium cylinder	99.9999%	0.7 23 cm/sec linear velocity	40
Make-up gas (N_2)	Research-grade N_2 cylinder	99.9995%	30	28

Table 2

Gases used to establish baselines shown in Figure 4

Gas function	Gas source	Specified purity	Flow rate (cm³/min)	Pressure (psig)
Fuel air	Parker Balston® Zero Air Generator	< 0.05 ppm total hydrocarbons	300	35
Fuel Gas (H_2)	Research-grade H_2 cylinder	99.9999%	40	22
Carrier gas (He)	Research-grade helium cylinder	99.9999%	0.7 23 cm/sec linear velocity	40
Make-up gas (N_2)	Parker Balston® UHPN2-1100 N_2 generator research-grade N_2 cylinder	99.9999%	30	28

Ultra Pure Hydrogen as a Carrier Gas for Capillary Chromatography

Traditionally, chromatographers have used helium and nitrogen as the carrier gases of choice in gas chromatography. Now, with the availability of a reliable, safe, ultra pure Parker Balston® Hydrogen Generator from Parker Hannifin Corporation (Tewksbury, MA) for the laboratory, the use of hydrogen as a carrier gas for capillary G.C. has advantages worth considering.

A comparison of the Van Deemter curves for nitrogen, helium and hydrogen is illustrated in *Figure 1*.

The small slope after the optimum flow velocity would mean that flow velocities could be increased without too much loss in efficiency (increase in H). Increased flow velocities will shorten analysis time (often cutting analysis time in half), resulting in lower elution temperature requirements, lower cost per analysis, and extended column life. From a theoretical yet practical viewpoint, the use of Hydrogen as a carrier gas allows the generation of nearly four times as many effective theoretical plates per second as Nitrogen. From a practical chromatographer's view, the chance of picking a good flow rate with the first experiment is increased.

Summary

Very acceptable separations and increased sensitivity for trace analyses can be obtained by using hydrogen generated by the Parker Balston® Hydrogen Generator as a carrier gas. This unit provides a safe, reliable, economical source of very pure hydrogen. Cost figures show that the 300 ml/min Parker Balston generator pays for itself in 1 to 2 years. The hydrogen is produced by electrolysis through palladium, which produces ultra-dry hydrogen with less than 10 ppb impurities. Only 50 ml of hydrogen are stored at any time in the unit, ensuring complete safety and compliance with OSHA and NFDA regulations.

With this new, safe source of ultra pure hydrogen available, chromatographers are experiencing some additional benefits with the use of hydrogen as a carrier gas. These benefits would include the subjected to shorter runs of cooler temperatures, typically increasing their useful life by 33%.

"The predominant opinion… that the gas with the lower viscosity, that is, hydrogen, is the best carrier gas… " for capillary G.C. has been expressed by Rohrschneider and Pelster. The Parker Balston® Ultra High Purity Hydrogen Generators are the only Generators available that enable Chromatographers to use hydrogen for both carrier gas and fuel gas applications. Hydrogen is being put into use in more laboratories with the availability of a safe, economical, ultra pure Parker Balston® hydrogen generator.

For Additional Information

Parker Hannifin Corporation, also manufactures and markets a complete line of Parker Balston® Gas Generators including: Ultra High Purity Nitrogen Generators, Gas Generators for FT-IR Spectrometers and NMR's, TOC Gas Generators, and Complete Systems with Oil-less Compressors. All generators are designed to enhance instrument accuracy and performance, and increase laboratory efficiencies by automating gas delivery systems.

Dr. Eugene Barry is a Professor of Chemistry and Graduate Coordinator at the University of Massachusetts, located in Lowell.

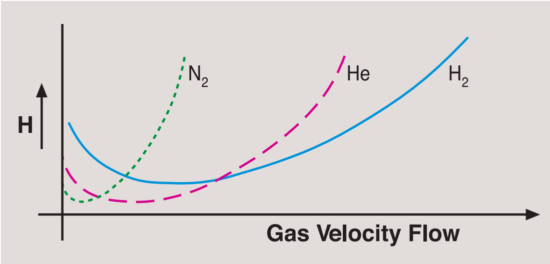


Figure 1: *A Comparison of the Van Deemter Curves for Nitrogen, Helium, and Hydrogen.*

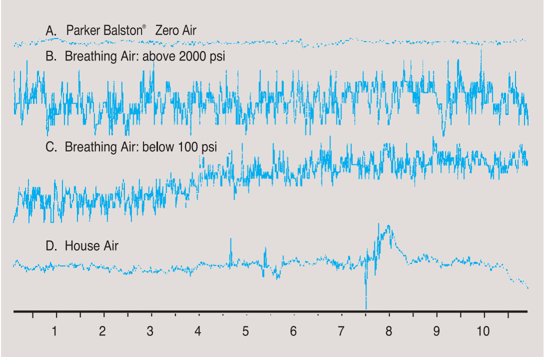


Figure1: *Baseline Signals – Random spike at 6min. for Aero Air (A). Baselines are raw data (mA) on equivalent scales.*

Exhibit A: *A Parker Balston® Zero Air Generator*

Exhibit B: *A Parker Balston® Hydrogen Generator*

The chromatographer's concerns with the quality of the gases used in the analysis focus on impurities. Impurities in a chromatographer's gas supply can result in excessive noise, baseline drift, ghost peaks, column bleed, and reduced column life.[1-3] The specified purity of the gases supplied by the generators is 99.9999% for the nitrogen and 99.99999% for the hydrogen. These stated purities are sufficiently high that the gases should yield a baseline stability comparable to that achieved with the highest purity cylinder gases available, namely research grade.

Experimental

This gas chromatography performance study was conducted at the University of Massachusetts, Lowell, using a 5890A GC (Hewlett-Packard Co., Palo Alto, CA) with flame ionization detector. The column used during the study was a HP-1 fused silica capillary column, 30 m in length, 0.07-mm i.d., with a film thickness of 0.25 um, and the column was operated under isothermal conditions at 100½C at a linear velocity of 23 cm^3/sec. The split ratio used in the performance testing was 100:1. The instrument used two sets of conditions in order to obtain a set of baselines to show the effect of the hydrogen generator as a source of fuel gas (Figure 3) and a set of baselines to show the effect of the UHP nitrogen generator as a source of make-up gas (Figure 4). The operation of the instrument to obtain the baselines shown in Figure 3 used the gases as described in Table 1. The operation of the instrument to obtain the baselines shown in Figure 2 used the gases as described in Table 2.

Results

Figure 3 shows the effect of using fuel hydrogen supplied by a H2-300 hydrogen generator on baseline stability. The baseline generated is compared to that generated while using a research-grade cylinder of hydrogen as the fuel gas source. Figure 3 shows that there is not a distinguishable difference between the two baselines.

Figure 4 shows the effect of using make-up nitrogen gas supplied by a UHPN2-1100 UHP nitrogen generator on baseline stability. The comparison of the baseline generated while using make-up gas from a research-grade cylinder shows that the two gas sources are indistinguishable.

***Figure 2:** Model UHPN2-1100 UHP Nitrogen Gas Generator*

Conclusion

A GC was used to compare the baseline stability of a flame ionization detector while using a gas generator as the source of detector fuel and make-up gas with the baseline stability obtained while using corresponding research-grade cylinder gases. The results demonstrate that the H2-300 hydrogen generator (used as a source of detector fuel) and the UHPN2-1100 UHP nitrogen generator (used as a source of make-up gas) will provide the chromatographer with GC baseline stability equivalent to that achieved with the highest purity grade of gas cylinder available, while offering the inherent advantages of eliminating high pressure gas cylinders (such as safety, convenience, and cost).

References

1. Hinshaw JV. LC•GC 1988; 6(9):794-8.
2. Hinshaw JV. LC•GC 1990; 8(2):104-14.
3. Hinshaw JV. LC•GC 1991; 10(5):368-76.

For additional Information

Parker Hannifin Corporation, also manufactures and markets a complete line of Parker Balston® Gas Generators including: Ultra High Purity Nitrogen Generators, Gas Generators for FT-IR Spectrometers and NMR's, TOC Gas Generators, and Complete Systems with Oil-less Compressors. All generators are designed to enhance instrument accuracy and performance, and increase laboratory efficiencies by automating gas delivery systems.

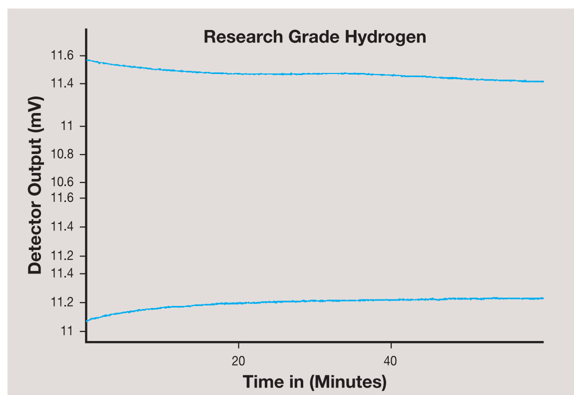


Figure 3: Gas chromatograph baselines using a 75-34 hydrogen generator and a research-grade cylinder as fuel sources.

