ProSpec
by Praxair

PRAXAIR
Making our planet more productive

Global Specialty Gas Solutions

Forward

WHY INDUSTRY LEADERS CHOOSE PRAXAIR

Trust. Track record. Integrity. Innovation. Reliability. Global capability.

These are among the many reasons businesses like you choose Praxair as their Specialty Gases supplier.

More than just an established leader in the manufacture and distribution of atmospheric, process, and specialty gases and equipment – Praxair helps customers maximize their economic performance while minimizing their environmental impact.

That has been our focus and track record for over 100 years.

In fact, in the recent past more than 20% of Praxair's annual revenue was generated by applications technologies that help customers reduce operating costs, increase process efficiencies and improve their environmental performance.

It's how Praxair, Inc. has become a Fortune 250 company, the largest industrial gas company in North and South America, and one of the largest worldwide.

This handbook provides information about Praxair's Specialty Gases, equipment, and capabilities – including descriptions of how our pure and mixture gases have helped customers work more productively and sustainably.

We invite you to have a look.

INTRODUCING *ProSpec*™ By PRAXAIR

ProSpec by Praxair is not simply a line of the highest quality specialty gases, equipment and services – it is a way of supporting your business and helping to ensure your success. Backed by the global infrastructure of Praxair, and the industry-leading experience and technical expertise of our teams, *ProSpec* by Praxair is all about meeting the most demanding requirements of customers like you.

Quality

With *ProSpec* by Praxair you can expect the highest quality pure gases and mixtures produced to the most ambitious environmental standards – complemented by an extensive line of gas handling and delivery equipment as well as a broad range of services. The result: a complete product supply solution for your business.

Innovation

ProSpec by Praxair are new technologies, products and offerings, designed to meet your specific technical and regulatory requirements. This helps enhance your opportunity to increase productivity while decreasing environmental impact.

Reliability

This is about breadth *and* depth. Our wide-ranging global locations offer responsive customer service coverage while our deep product offerings and distribution capability ensure fast, cost-effective delivery. We provide product via common carriers, express carriers, and our own exclusive delivery systems. In short, we do whatever it takes.

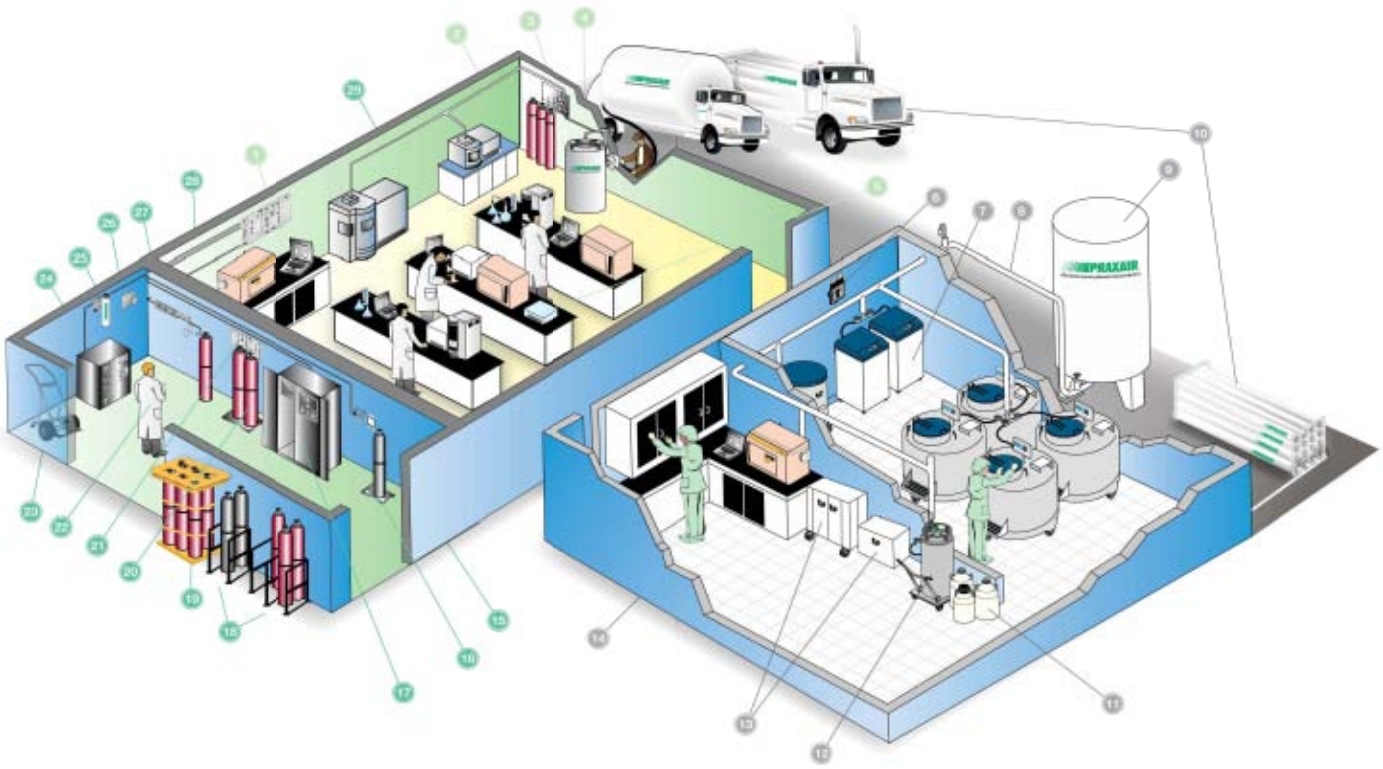
Support

Our regional centers – staffed with highly trained product chemists, technical service personnel, and field sales representatives – provide answers to your questions and can assist you in meeting any regulatory, technical, and safety requirements. We not only stand behind our products, we help you.

Coverage

ProSpec by Praxair is offered everywhere we are. For us, that means in 50 countries. For you it means world-class products, services, and peace-of-mind.

Total Solution For Specialty Gases



Laboratory analysis	Storage and Supply	Cylinder Handling
1. Control panel	6. Oxygen deficiency sensor	15. CO_2 Heaters
2. Gas generators	7. High efficiency freezers	16. Electronic scale
3. Wall-mounted gas switchover	8. Vacuum-insulated piping	17. Gas cabinets
	9. Cryogenic bulk tank	18. Storage accessories
4. Switch microbulk	10. Banks of tubes and tube trailers	19. Cylinder bundle
5. Mass flow controller	11. Portable cryogenic tanks	20. Gas supply systems
	12. Mobile cryogenic dewars	21. Automatic gas switchover
	13. Dry Ice containers	22. Portable gas detection monitors
	14. Refrigerators for samples control	23. Cylinder trolley
		24. Air Compressor
		25. Membrane nitrogen
		26. Fixed gas detection monitor
		27. Gas purifiers and filters
		28. EPA protocol gas station
		29. Gas piping and connections

Pure Gases

With over 50 Pure Gases in more than 170 grades, whether in liquid, cryogenic, or compressed gas form, Specialty Gases cover a wide range of products and applications. Whether you need sulfur hexafluoride (SF_6) for electric transmission power insulation, hydrogen sulfide (H_2S) for sour gas testing, hydrogen chloride (HCl) for cotton seed delinting, or hydrocarbon mixtures for stove testing, Praxair can supply you with any of your Specialty Gases product needs.

Readily Available Gas List*

- Acetylene
- Air
- Ammonia
- Argon
- Arsine
- Boron Trichloride
- Boron Trifluoride
- 1,3 Butadiene
- n-Butane
- 1-Butene
- cis-2-Butene
- trans-2-Butene
- Carbon Dioxide
- Carbon Monoxide
- Chlorine
- Deuterium
- Diborane
- Dichlorosilane
- Dimethyl Ether
- Disilane
- Ethane
- Ethylene
- Ethylene Oxide
- Germane
- Halocarbon
  - 14
  - 22
  - 23
  - 41
  - 116
  - 134A
  - 218
  - C318
- Helium
- Hydrogen
- Hydrogen Bromide
- Hydrogen Chloride
- Hydrogen Sulfide
- Isobutane
- Isobutylene
- Krypton
- Methane
- Methyl Chloride
- Neon
- Nitric Oxide
- Nitrogen
- Nitrogen Dioxide
- Nitrogen Trifluoride
- Nitrous Oxide
- Oxygen
- Phosphine
- Propane
- Propylene
- Silane
- Silicon Tetrachloride
- Sulfur Dioxide
- Sulfur Hexafluoride
- Trichlorosilane
- Tungsten Hexafluoride
- Xenon

*More gases available upon request.