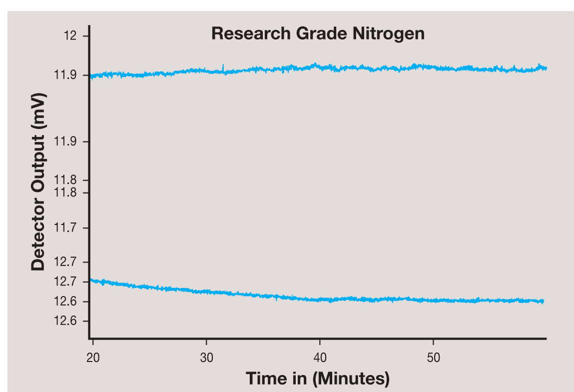


Figure 4: Gas chromatograph baselines using a 76-94 UHP nitrogen generator and a research-grade cylinder as make-up gas sources.

Loctite Saves Almost $20,000 Per Year By Generating Its Own Hydrogen for GC/FIDs

Loctite is saving almost $20,000 per year in cylinder costs alone by generating its own hydrogen for use as carrier gas and fuel in gas chromatographs with flame ionization detectors (GC/FIDs). Helium and hydrogen gas cylinders used in the past were expensive to purchase and required a considerable amount of time on the part of the laboratory staff to order, transfer to the lab and install them while maintaining safety regulations. As a result, a few years ago the company's Rocky Hill Analytical laboratory purchased an on-site hydrogen generator to produce hydrogen from water on demand which results in virtually no operating costs. "We save a considerable amount of money every year, avoid the time and difficulties involved in dealing with gas cylinders and produce purer gas more reliably with our on-site generator," said Robert Trottier, Manager, Analytical Services for Loctite.

Loctite manufactures and markets a broad range of high-technology sealants, adhesives and coatings that are used in computers, automobiles, airplanes, vacuum cleaners, speakers, syringes, cosmetics, compact disk players and many other products. The company often develops the complex equipment used for application and assembly as well. Loctite is in the business of solving problems. When a customer buys a Loctite product it also gets a partner that will work side-by-side with them to find innovative solutions to their design and manufacturing problems. Loctite is a subsidiary of Henkel, KgaA, an international manufacturer of chemicals, detergents, industrial adhesives and cosmetics.

Analytical Services group

Loctite's Analytical Services group supports the company's research activities by providing chemical testing of incoming raw materials, intermediates, new compounds and formulations developed to meet customer needs. The vast majority of materials involved in the company's research are organic based. Liquid chromatography (LC) and gas chromatography (GC) are two of the best tools for characterizing these types of materials. Several years ago, the Analytical Services group converted several of their GCs to capillary column systems. Capillary GC systems typically produce sharper analyte peaks and deliver higher resolution in separating these organic materials.

About the same time, Analytical Services management began considering converting the carrier gas for its Perkin Elmer Autosystem and Autosystem XL GC/FIDs over to hydrogen from helium. "Helium tends to be relatively expensive, it's a nonrenewable resource," Trottier said. Another problem is that the purity of commercial-grade helium can be less than ideal for some of the more sensitive analytical methods. We occasionally experienced problems with contaminants that generate background noise in our chromatograms, sometimes causing us to expend time trying to identify the source."

Cost of gas cylinders

In addition, Trottier said, he was not happy with the cost or the time involved in dealing with gas cylinders. "Each instrument used approximately one cylinder of helium per week at a cost of $167 per cylinder or $8,684 per year. In addition, our laboratory staff had to spend time checking on the supplies of gas for each of our instruments and ordering new tanks when required. Our new Analytical labs are located at the opposite end of the R&D building and are somewhat distant from the shipping & receiving docks. So we would either have to transport the tanks across the building or alternatively, pay to have a gas line run from the receiving area to the lab. It typically took about an hour of staff time to haul the cylinders from the loading dock and install in the laboratory. The cylinders also took up a lot of valuable space. Each instrument required a cylinder to run, a spare cylinder supply and often an additional one in transit or storage."

"When it was time for us to move to our new facility in Rocky Hill, we decided to take a close look at whether it made sense to switch to hydrogen as carrier gas and fuel for the GC/FIDs," Trottier said. "The primary motivation was cost – hydrogen is less expensive than helium. But what intrigued us even more was the availability of a new generation of hydrogen generators that are capable of producing hydrogen on an as needed basis with virtually no operating costs. This eliminates the need to purchase, transport and install cylinders. The generator services each instrument and automatically produces what is required on demand."

Eliminating need to purchase cylinders

Trottier spoke to Phil Allison, at that time a Sales Representative and now Product Manager for Parker Balston® Branded Products at Parker Hannifin Corporation in Haverhill, Massachusetts, the leading producer of hydrogen generators. Based on usage, Allison demonstrated that nearly $20,000 per year could be saved by equipping the 2 Perkin Elmer GC-FIDs in the new laboratory with a hydrogen generator. In addition to these hard savings by eliminating the need to purchase gas cylinders, Trottier felt that the lab could achieve a significant productivity increase by avoiding the need for lab personnel to spend time dealing with cylinders. The gas generator could simply be set up and (almost) forgotten.

Trottier also considered the safety issues involved in the switch from cylinders to on-site generation. Loctite expended considerable effort in ensuring safe handling of gas cylinders and never experienced a gas cylinder accident. Yet Trottier was aware of potential dangers, as

Loctite Saves Almost $20,000 Per Year By Generating Its Own Hydrogen for GC/FIDs

(Continued)

highlighted by the American Chemical Society's training film that is shown to laboratory personnel. The film depicts a cylinder valve being suddenly broken off and the resulting rush of pressurized gas which propels the cylinder through a concrete wall. Gas cylinders also present far more prosaic dangers to extremities such as rolling onto a person's toe.

On-site generation is safe

On-site generators, on the other hand, eliminate many of these concerns. The gas is produced under very low pressures and is consumed nearly as soon as it is produced, eliminating most of the safety issues involved with cylinders

Parker Balston H2-300 generators produce dry hydrogen gas to a purity level in excess of 99.99999% from deionized water and electricity. The hydrogen generator utilizes the principle of electrolytic disassociation of water and subsequent diffusion through a palladium membrane. The outlet pressure of the hydrogen generator is adjustable and the generator can deliver hydrogen at pressures up to 60 psi. The H2-300 has a hydrogen delivery capacity of 300 cc/minute. The high purity of the gas produced by this generator makes it ideal for use with FIDs, TCDs, trace hydrocarbon analyzers and air pollution monitors.

How on-site generators work

The electrolytic disassociation of water takes place in the electrolytic cell as electricity passes through deionized water. During electrolysis, oxygen and other impurities collect at the nickel anode and are vented from the generator. Hydrogen ions collect at and pass through the tubular palladium cathode driven by the applied electric potential. Inside the tubes, the hydrogen recombines to form purified molecular hydrogen. The newly formed hydrogen is under pressure and ready to be delivered to the usage point. The purity of the hydrogen is ensured by the fact that the palladium membrane allows only hydrogen and its isotopes to pass.

The hydrogen pressure at the outlet is regulated by an electronic pressure control circuit. A pressure transducer monitors the hydrogen pressure at a point between the cell and the outlet of the hydrogen generator. The control circuit adjusts the electrical current to maintain the set hydrogen pressure. Key safety features include minimal hydrogen storage capacity, a production control switch, an electrolytic leak detector, an over-temperature switch, a pressure sensor and a low water shutoff control. The generators also have built-in system diagnostics to monitor the performance and operation of the generator.

Annual maintenance and electricity costs are only $248 per year. The primary maintenance activities are filling the feed water bottle and changing the electrolyte solution. If the generator is operated 24 hours per day at the rated maximum flow, the water in the feed bottle lasts for 8 to 10 days. At this point, the water reservoir is refilled using deionized water with a rating of 5 Megaohm-cm or better. The electrolyte solution must be changed once each year to maintain efficient operation of the hydrogen generator. The electrolyte is a specially prepared solution of sodium hydroxide.

The net result was a substantial and easily measured cost savings as well as significant intangible benefits. "The hydrogen generator more than paid for itself in the first year of operation and has generated savings of approximately $10,000 per machine or $20,000 total each year since," Trottier said. "In addition, we have eliminated the time and aggravations that were previously involved in purchasing, installing and monitoring the gas cylinders. In my opinion, on-site generation is the wave of the future in gas chromatography."

BASF Corporation Eliminates Costly, Inconvenient Cylinders of Zero Air with New Zero Air Generator

Industrial Process Products and Technology

Reprinted from Industrial Process Products and Technology October 1993

BASF Corporation is the North American member of the BASF Group. The corporation employs about 19,000 people at 41 major production facilities in North America. BASF Corporation's highly diversified product mix includes printing links and plates, antifreeze, audio, video and computer recording media, automotive coatings, basic colorants, crop protection products, pharmaceuticals and plastics.

Ernie Bedard, a Senior Chemist at the company's Greenville, Ohio resin plant, was using cylinders of hydrogen and zero air to supply fuel and air to the Flame Ionization Detectors of his two gas chromatographs which are used to follow the course of reactions, check for residual monomers in certain products, check compositions on solvent blends, and analyze waste water. Although the cylinders provided adequate gas purity, he had some concerns about the handling of the cylinders. "We weren't experiencing any problems with gas purity, but it was an unwieldy situation handling the cylinders, and I wasn't happy with it." Another problem occurred when the cylinders were not monitored carefully. "We would know that a cylinder needed to be changed when the Flame Ionization Detector went out. No damage would occur, but we would have to change the cylinder, start-up, and repeat the run which was an inconvenience." To change a cylinder, a person had to remove the regulator, replace the cylinder and re-attach the regulator. If the regulator was not seated properly, the cylinder would leak, resulting in gas loss. Since a move to a new laboratory was planned, Ernie thought that it would be ideal, at this time, to eliminate the inconveniences associated with handling gas cylinders. The generator was reviewed and approved by the site safety committee prior to its installation in the new laboratory.

When contacted by BASF, Parker Hannifin Corporation, Tewksbury, MA recommended the Parker Balston® Zero Air Generator. The Generator reduces the total hydrocarbon content of compressed air to less than 0.05 ppm, measured as methane, by using catalytic oxidation to convert hydrocarbons to carbon dioxide and water. The Generator is a complete system with carefully matched components engineered for easy installation, operation and long term reliability. Standard features include coalescing prefilters with automatic drains, state-of-the-art heater module and a membrane final filter.

A Parker Balston® Zero Air Generator

"Installation was easy. All we had to do was just hook the Zero Air Generator up to the plant air line and then get it up and running."

Ernie is pleased to report that the Generator "has been running trouble-free" since it was installed. "The GC baselines have been nice and stable with no fluctuations." The unit has completely eliminated the problems associated with handling gas cylinders. Ernie also reports that prior to installation, "BASF was using approximately 2-3 cylinders of zero air a week at an annual cost of $5,054, not including demurrage and shipping fees." The Generator paid for itself in six months.

Effect of Purging a Sealed and Desiccated FTIR Spectrometer Sample Compartment

By R. Daly and D. Connaughton

American Laboratory

Reprinted from American Laboratory News Edition February 1994

The purpose of providing a dry, CO_2-free purge to an FTIR spectrometer is twofold. The purge prevents deterioration of the beamsplitter by moisture and also eliminates undesired absorbance by water and carbon dioxide in the background. Consequently, the purge enhances the instrument's reliability by the reduction of the potential need for service and increases the accuracy of analysis by the elimination of inconsistencies in the background levels of water and carbon dioxide.

A study was undertaken to demonstrate the inconsistency in background levels of water and carbon dioxide for an unpurged, sealed, and desiccated FTIR spectrometer as compared to a sealed and desiccated FTIR spectrometer with the sample compartment purged.

All of the testing discussed in this application note was conducted by an independent consultant with extensive experience in the field of FTIR spectroscopy who is unbiased toward the instrument and the purge gas generator. The tests were performed on an FTIR spectrometer that was designed as a sealed and desiccated instrument to be operated without purged gas. All data were collected in scan sets of four scans and each scan took approximately 15 sec. One scan was recorded for the background spectrum and a second was collected to produce the 100% transmittance line. For some spectra, scan sets were collected consecutively; for others, there was a time lag between the collection of the scans. The specific conditions are noted in the discussion of results. All spectra were apodized with the Norton-Beer strong function. The detector was a deuterated triglycine sulfate (DTGS) detector.

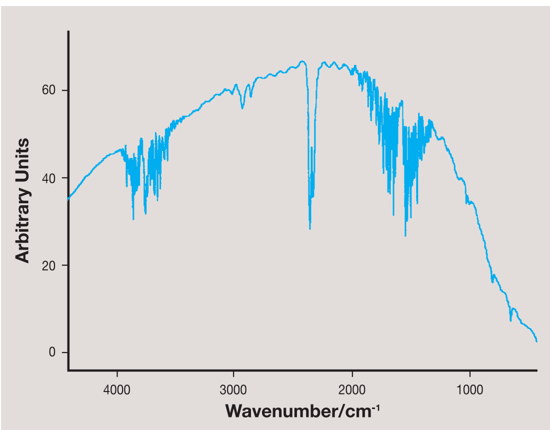


Figure 1: Single-beam spectrum from unpurged, sealed, and desiccated FTIR spectrometer.

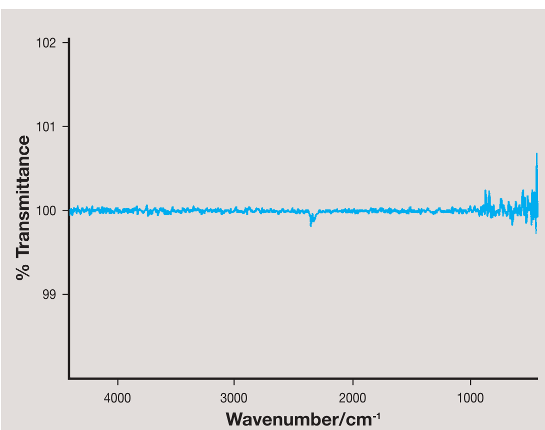


Figure 2: 100% Transmittance from unpurged, sealed, and desiccated FTIR spectrometer.

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Experimental

Two sets of tests were conducted in order to demonstrate the effect of purging an FTIR spectrometer sample compartment. The first set of tests consists of various scans without the instrument sample compartment being purged. The second set of tests demonstrates the effect of purging the spectrometer sample compartment.

A model 75-45NA FTIR purge gas generator (Parker Hannifin Corporation, Haverhill, MA) was used as the source of purge gas in the experiments. The generator was connected directly to an air line and operated at 80 psig. The air was treated prior to entering the generator by a condensing unit in order to remove gross quantities of water, and by filtration to remove oil droplets. During experiments with the use of a purge gas, the gas entered the sample compartment at a flow rate of 0.4 scfm.

Results

Performance without sample compartment purge *Figure 1* shows a single-beam spectrum of an unpurged, sealed, and desiccated FTIR spectrometer. Figure 2 shows the 100% transmittance line for the same, unpurged spectrometer. This line was produced from two consecutive scan sets. The spectrometer sample compartment had not been opened for at least 8 hr. The time between the two scan sets was less than 1 min. Despite the fact that there was a sealed atmosphere in the system, it can clearly be seen that there is a change in the carbon dioxide concentration.The problem is that the interferometer compartment is sealed, but the sample compartment is not. The carbon dioxide and water levels in the atmosphere change because the operator is in the vicinity of the spectrometer. If the operator were to cease breathing, there would be no recorded change in the carbon dioxide or water levels. If the time between scans increases, the situation becomes worse. This is illustrated in *Figure 3*. The time between scans was 40 min. The spectrometer was not opened in this time, but the operator was in the laboratory during that period. The operator was in the laboratory during that period. The operator was across the room for most of the time, and was alone.

Effect of Purging a Sealed and Desiccated FTIR Spectrometer Sample Compartment

(Continued)

Figure 3 indicates that the carbon dioxide and water content of the air change as a result of one person being in a room of approximately 7200 ft^3. In this case, the water level actually decreased, but there was a marked increase in the amount of CO_2 in the air. In an actual experiment, scan sets should never be collected 40 min apart. This figure simply illustrates how severe the lack of purge can be even for a sealed system.

A new background scan set was collected, and the sample cell was opened for 15 sec; then another scan set was collected immediately after the sample compartment was closed. The resulting 100% transmittance line is shown in *Figure 4*. As can be seen from this spectrum, the level of atmospheric water has decreased and the level of carbon dioxide has increased. Without purge, it is virtually impossible to maintain the atmospheric absorption bands as constant while a sample is changed. The levels of these vapors and gases are constantly changing, and the spectrometer is a very good detector for the change. Even if the operator were to hold his or her breath while opening the sample compartment, the ambient level of water and CO_2 in the atmosphere has enough fluctuation that it is impossible to maintain a constant level of water and CO_2.