Nomenclature and Purity

Actual nomenclature will vary with difference in trade and grade names. One of the most important factors is the gas purity. While some products are defined by specific monikers such as UHP (Ultra High Purity) or Research grades, actual purity level can be represented in two ways and usually represents the minimum purity level in the product:

- As a quality code, e.g. 4.5 – where the number before the dot represents the number of nines and the last number indicates the last decimal:
  - 4.5 = 99.995%
  - 5.7 = 99.9997%
  - 6.0 = 99.9999%
- As purity in percent, e.g. > 99.9995%

This typically represents the minimum concentration of the actual gas. In the case of liquefied gases the purity always represents concentration in the liquid phase.

As, or sometimes even more, important than the purity grade are the impurities in the gas. Impurities usually result from the gas manufacturing process and, as such, vary by gas and gas products. In the product specifications, the maximum concentrations of the different known impurities are listed in percentage, parts per million (ppm), or parts per billion (ppb) either in function of relative moles, weight, or volume.

Common Atmospheric Pure Gases

Air

Air

- Zero Gas
- Oxidizer in flame detectors (FID, FDP, AA)
- Purge Gas
- Pneumatic Operation

Argon

Ar

Argon

- ICP, AA, GC
- Ar/CH_4 mixtures
  - Nuclear Counters / ECD
  - P-5 / P-10
- Purge Gas
- Inerting
- Gas Discharge Lamps
  - Fluorescent

Carbon Dioxide

CO_2

Carbon Dioxide

- Incubation Gas
- Biological Atmosphere
- Laser Gas
- Detector Cooling

Helium

He

Helium

- GC Carrier Gas
- Inert atmosphere
- Leak detection
- Liquid Helium
  - NMR, MRI, Superconductors
  - Operate at Abs. Zero (-452 °Deg. F)

Hydrogen

H_2

Hydrogen

- Carbon free elemental gas
- Fuel gas in flame detectors
  - FID, FPD, THC analyzers
- Carrier gas

Nitrogen

N_2

Nitrogen

- Purging and inerting
- Zero Gas
- Carrier gas
  - GC Mass Spec
- Biological storage freezers
- Pre-cooling
  - NMR
  - MRI
  - Superconductor

Helium

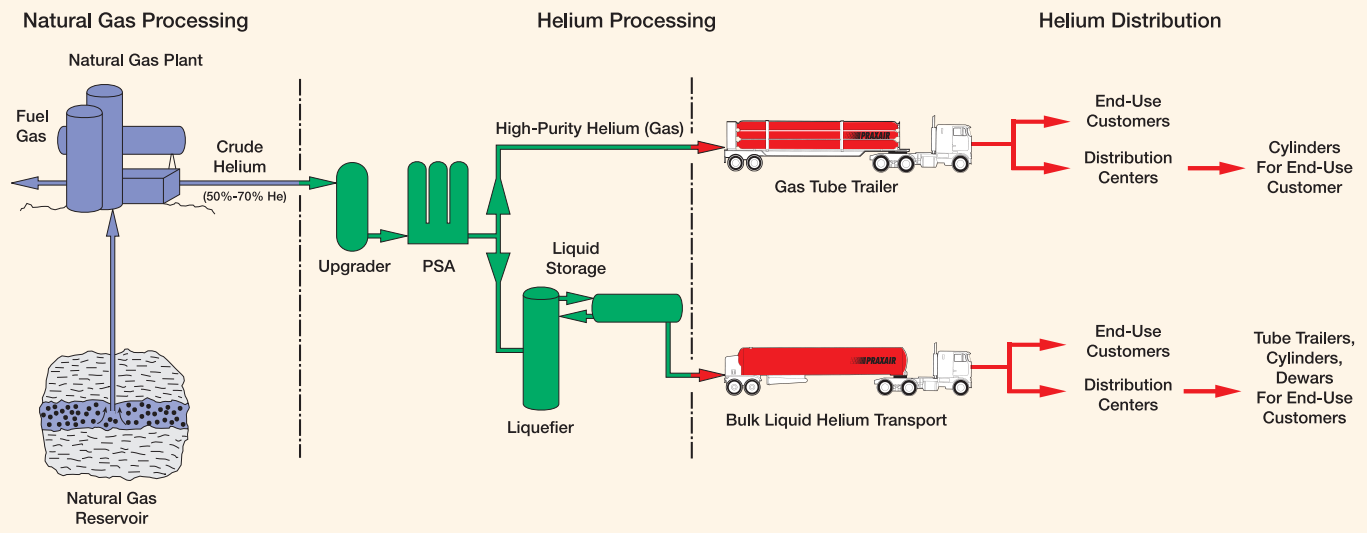
A unique resource for unique applications.

Praxair is one of the industry leaders in Helium with a global presence. With over 25 helium specific patents and a comprehensive logistics system, Praxair can offer you a solution for all your helium needs.

- Pioneered Helium production
- Reliability of supplies is a priority
- Diversity of secured sources
- Re-investment in helium infrastructure
- Global Supply Chain management

Properties	Applications
Low Mass ("Ligher than Air")	Lifting – blimps & balloons
Smallest Atomic Radius	Leak detection
High Thermal Conductivity and Specific Heat	Chemical analyses, Plasmas, Welding
Lowest Boiling Point (Coldest Liquid)	Superconductivity (MRI, NMR, Physics) Purge/pressurize cryogens Low temperature science

Praxair – A Fully Integrated Helium Supplier from Source to Customer



Mixtures Preparations

Mixture manufacturing requires a careful development process to ensure accurate and stable content. Careful attention to raw materials, cylinders, and mixing techniques is required for every product.

Raw material assay

- All source gases are qualified to ensure quality and compliance with specifications.
- Impurities can affect performance or stability of the final mixture.
- Various purification techniques are used to remove impurities.
  - Entrapment (Molecular Sieve)
  - Moisture Absorption (Dryer)
  - Distillation Sparging

Cylinder preparation

Cylinder preparation varies based upon product specifications.

- Computer controlled heating, vacuum and purge cycles.
- For reactive gas mixtures, passivation may be used to deactivate surfaces. This helps eliminate unwanted residual moisture or oxygen.

Blending techniques

Volumetric

By partial pressure blending

Gravimetric

- By weight using precision scales
- Calibration using independent certified weights

Dynamic

- Instrument based blending
- High volume / same mixture

Mixture homogenization

- Most common methods used to ensure gas mixture homogeneity include:
  - Mechanical rolling
  - Gas turbulence

Analytical Instrumentation

Full range of analytical instrumentation for certifying purity and mixture composition

- Gas chromatography with TCD, FID, ECD, FPD, PID, etc. detectors
- Non-Dispersive Infrared (NDIR) for CO, CO_2
- Process analyzers for O_2, H_2O, THC
- Chemiluminescence for NO, NO_2
- Fourier Transform Infrared (FTIR)
- Mass Spectroscopy

Certification Documentation

Type of Documents

- **Certificate of Batch or Compliance:**
  Batch Raw Materials Analysis
- **Certificate of Comformity or Conformance:**
  Batch Cylinder Analysis
- **Certificate of Analysis (COA):**
  Individual Cylinder Analysis

Gas Mixtures

Mixture Grades

Since most analytical methods are relative and not absolute, it is necessary to calibrate the analyzer with reference calibration mixtures standards of known composition and concentration to determine the quantitative content of the sample accurately. The requirements for a calibration gas are: accuracy stability and homogeniety. Several classes of mixtures are provided based on their certification and accuracy levels.