Performance with the sample compartment purged

The sealed and desiccated spectrometer used in this study has a purge port with a line that leads directly to the sample compartment. This is provided so that the atmosphere within the sample compartment can be purged and maintained in a water-free and carbon dioxide-free state. *Figure 5* is a single-beam spectrum of the spectrometer once the sample compartment had been totally purged by the purge gas generator. When this is compared with *Figure 1*, it is evident that the water and the CO_2 bands have reduced in intensity, but there is still plenty of water in the desiccated compartment. It should be mentioned, however, that the desiccant was at the end of its cycle; consequently, there is more water than there would be if the desiccant were fresh. Herein lies another problem with sealed and desiccated systems: The dryness of the sealed interferometer compartment changes as the desiccant becomes saturated. The corresponding 100% line from the purged sample compartment is shown in *Figure 6*. The sample compartment door had not been opened between the two consecutive scan sets, so the 100% line is again very good.

If the sample compartment is open for 15 sec, then closed, and a new 100% line is measured with the background spectra from before the door had been opened, the resulting 100% line is shown in *Figure 7.* Clearly, there is a great deal of water vapor in the spectra. If the system were allowed to purge for 3 min, the water vapor and CO_2.

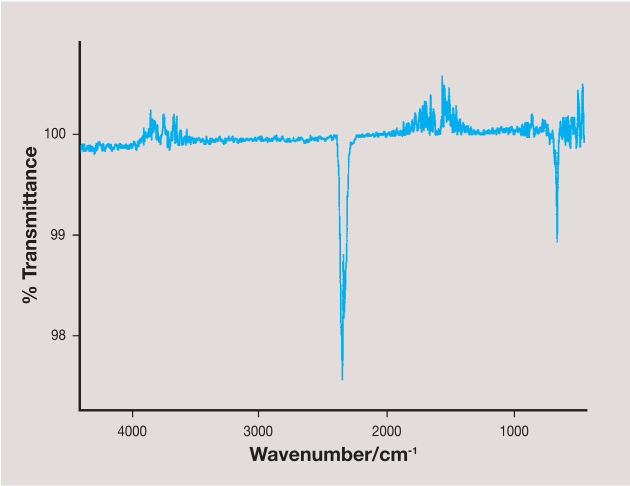

Figure 3: 100% Transmittance from unpurged, sealed, and desiccated FTIR spectrometer: 40 min between scans.

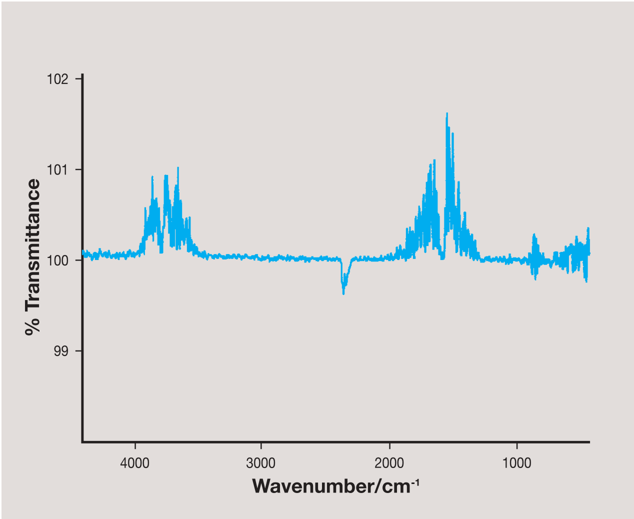

Figure 4: 100% Transmittance from unpurged, sealed, and desiccated FTIR spectrometer: 15 sec between scans.

Effect of Purging a Sealed and Desiccated FTIR Spectrometer Sample Compartment

(Continued)

that were in the sample compartment are completely removed. This can be seen in Figure 8 where a 100% line is obtained from the background spectra before the door was opened, and a new scan was collected 3 min after the door was closed. Figure 6, 7, and 8 illustrate that simple purging the sample compartment will provide good results. This, of course, does not remove all of the water and CO_2, and the water vapor and the CO_2 gas are still present in the desiccated chamber. Nonetheless, if a system is purged only in the sample compartment, it is far better than not purging at all.

Conclusion

Changing levels of CO_2 and water vapor in a laboratory atmosphere can result in interference from these contaminants for unpurged FTIR spectrometers. The changing levels of CO_2 and water are primarily a result of operator breathing, and the extent of interference to the FTIR spectra is dependent on the amount of time elapsed between the background spectra and the sample spectra.

Purging of the sample compartment increases the reliability and consistency of FTIR spectra. The experiments described above clearly identified the need for purge, even for the purgeless sealed and desiccated FTIR spectrometer sample compartment. The purge gas generator proved to be a suitable source of purge gas for such FTIR spectrometers.

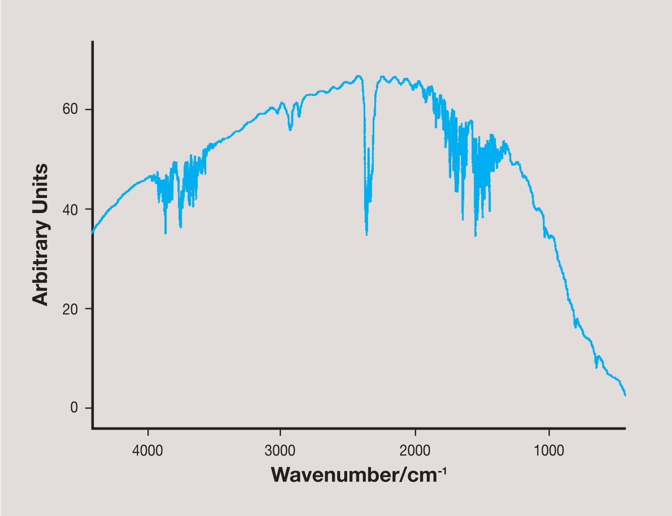

Figure 5: *Single-beam spectrum from sealed and desiccated FTIR spectrometer with purged sample compartment.*

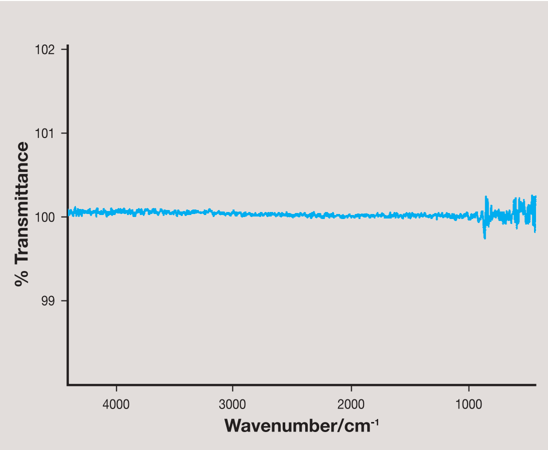

Figure 6: *100% Transmittance from sealed and desiccated FTIR spectrometer with purged sample compartment.*

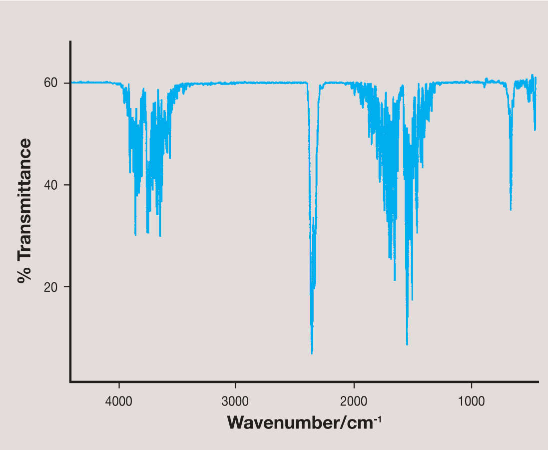

Figure 7: *100% Transmittance from sealed and desiccated FTIR spectrometer with purged sample compartment. Sample compartment opened for 15 sec between scans.*

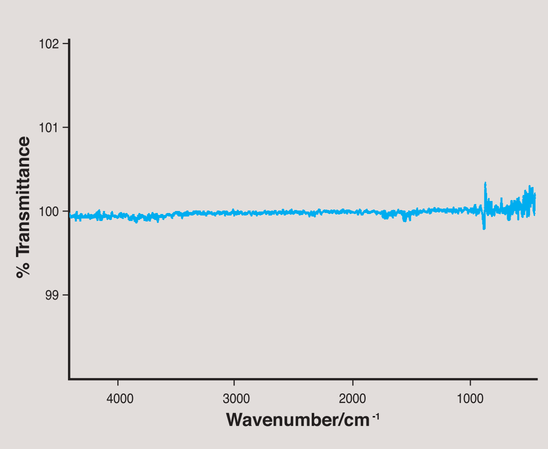

Figure 8: *100% Transmittance from sealed and desiccated FTIR spectrometer with purged sample chamber. Second scan collected 3 min after sample compartment was opened.*

Nitrogen Generation in a Drug Metabolism Laboratory *by Eldridge Luther*

American Laboratory
Reprinted from American Laboratory March 1999

A drug metabolism laboratory is now saving $750,000 per year in cylinder costs alone by generating its own nitrogen. Pfizer, Inc. (Groton, CT) has also saved the time required to change 30 gas cylinders per day, which would keep one person busy for the entire day. The laboratory uses nitrogen as curtain gas and shield gas in mass spectrometers used in high-throughput screening applications. The on-site nitrogen generation system uses a membrane separation technique to produce nitrogen from air on demand with virtually no operating costs.