- Calibration mixtures with a traceability to metrological institutes and standards

  Typically the highest level of certification available for any mixture.
  - EPA Protocol Standard
  - NTRM (NIST Traceable Reference Material) standard
  - ISO 17025 accredited standard
- Calibration mixtures certified by gravimetric and laboratory quality controls:

  Highly accurate mixtures analyzed against laboratory and metrological standards
  - Primary Standard
  - Primary Master
- Calibration mixtures certified by laboratory analysis:

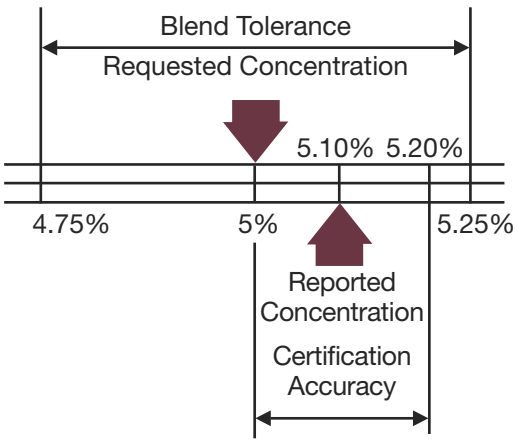
  These other mixtures are typically mixed and analyzed based on customer or Praxair's internal specifications
  - Certified Gas Standard
  - Certified Liquid Standard
  - Certified Master
  - Dynamic Blend Master
  - Custom Mixtures

Blend Tolerance and Uncertainty

Blend tolerance specifies how close to the ordered concentration the produced mixture will be. The analytical uncertainty identifies the maximum deviation from the certified value that the actual blend mix can have.

Example: 5% minor component mixture. The reported value on the analytical certificate is 5.10% (within the 5% relative blend tolerance) with a certified accuracy between 5.00% and 5.20%.

Example:	Relative Value	Absolute Value
Blend Tolerance	±5% of minor component	±0.25%
Analytical Uncertainty	±2% minor component	±0.10%



ISO 17025 and Guide 34 accredited standards

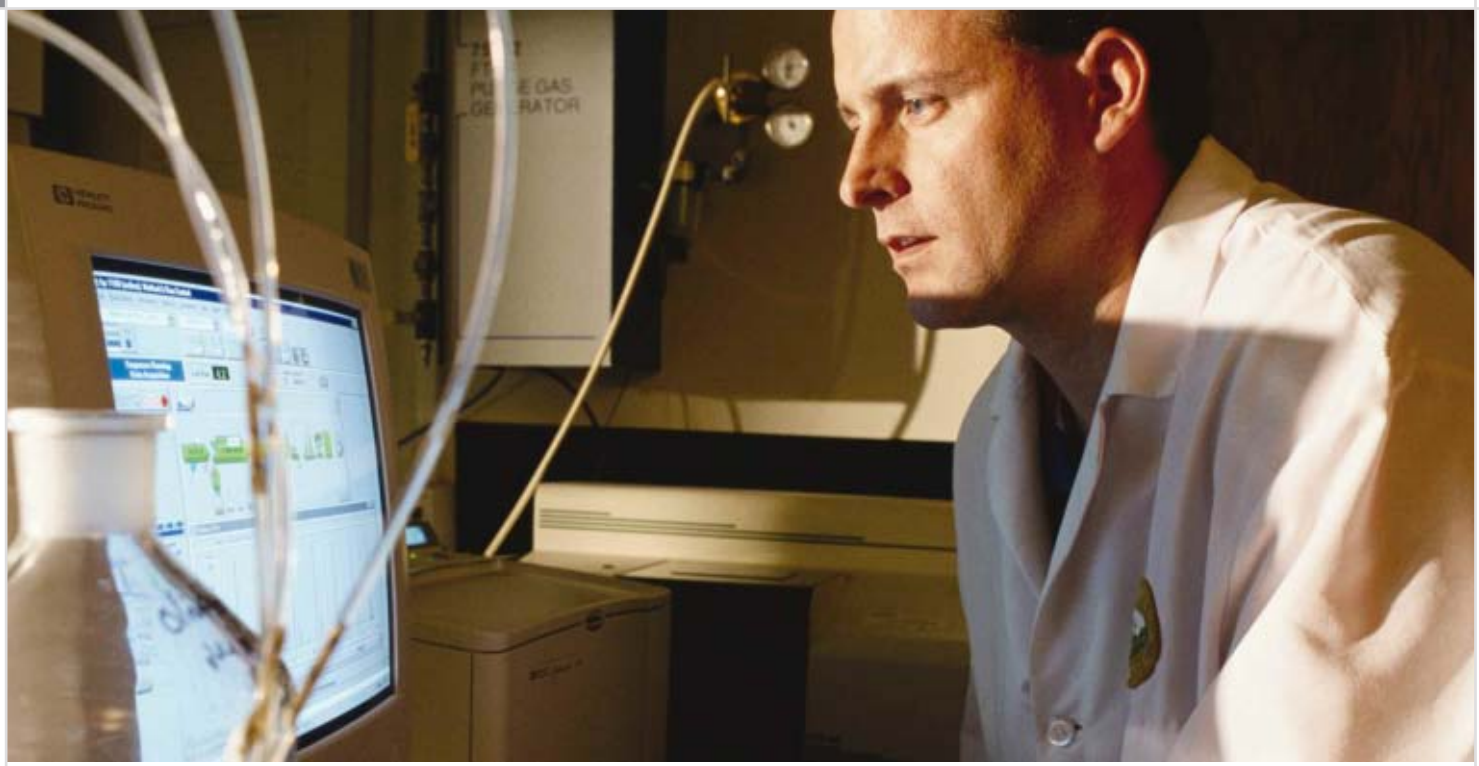
Available in some regional offerings, the ISO 17025 international levels of certification are part of a detailed specific audit program to ensure a consistent quality audited by an external agency traceable to chemical reference standards of a metrological level.

Guide 34 sets out the management system requirements for the product reference materials and is intended to be used as part of a reference material producer's general quality assurance (QA) procedures.

Key Markets for Specialty Gases

Market	Gases	Applications
Chemical	■ Process gases, environment mixtures, industrial hygiene ■ High purity 5.0-6.0, zero gases	■ Production process ■ Environmental monitoring ■ Lab QA/QC
Laboratories	■ Instrument gases ■ High purity 5.0-6.0, zero gases ■ High purity liquids: Ar, N_2	■ Laboratory ■ Special applications, ie environmental
Life Sciences	■ Research mixtures, drug mixtures ■ High purity 5.0 – 6.0, zero gases ■ High purity liquids: CO_2, N_2, Ar, O_2, HCL ■ EP, JP, USP and NF grade gases, dry ice	■ Pharmaceutical drug / device production ■ Lab QA / QC ■ Research ■ Cord blood / stem cell preservation
Lighting	■ Krypton, Xenon, Neon, Mixtures	■ Fluorescent tubes ■ Specialty halogen lamps ■ High intensity discharge (HID) lamps
Refining	■ Protocols, environmental mixtures, VOC mixtures, industrial hygiene ■ High purity 5.0 / 6.0, zero gases, microbulk ■ Disposables	■ Stack emissions ■ Process analysis ■ QC / QA, lab gases
Solar Photovoltaic	■ Silane, Dichlorosilane, Trichlorosilane, Mixtures ■ Argon, Hydrogen, Nitrogen	■ Solar/Photovoltaic production
University	■ Research mixtures ■ High purity 5.6 – 6.0, zero gases ■ High purity liquids: He, Ar, N_2	■ Research ■ Labs
Utilities	■ Protocols, Environmental mixtures, mercury (HG) standards, dry ice ■ SF_6, high purity 5.0, zero gases	■ Stack emissons ■ Breaker insulation
Window	■ Krypton, Argon, Silane, mixtures	■ Insulation

Specialty Gases for Analytical Instrumentation



Analytical instruments are used within virtually every industry. Primary applications include process control, QA/QC, and environmental and safety monitoring. Gas purity is an essential element in the proper operation of instrumentation and plays a vital role in obtaining precise, accurate, and repeatable results.

In addition to high quality carrier gases, fuel gases, instrument support mixtures and calibration gases, Praxair can also provide:

- Cost effective supply modes
- Gases and grade tailored for specific applications
- Safe and compliant gas storage and handling systems
- Compatibility of gases and delivery systems

Analytical Instrumentation

Most common analytical instrumentation applications for specialty gases:

Fuels / Oxidizers – Used to burn

A reference flame is created in the detector head by mixing the fuel and oxidizing gases.