An important portion of drug development is determining the pharmacokinetics—the impact of the body on the drug. An aspect of the study of pharmacokinetics is concerned with measuring the rate and extent with which the drug is absorbed into the systemic circulation and the manner through which the body disposes of the drug. One goal is to determine a dosing regimen that will maintain the drug in the body at a level at which it is therapeutically effective without any undesirable toxic or side effects.

Rise of mass spectrometry

To measure how rapidly the body disposes of drugs, the drug metabolism group must perform a huge number of analytical measurements of drugs in tissue slices and animal and human blood samples. Over the last several years, atmospheric pressure ionization (API) mass spectrometry has become the primary tool for making these measurements. Before a sample is introduced into the mass spectrometer, LC mobile phase solution containing the sample is nebulized using nitrogen gas. As the aerosol spray droplets evaporate, the molecules are charged. These charged gas phase ions are then drawn from the atmosphere into the vacuum of the mass spectrometer passing through a curtain of nitrogen gas to decluster from polar neutrals (solvents). Parent ions are very readily formed and can be fragmented into daughter ions by up-front collision induced dissociation (CID) or between the first and second quadrupole with LC-MS-MS by introducing a collision gas such as nitrogen. All the ions are accelerated, separated, and focused onto an ion detector by means of a quadrupole mass analyzer. The fragmentation pattern usually provides a unique fingerprint of a molecule, allowing positive identification.

Nitrogen is a critical requirement for nearly all state-of-the-art mass spectrometers. First of all, it is used to form a curtain of gas behind the inlet of the instrument that prevents air from entering along with the sample. Curtain gas must be maintained at higher than atmospheric pressure so that it continually seeps out of the inlet and requires continual replenishment. Secondly, after they enter the instrument, sample molecules are accelerated and made to collide with a second reservoir of nitrogen, known as collision gas. The purpose of the collision gas is to knock molecular clusters apart into individual ions that are far simpler to analyze.

Cost of nitrogen

The drug metabolism laboratory at Pfizer was the first in the pharmaceutical industry to use API mass spectrometry to evaluate drug pharmacokinetics. The company purchased one of the first laboratory-scale API mass spectrometers offered for sale on a commercial basis from Sciex, formerly a division of Perkin-Elmer (Norwalk, CT) (*Figure 1*). This instrument provided substantially more utility and greater sensitivity than the earlier analytical methods; therefore the drug metabolism laboratory soon purchased two more. This was the point at which management noticed that it was using a lot of nitrogen. The three instruments required an average of three nitrogen cylinders per day at a total cost of $300. In addition, about an hour of a technician's time had to be devoted to hauling the cylinders from the loading dock and installing them in the laboratory.

The expense and inconvenience associated with the use of nitrogen cylinders were high enough that management was motivated to investigate the recent development of inexpensive methods for on-site nitrogen generation. Joint ventures between industrial gas companies and chemical companies have resulted in successful R&D programs to improve gas generation technology. The most influential of these developments is the use of membranes and specialized adsorbents for the production of nitrogen gas.

Membrane filtration methods

The laboratory initially purchased a model N2-14 nitrogen generator (*Figure 2*). The system utilizes proprietary membrane separation technology. The generator separates air into its component gases by passing inexpensive, conventional compressed air through bundles of individual hollow-fiber, semipermeable membranes. Each fiber has a perfectly circular cross-section and a uniform bore through its center. Because the fibers are so small, a great many can be packed into a limited space, providing an extremely large membrane surface area.

Two stages of coalescing prefiltration are incorporated into the generator to protect the membrane module from contamination. These filters are located behind the filtration access panel, and they remove liquids and particulate matter from the incoming air supply. The filters are equipped with float drains that automatically open to empty any accumulated liquid inside the filter housing. The drains are connected to 1¦4-in.-o.d. plastic tubing, which discharges to atmosphere at the back of the nitrogen generator.

Nitrogen Generation in a Drug Metabolism Laboratory *(Continued)*

High-purity source

Air separation takes place in the membrane module. The module consists of bundles of hollow-fiber membranes. The inlet air enters the center bore of these fibers and travels the length of the fibers. As the air passes through these hollow fibers, oxygen and water molecules pass through the membrane at a higher rate than nitrogen molecules. This results in a high-purity, dry LC-MS grade nitrogen gas exiting the membrane module. The oxygen-enriched permeate stream exits the membrane module through ports on the side of the module at very low pressure.

The final filter, a 0.01-µm absolute membrane filter, provides a clean, commercially sterile supply of high-purity nitrogen. The controls on the nitrogen generator consist of an operating pressure gauge, flowmeter and flow control valve, outlet pressure regulator, and final gauge. Proper use of these controls ensures the user of a 99–99.5% LC-MS grade nitrogen outlet stream, depending on operating pressure and flow rate. The pressure gauges, which are mounted on the front panel, measure operating pressure and outlet pressure. The flowmeter measures the flow rate of nitrogen exiting the membrane module.

Cost savings

This initial nitrogen generator installation saved $300 per day or about $75,000 per year. This paid for the approx. $8,000 cost of the nitrogen generator within a few months and generated substantial savings from that point on. However, these savings were soon to greatly increase because the use of mass spectrometry at the drug metabolism laboratory was just beginning to take off. Today, the laboratory has 30 of these instruments, including Sciex model 150 single quadrupoles and 300 and 365 triple quadrupoles and Finnigan (San Jose, CA) TSQ and LCQ instruments (*Figure 3*). Researchers estimate that if the laboratory were still using nitrogen cylinders, the annual cost would be in the area of $750,000, and one full-time employee would be required to install the 30 cylinders per day needed to keep the instruments running.

Instead, the laboratory has purchased several model N2-14 nitrogen generators and a compressor that provides 125 psig air. The total cost of this equipment was about $34,000. As a result, instead of paying $750,000 for nitrogen, the cost is nearly zero. The only recurring expense is the electricity required to operate the compressor. Operating costs of the nitrogen generators are limited to changing the filter on each unit every six months or so, which costs about $300. In addition, the generator has saved one full-time position by eliminating the need to handle nitrogen cylinders and eliminating the danger of downtime caused by running out of nitrogen.

Zero environmental impact

The generator requires virtually no attention because it uses simple electromechanical components such as pressure vessels, and valves with a history of reliability in laboratory applications. A key factor in the increased reliability provided by the generator is its elimination of the logistics of the gas supply chain. Since the nitrogen generator simply separates air into its constituent parts, it has no adverse environmental effects. Both the nitrogen produced by the unit and the oxygen mixture generated as a by-product can be released into the atmosphere. Gas generators are also much safer than high-pressure cylinders. The generator typically operates at a low pressure of around 100 psig and stores small volumes of compressed gas. The stored volume is much less than 1 ft3, compared to about 200 ft3 stored in a typical high-pressure gas dewar. Gas generators also eliminate the need to handle cylinders, which presents a risk of injury caused by dropping, lifting, or asphyxiation.

The development of on-site gas generators is very good news for drug development laboratories and diverse users of mass spectrometers and other instruments that require a regular supply of nitrogen. In addition to saving money, nitrogen generators provide long-term cost stability by eliminating the risk of gas shortages or uncontrollable vendor price increases.

Model N2-14 **Figure 2**

American Environmental Laboratory
Reprinted from American Environmental Laboratory March 1995

Over the past three decades we have experienced many changes in our culture: in our homes, governments, institutions and occupations. Technological advancement has resulted in the elimination of time-honored traditions and behaviors. In many instances, we have forever changed the way we do things. This phenomena is often described as a paradigm shift. The word paradigm is derived from the Greek word paradeigma, which means pattern, example, or model. A paradigm shift is the change from a traditional way of acting, thinking, or doing, to newer, more effective ways.