Charged particles generated in the flame (from the sample) migrate to the polarized electrodes.

They are then converted to an electrical current by the electrometer at which point an output signal is generated. The output signal is measured thereby allowing identification of the compound of interest.

Carrier gases – Used to carry

Typically provided at high purity – 5.0 + grades, these gases are used to carry the sample product.

As such, they need to be inert, non-reactive, non-combining, non-interfering with the molecule of interest.

In addition, they also need to be dry so as to prevent damage to the instrument.

Calibration gases – Used to compare

These gases are used to provide a reference standard to compare with the sampling product.

They typically require high purity and low blend tolerance, with a higher certification level, usually offered as reference standards.

COMMON GAS CHROMATOGRAPHY DETECTOR TYPES

TCD – Thermal Conductivity Detector – Universal
FID – Flame Ionization Detector – Organic Compounds
ECD – Electron Capture Detector – Halogenated Compounds
FPD – Flame Photometric Detector –Sulfur or Phosphorous
PID – Photo-Ionization Detector – Selective
GC/MS – Mass Spectrometer – Universal
DID – Discharge Ionization Detector – Universal

Specialty Gases for Environmental Monitoring

Environmental monitoring continues to be an important regulatory mandate affecting almost every industry on the planet. Praxair's product line addresses the needs of continuous emission monitoring (CEM), mobile emissions monitoring, and ambient monitoring.

We are an acknowledged leader in the supply of high purity specialty pure gases and mixtures for environmental applications. From EPA protocols to a wide variety of globally regulated traceable grades, Praxair products help our customers meet the demanding requirements associated with environmental compliance and control.

Today, industry must carefully monitor its environmental emissions and use reference standards to obtain precise measurements. Praxair produces highly accurate calibration gas standards and ultra pure zero gases for a wide variety of emissions applications.

Praxair environmental solutions help ensure regulatory compliance, reduce emissions, increase capacity, improve economics, and help our customers achieve a broad range of environmental benefits.

Among the key Environmental segments we serve:

Stationary Source Emissions Monitoring

- Utilities / Petrochemical
- Pulp and Paper Plants
- Natural Gas Turbine Pumping Stations
- Incinerators
- Boilers and Industrial Furnaces
- Cement Kilns
- Steel Mills

Mobile Sources

- Motor Vehicle Manufacturers
- State Vehicle Inspection and Maintenance Testing
- Aircraft Engine Testing
- Environmental Laboratories
- Air Quality

Specialty Gases for Electronics

Praxair is a world leader in the supply of semiconductor process gases for the electronics industry. We offer a full product line including silicon source materials, dopants, etchants, and bulk products. The continuous drive to increase device performance means that specialty gases and chemicals must achieve higher purity levels, containers must be free of contamination, and analyses must be precise.

Specialty Gases for Hydrocarbon Processing Industry

Oil and gas exploration, refineries, petrochemical / chemical plants, gas processing units, distribution networks…

Performance expectations for these hydrocarbon processing industry (HPI) operations have never been greater. Key to achieving and maintaining this performance level are the many gases critical to this multipurpose industry.

Full Spectrum Product Line

From bulk quantities to small portables, Praxair offers a large selection of gases, containers, and delivery systems:

- Liquid mixtures (Propane, Butane, Pentane…)
- Refinery gas standards
- Trace impurity mixtures (fuel standards, industrial hygiene, environmental…)
- Ultra low sulfur and gasoline standards (stable high quality standards for fuel calibration)
- Custom multicomponent gas blends with over 100 individual components
- Highly reactive volatile organic compounds (HRVOC) standards (vents, flares, cooling towers and fugitive emissions testing)

Support all applications

Praxair has a long history and strong expertise in hydrocarbon processing and has developed solutions to improve productivity, increase capacity, reduce emissions, and enable performance monitoring and tracking.