Paradigm shifts are often motivated by the availability of new technologies and typically result in obvious benefits such as increased efficiency and convenience, improved performance, reduced cost and an ability to solve difficult problems. Two examples of a paradigm shift are elimination of the home delivery of ice by the invention and commercialization of the refrigerator/freezer and replacement of the home delivery of milk in resuable glass bottles by disposable packaging. More recently, the delivery of water deionization tanks to laboratories has been replaced by the availability of point-of-use water purification systems; personal computers have resulted in internal corporate desktop publishing, and a paradigm shift in Japanese manufacturing has resulted in the changed perception of Japanese products from poor quality during the 1960s and 1970s to among the highest quality in the world during the 1980s and 1990s. It is easy to imagine the future obsolescence of video rental stores resulting in the availability of movies through a fiber optic superhighway and replacement of the current internal combustion engine by one that is powered by alternative fuels such as natural gas, electricity, or hydrogen.

Many such paradigm shifts have occurred in the laboratory, including the use of autosamplers, computer-controlled instrumentation, automated titration, fused-silica capillary columns and the use of supercritical fluids for extraction.[1] This article describes the paradigm shift occurring within the laboratory related to the method for supplying compressed gases used for a variety of purposes.

Applications for compressed gases

Many applications exist for compressed gases in the laboratory. These include purge gas, carrier gas, and fuel gas for instruments such as fourier transform infrared spectrometers, gas chromatographs, total organic carbon analyzers, nuclear magnetic resonance spectrometers and thermal analyzers. Noninstrument applications include solvent evaporation, purging of laser gas chambers, use with autosamplers, and blanketing of solvents and samples. The gases typically used for these applications include air, nitrogen, hydrogen, helium, argon and various mixtures. The required gas purity depends on the application and can range from filtered air to research-grade nitrogen with less than 1ppm contaminant concentration.[2]

For these applications, compressed gases are an important utility. Much like electricity, water, natural gas, heat and telephones, compressed gases are essential to the operation of the laboratory. Consequently, the source of this utility should be convenient, reliable, safe, and cost effective. As with many other utilities, the supply of compressed gases should be simple and taken for granted. Currently, the availibility of on-site, point-of-use gas generators is allowing scientists and managers to treat the supply of compressed gases as a utility as opposed to a contracted service.

Traditional source of compressed gases

Ever since compressed gases have been used in the laboratory, the accepted source has been the high-pressure gas cylinder. These cylinders are filled to a high pressure, typically 2200 psig, with the required gas by a supplier operating a gas production facility. The cylinders are delivered to customers upon purchase and picked up when empty. The empty cylinders are then refilled and delivered to another customer.

The primary disadvantages of gas supply in the form of high-pressure cylinders are delivery and service inconveniences, safety, purity and cost (including hidden cost). The advantage of high-pressure cylinders is the availability of a wide range of gases for applications in a laboratory.

Several types of inconvenience are frequently experienced in the use of delivered high-pressure gas cylinders. Every user of gas cylinders will eventually experience unplanned downtime as a result of an empty cylinder. This may occur in the midst of an analysis, overnight, or during a weekend. Other inconveniences include delayed delivery, inflexible delivery schedules, price increases, and long-term contracts. The procurement procedure within the customer's company may also result in unwanted delays.

The use of high-pressure compressed gas cylinders must be accompanied by a concern for safety. The primary safety issues are transportation, handling, storage, use, asphyxiation, toxicity and flammability.[3] Special precautions must be taken while handling high-pressure cylinders.[4,5]

A dangerous situation can be created if a cylinder is dropped and a valve is broken off, potentially causing the cylinder to become a projectile.[6] Other potential hazards that are inherent in the storage of compressed gases include asphyxiation, combustion, and explosion.[7] Various regulations by the Department of Transportation (DOT) and the Occupational Safety and Health Administration (OSHA) address the hazardous aspects of high-pressure gas cylinders.[8,9] Potential hazards in the use of high-pressure gas cylinders are serious enough to warrant the use of warnings indicating that improper use can result in serious injury or death.

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There are disadvantages to the use of compressed gas cylinders based on gas purity considerations. The gas purity will vary from one cylinder to another and it will also vary as the gas within the cylinder becomes used.[10] Cylinders may be dirty, rusted, and contaminated, resulting in outgassing of contaminants from the cylinder walls. Compressed gas supplied in high-pressure cylinders can be tested and certified upon request, for an additional charge. If a cylinder is not certified, the customer has no confirmation that the actual purity meets the stated specification.[11] The result of using a gas that has a purity below specification can be the costs associated with inaccurate analysis.

Many indirect or hidden costs in the use of high-pressure gas cylinders include the time and effort to change cylinders; generation and expedition of a purchase order; receipt of full cylinders and shipment of empty cylinders; payment of monthly invoices; and maintenance of a gas inventory for reordering purposes. Consider the departments involved in this process; R&D, purchasing, shipping, accounts payable, and central supplies. These hidden overhead costs are generally accepted as part of the cost of operating a laboratory and should be taken into consideration during the process: of choosing a supply of compressed gases. Laboratory managers might be surprised if the full cost of compressed gas delivery was plainly visible.

All the costs listed (direct and indirect) can be obtained either from the compressed gas supplier or through an activity-based costing approach to the purchasing company's overhead costs. This type of cost analysis is shown in Table 1 for the purchase of a single cylinder of ultrazero-grade air used for one month, before replacement. This analysis shows that the hidden costs amount to an additional 47% of the actual purchase price of the gas delivered in the high-pressure cylinders.

Table 1

Cost analysis for compressed gas supplied in a high-pressure cylinder *

Cost component		Typical cost
Cylinder gas price		$100
Cylinder demurrage (one month)		$5.25
Labor cost to change cylinder		$8.33
Order processing cost		$10
Shipping cost		$10
Invoice payment cost		$10
Inventory control cost (monthly		$3.33
Total	US	$146.91

* Gas cylinder price is based on typical ultra zero-grade air.
All indirect costs are typical for gas cylinder suppliers or calculated through activity-based costing of a manufacturing company.

On-site generation of compressed gases

In the past five years, the availability and use of on-site compressed gas generators has increased significantly.[12] This increase can be attributed primarily to the improvement of technologies used in the generation and purification of gases, the recent commercialization of many on-site generators and the ever-increasing prices for compressed gases delivered in high-pressure cylinders.

The technologies contributing to the increased availability of point-of-use gas generators include membranes, specialized adsorbents and catalysts, improved air compressor designs, and enhanced electronic controls. These technologies will continue to improve the availability, performance and value of laboratory gas generators. The most influential of these technological developments is the use of membranes and specialized adsorbents for the production of nitrogen gas. Joint ventures between industrial gas companies and chemical companies have resulted in successful R&D programs to improve the technology for on-site generation of nitrogen. On-site generation of nitrogen is available for purities ranging from 95% to 99.9999%. Other gases that can be reliably produced on site include hydrogen and various purities of air.

The effectiveness of on-site generation should be analyzed based on convenience, reliability, safety, and cost. The attractiveness of on-site gas generation depends greatly on the specific gas being used, the required purity, required flow rate, hours of operation per day, and local gas prices. For instance, on-site generation may not be an attractive alternative for an application requiring sporadic usage of research-grade nitrogen based on cost alone, whereas it will be attractive for purging an FTIR spectrometer or providing hydrogen fuel to a flame ionization detector (FID) that operates 24 hr/day (based solely on cost).

Gas generators provide convenience through the elimination of reliance on an external delivery service. Once the on-site gas generator has been purchased and installed, delivery of the desired gas is automatic, reliable and relatively inexpensive. Typical preventative maintenance is performed on an annual basis and requires little or no downtime.

Reliability of on-site generators is based on the operation of simple electromechanical components involved in gas purification. These components, such as pressure vessels, valves, timers and heaters, have a history of reliability in industrial applications. The logistics of a delivery system have been eliminated so that reliability is based only upon the performance of the gas generator.

The purity of gas delivered by quality on-site generators is typically very consistent and dependent upon adherence to maintenance schedules. On-site generators deliver gases through the same flow system from the day they are installed until they are decommissioned. Thus, the gas purity is not influenced by a change in the materials of contact, as it is with high-pressure cylinders.

Gas generators provide increased safety in comparison to high-pressure cylinders. The generators typically operate at low pressures (such as 100 psig) and store small volumes of pressurized gas. This stored volume may vary from less than 50 cm^3 to several gallons as compared to over 200 ft^3 of gas stored in high-pressure gas cylinders. Gas generators eliminate the need to handle heavy gas cylinders, which is a risk of injury or damage caused by lifting, dropping, asphyxiation, and potential explosion. Safety issues with gas generators concern the use of electrical and mechanical components. These types of concerns should be relieved if the generators are designed and tested to Underwriters Laboratories (UL), Canadian Standard Association (CSA) and International Electrotechnical Commission (IEC) specifications.

The cost of purchasing and operating a gas generator is attractive as compared to the use or high-pressure cylinders. Paybacks are typically calculated at less than one year depending on the specific usage and required purity. Perhaps most importantly, the cost to operate and maintain a gas generator is very low, especially relative to the cost of ordering, storing and changing high-pressure gas cylinders. Table 2 shows a cost analysis for a typical installation of a gas generator to replace the use of high-pressure gas cylinders. This cost analysis of a hypothetical laboratory replacing high-pressure gas cylinders with an on-site gas generator shows a payback of about six months.

Disadvantages to on-site generation should be mentioned. Generation equipment may need to be budgeted for purchase as opposed to paying for delivered gas through an expense account. Users of gas generators should plan for present and future gas requirements in order to properly size a system.

American Environmental Laboratory

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Table 2

Ultrazero-grade air cost comparison:
On-site generator versus high-pressure cylinders *

Cost component	Gas generator	High-pressure cylinder
Gas generator price	$3,500	NA
Annual power cost	$15	NA
Annual maintenance cost	$411	NA
Annual cylinder gas price	NA	$5,700
Annual cylinder demurrage	NA	$126
Annual labor cost to change cylinders	NA	$475
Annual order processing cost	$30	$360
Annual shipping cost	$10	$570
Invoice payment cost	$10	$120
Inventory control cost	NA	$40
Total	$3,961	$7,391

* Gas generator cost is based on a model HP2A-3500 (Parker Hannifin Corporation, Haverhill, MA), which requires 120 VAC power.

Cylinder gas cost is based on 3 slpm flow rate of ultra zero-grade air for 8 hr day, 260 days/yr, at a price of $100/cylinder.

Other cylinder costs include demurrage at $5.25/cylinder per month, cylinder change labor at 10 min/cylinder and $50 hr, order processing cost at $10 order, shipping cost of $10/cylinder, invoice payment of $10/monthly invoice, and an inventory control cost of $40/yr.

Test laboratory example

Minnesota Valley Testing Laboratories (MVTL, New Ulm, MN) represents an example of the benefits of on-site gas generation. The laboratory provides environmental, agricultural, and energy testing services to industry. The laboratory was purchasing ultrahigh-purity hydrogen cylinders to supply fuel gas for FIDs and nitrogen phosphorous detectors (NPDs), make-up gas for electrolytic conductivity detectors (ELCDs), and carrier gas for GC columns. Safety was a concern and monitoring of the cylinders was an inconvenience. Technicians had to continually watch the cylinders. Hydrogen was used as a carrier gas for GC columns, and if it were to run out, the column would be damaged.[13] Also, MVTL would occasionally get a contaminated cylinder, resulting in skewed analysis and delayed work.

The laboratory has purchased on-site generators to replace zero air cylinders for fuel air to FIDs, flame photometric detectors (FPDs), and NPDs; to replace ultrahigh-purity nitrogen cylinders for make-up gas for electron capture detectors (ECDs), NPDs, ELCDs, and FIDs; and to replace hydrogen cylinders for fuel gas applications. An MVTL chemist indicated that the unit will have paid for itself in less than two years, after which the laboratory will be producing its own hydrogen at a fraction of the cylinder cost. Other benefits cited by MVTL include no longer having to handle and monitor cylinders. Low maintenance is also an advantage. Installation was easy: the generator was plugged in, water was added, and the instruments connected. The hydrogen generator also takes up less space.

Conclusion

Change is never easy and it is seldom comfortable, but change allows us to learn and improve, increase efficiencies and convenience, achieve better performance, reduce costs and solve difficult problems. In this day of corporate reengineering and global competition, laboratories are experiencing a paradigm shift related to the use of compressed gases. This shift from high-pressure gas cylinders to on-site gas generators will result in reduced operating and overhead costs, positioning laboratories to be more competitive and successful.

users should use convenience, reliability, safety and cost as primary criteria. The convenience, reliability and safety of gas generators compare favorably to high-pressure gas cylinders. A simple cost analysis utilizing activity-based costing techniques will show paybacks of less than one year for the change to on-site gas generation for many typical applications. Over the next decade, as this paradigm shift matures, laboratory managers and scientists will view the last few cylinders in their laboratory similar to the way we all view the glass milk bottle.

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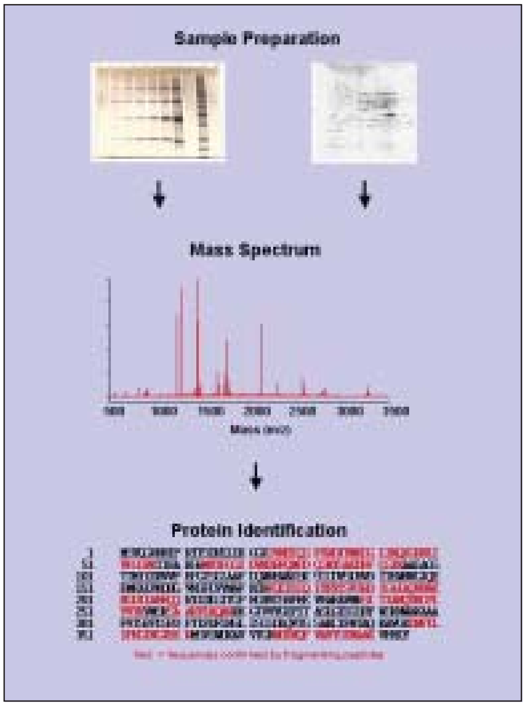
Proteomics Mass Spectrometry Facility Saves Time, Money and Space By Using a Nitrogen Generator

The Johns Hopkins School of Medicine Mass Spectrometry Facility is saving time, money and space by generating its own nitrogen gas, according to Robert N. Cole, Ph.D., facility director. “When we first opened this facility, we obtained nitrogen gas from cylinders and discovered that we were changing tanks daily to prevent interruption in the nitrogen supply” Cole said. “So we invested in a nitrogen generator and compressor that produces all of our nitrogen requirements. It takes up less space than a single cylinder and, best of all, almost never needs any attention. Based on cylinder costs alone the gas generator and compressor will pay for itself in less than two years. In addition, it saves me from spending time checking gas levels and setting up tanks. The unit provides very high purity gas and has run reliably since we put it into operation.”

Of all the medical schools in this country with associated basic science research, Hopkins has perhaps the longest-standing reputation. It was the first institution, in the late 1890s, to separate teacher-researchers from clinicians and offer them a salary for their work. Many of this country’s first true basic scientists gathered at Hopkins then, eager to set up laboratories. William Henry Howell, for example, sparked physiology research and first laid down a clear explanation of blood clotting. Today, researchers in the School of Medicine bring to Hopkins more National Institutes of Health research funding than to any other medical school. For the 11th consecutive year, The Johns Hopkins University School of Medicine was one of the top two medical schools in the nation, according to U.S. News & World Report’s annual ranking. Hopkins was a close second to Harvard with a score of 94, up dramatically from 73 points last year.

Sciex QStar



New mass spectrometry facility

Johns Hopkins recently opened a new mass spectrometry facility designed to service the entire university. Most of their work involves the identification of proteins or peptides that researchers have isolated and are trying to identify. The facility has two mass spectrometers, the most advanced is the QSTAR hybrid liquid chromatograph/mass spectrometry system from Applied Biosystems, Inc. For scientists engaged in identifying metabolites or potential-lead compounds, the QSTAR system offers high mass accuracy to determine the compound’s elemental composition and fragmentation analysis to obtain structural information for compound identification. Parent molecules or fragment ions from the quadrupole section enter the ion accelerator and are pulsed into the flight tube. The ion mirror reverses the direction of the ions and corrects for small energy differences in ions. The detector records the precise arrival time of each ion and generates the signal to form the mass spectrum.

Nitrogen is a critical requirement for the QSTAR as well as nearly all state-of-the-art mass spectrometers. It is used to form a curtain of gas behind the inlet of the instrument that prevents air from entering along with the sample. Curtain gas must be maintained at higher than atmospheric pressure so it continually seeps out of the inlet and requires continual replenishment. Nitrogen is also used as a

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Proteomics Mass Spectrometry Facility Saves Time, Money and Space By Using a Nitrogen Generator *(Continued)*

collision gas. After ions enter the instrument, they are accelerated and made to collide with a second reservoir of nitrogen. The purpose of the collision gas is to break up sample molecules to determine their composition.

Solving the nitrogen supply problem

When Johns Hopkins first purchased the QSTAR, they were faced with the issue of how to provide nitrogen gas to their new instrument. Cole decided to try purchasing nitrogen cylinders from a local gas supplier. He soon discovered that the cylinders needed to be changed at least once and sometimes twice a day. This meant that he had to pay close attention to the amount of gas in the cylinder and, when it was nearly empty, take the time to change the cylinder and order a replacement. The time spent dealing nitrogen supply subtracted from the amount time that he had to set up analysis runs and manage the facility. In addition, he had to keep two or three cylinders on hand at all time to avoid a supply disruption that could shut down the laboratory. The problem was that the cylinders are quite bulky and the laboratory is small, creating a substantial space problem.

Cole investigated the new breed of nitrogen generators that eliminate the inconvenience and cost of cylinder gas supplies. He made the decision to purchase the Balston N2-22 membrane nitrogen generator and AGS-L189 compressor from Parker Hannifin Corporation, Filtration and Separation Division, Haverhill, MA. The system utilizes proprietary membrane separation technology. The generator separates air into its component gases by passing inexpensive, conventional compressed air through bundles of individual hollow fiber, semi-permeable membranes. Each fiber has a perfectly circular cross-section and a uniform bore through its center. Because the fibers are so small, a great many can be packed into a limited space, providing an extremely large membrane surface area.

Three stages of pre-filtration

Three stages of coalescing pre-filtration are incorporated into the Balston N2-22 nitrogen generator to protect the "The nitrogen generator now supplies all curtain and collision gas required by the QSTAR mass spectrometer," Cole said. " It basically runs by itself without requiring any attention from me. It eliminates the need to keep track and change gas cylinders. Most important, it eliminates having to worry about whether we have enough gas to continue in operation until new cylinders are delivered. It saves a considerable amount of space. The gas generator is less than the size of a single cylinder. The gas generator also saves about $1,000 per month in cylinder costs. Including the compressor and storage tank, it cost about $20,000, so it will pay for itself in cylinder costs alone in less than two years. The unit has provided trouble-free operation since it was installed. The only interruption of supply that I have had was when someone accidentally turned off the compressor, which is located in a different room. All in all, it has met all my requirements, providing high quality gas without disrupting my work."

For additional information on Balston® products, contact Parker Hannifin Corporation, Filtration and Separation Division, 242 Neck Road, P.O. Box 8223, Haverhill, MA 01835-0723, Tel: 800-343-4048 Fax: 978-858-0625 Web site: www.parker.com/ags

Model AGS-L189 Series Compressor

Hydrogen/Zero Air Gas System Saves Money in GC/FID Operation at Crime Lab

A new system specifically designed to support gas chromatography/flame ionization detector (GC/FID) operation has generated cost savings at the Texas Department of Public Safety's Crime Laboratory Service. The gas cylinders used in the past for the FID were expensive and costly, building modifications would have been needed to meet new regulatory requirements if they had continued to be used. Crime Lab staff were aware that gas generators were available but found it difficult to justify the cost and space required by two separate units. Then they discovered the Parker-Balston Model FID-1000 gas station, which is specially designed for FIDs and provides both pure hydrogen and zero grade air. The new gas station has eliminated the expense of purchased gas as well as the labor involved in handling gas bottles and has also eliminated the need for what would have been expensive building modifications.

From a one-chemist operation established in 1937 at Camp Mabry in Austin, the Crime Laboratory Service has developed into a staff of more than 160 in 13 locations today. The major function of the Toxicology Section is body fluid analyses in cases of driving while intoxicated (DWI) and drug overdose. The analyses require specialized instrumentation and procedures such as automated gas chromatography (GC), automated gas chromatograph/mass spectrometry (GCMS), solid phase extraction preps, and Enzyme Multiplied Immunoassay Technique (EMIT) screening techniques, which is a drug screen of blood and urine. Targeted drug classes include amphetamines, barbiturates, benzodiazepines, cocaine, opiates, and phencyclidine. Additional drugs are detected with GCMS screening.

FID used for blood alcohol analyses

The Crime Lab in Austin analyzes approximately 250 samples per month for blood alcohol using a PerkinElmer Autosystem XL GC with a HS40-XL Headspace autosampler. Blood alcohol analysis is typically performed in DWI investigations and in traffic accidents where people have been critically injured or killed. Alcohol analysis is used to determine the concentration of ethanol and to determine if methanol, acetone, 2-propanol, or toluene is present in blood or urine. The procedure used by the Toxicology Section employs automated headspace GC with quantitation by internal standard integration. According to Henry's Law, at equilibrium, in a sealed vessel, volatile compounds in the liquid state will be present in the vapor state at a concentration proportional to the concentration in liquid. By sampling this vapor, the headspace, through a gas chromatograph, the volatile compound may be qualitatively identified and quantitatively measured. A single headspace injection is split into two capillary columns, each exiting to an FID. The columns have different polarity for unique separations of the volatiles of interest. An FID consists of a hydrogen/air flame and a collector plate. Organic compounds eluting from the chromatographic column are swept into a flame that burns in a mixture of hydrogen and air within what is called the detector jet. During this process the organic compounds are broken down into carbon fragments and acquire a positive charge (i.e., become ionized) from the surface of the jet, which serves as an electrode. These ionized carbon fragments are detected by a second electrode slightly down-stream in the detector cell. This signal is amplified and sent to the data processing system. Because of its relatively high sensitivity to most organic compounds, the FID is very powerful tool for GC. The response of the detector does not change markedly with variations in changes in the flowrate, pressure or temperature of the mobile phase gas and thus, provides a very robust, stable detector. It also has a linear response over a wide mass range, generally encompassing several orders of magnitude.

Critical requirements for FID gas supply

"Purity of the hydrogen gas and air supplied to the FID is very critical to the accuracy of the measurements," said Glenn Harrison, Supervisor of Toxicology for the Texas Department of Public Safety Austin Laboratory. "Any extra hydrocarbons that enter the detector through either the hydrogen or air supply generate extra signal that raises the baseline of the measurements. In the past, we purchased hydrogen and zero air gas bottles to supply our FID detector used in blood alcohol analysis. This was pretty expensive, although we didn't track the costs with any level of precision. What brought the issue to a head was when we discovered that some new safety regulations would have required that we vent the special room to store the gas bottles outside the building."

"The costs of this construction project would have been high and it highlighted the general safety issues involved in storing pressurized hydrogen gas," Harrison continued. "Every time you have a cylinder of compressed hydrogen there are issues that you need to be concerned with. We have never had a problem handling hydrogen but the potential always exists for a person to make a mistake. I decided to take a look at gas generator technology to see if it could eliminate these concerns. At first, I expected that I was going to have to purchase two separate units to supply the needs of the FID, pure hydrogen and zero grade air," Harrison continued. "That would have substantially stretched out the payback and two units also would have required more space, more maintenance, and involved more potential things that could go wrong. That's why I was very happy to hear that Parker-Balston had developed a gas system that meets all the requirements of an FID."

Parker-Balston unit meets all FID requirements

The Parker-Balston FID-1000 gas station provides both pure hydrogen gas at 99.9995% purity from deionized water and zero grade air from compressed air. Hydrogen is produced through electrolytic dissociation of water and hydrogen proton conduction. Positively charged hydrogen ions are transported across a solid polymer electrolyte where molecular hydrogen is formed. The hydrogen stream is further purified to scavenge oxygen and is delivered at an outlet of the device. Zero air is produced by purifying on-site compressed air to a total hydrocarbon concentration of less than 0.1 parts per million (100 ppb), measured as methane. The FID-1000 gas station produces up to 90 cc/min of hydrogen and 1000 cc/min of zero grade air. The system is designed to provide fuel and air to support two FIDs. It takes up a space of 16.5 inches high, 10.5 inches wide and 17 inches deep and weighs only 46 pounds.

The unit offers automatic water fill capability, silent operation and requires minimal operator attention. The generator requires virtually no attention because it uses simple electromechanical components such as pressure vessels, and valves with a history of reliability in laboratory applications. Routine maintenance is limited to periodic replacement of filter cartridges, requires no factory servicing and can easily be performed by the user. A key factor in the increased reliability provided by the generator is its elimination of the logistics of the gas supply chain. Since the gas station simply separates water into its constituent parts, it has no adverse environmental effects. Both the hydrogen produced by the unit and the oxygen mixture generated as a byproduct can be released harmlessly to atmosphere. Gas generators are also much safer than high-pressure cylinders. The generator typically operates at a low pressure in the neighborhood of 100 psig and stores small volumes of compressed gas. The stored volume is significantly less than 1 cubic foot, compared to about 300 cubic feet stored in a typical high-pressure gas cylinder. Gas generators also eliminate the need to handle cylinders, which presents a risk of injury caused by dropping, lifting, or asphyxiation.

"Our decision to purchase the gas station has eliminated the need to purchase gas bottles on a regular basis," Harrison said. "We have also eliminated the need to upgrade our facility because the gas station eliminates the need to store hydrogen and operates at such a low pressure that special venting is not needed. We haven't seen any change in the performance of the FID, which indicates that the gas we are producing is just as pure as what we were purchasing in the past. In the several months that we have operated the gas station, it has delivered trouble-free performance. We are also using a second gas station to support a GC/FID in the controlled substances section. This is clearly a concept that should be explored by other crime labs that are concerned about the high cost and safety issues involved in handling bottled hydrogen."

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