- **Refinery laboratory, Quality control laboratory, and Pilot plant:** carrier gases, certified gas mixtures, hydrocarbon blends for complex analytical work. Air quality monitoring, R&D, chemical analysis, gas samples…
- **Health and Safety department:** calibration gas mixtures, measurement of toxics and environmental compliance.
- **Cracker unit:** monitors carbon monoxide emissions at different levels
- **Sulfur recovery unit:** measures sulphur dioxide at different concentrations
- **Fuel gas and combustion control:** gas residue and hydrocarbon emissions in combustion gas and feed streams.

Specialty Gases for Food and Beverage

Keeping Food Fresher, Longer

Our gases provide the product characteristics that our customers need. Frozen, chilled, crisp, fresh, fizzy – it is all possible with Praxair gases and application expertise. We work with a wide range of customers to increase their productivity and improve yield, all while helping enhance food product quality and maintain their focus on food safety. And we do it by developing new and innovative applications and technologies, as well as continuously improving our existing systems to help make their processes even more efficient.

Products: available in Bulk & Cylinder deliveries

Carbon dioxide is a key cryogenic agent in cooling, chilling, and freezing applications, protecting the taste and texture of food products by maintaining proper temperature control. Carbon dioxide also reduces the need for preservatives in packaged products, and is the essential ingredient for fizz in carbonated beverages.

Nitrogen is a key cryogenic agent in cooling, chilling and food freezing. Because of its extremely cold temperatures, immersion freezing in liquid nitrogen is the fastest freezing method known for producing individually quick frozen (IQF) foods. Nitrogen also plays a key role in reducing spoilage, discoloration and off–flavors, while giving strength to retail packaging.

Oxygen is used in aquaculture to deliver the dissolved oxygen levels that are needed for high production and fish health. Praxair oxygen is also key to providing increased dissolved oxygen levels for enhanced aeration and aerobic digestion in food wastewater streams.

Modified Atmosphere Packaging (MAP) gases are used by food processors and packagers to extend the shelf life of their products. The gases include a mixture of pure nitrogen, carbon dioxide, and oxygen and function to displace unwanted atmospheric gases.

Specialty Gases for Life Sciences

Life Sciences

For biotech and pharmaceutical companies, Praxair's products and services support critical drug development and manufacturing requirements including:

- Research
- Clinical trials
- Cell culture
- Cryopreservation and repositories
- Fermentation
- Manufacturing
- Regulatory compliance

Whether the requirement is for specialized equipment or full turn-key systems, Praxair has the products and services to meet this sector's specialized needs.

Application specific products for this sector include:

- Biological equipment-freezers, dewars, shippers
- Cryogenic gases and delivery systems
- Controlled rate freezers
- USP, EP and JP grade gases (grade availability varies by country and region)
- Instrumentation gases
- Dry Ice

Laboratories/Research/Healthcare

Praxair's extensive product line, wide selection of containers, and excellent distribution network meet the needs of busy research scientists and lab technicians. Specialized offerings include:

- Carrier gases
- Laboratory audit
- Calibration gases
- Technical support
- Specialty equipment
- Cylinder management
- Therapy gases (medical drug gases)
- Diagnostic gases (medical device gases)
- Pulmonary functions mixtures (lung diffusion)
- Anaerobic and aerobic mixtures
- CT scanning mixtures
- Sterilant gases
- Instrument gases

Cylinder sizes

Compressed Gas Cylinders

The most common means to store compressed gases is to use high pressure cylinders. Some of the most common sizes available are listed below, additional containers from low pressure cylinders as well as liquid containers are available.

Material	Main Applications*	Model	Approval zone	Dimensions		Normal Fill Pressure		Internal Volume	Tare Weight	
				(in x in)	(mm x mm)	(psig)	(bar)	(L)	(lb)	(kg)
Ultra HP Steel	H_2, N_2, Ar, He for medical, industrial high volume low purity	6K	US	10 x 51	254 x 1295	6,000	413	42.7	303	138
HP Steel	Purge, inerting, carrier gases, dedicated non-reactive lab standards	T	US	9 x 55	235 x 1397	2,400	165	49	138	63
		K	US	9 x 51	229 x 1295	2,000	137	43.8	133	60
		50H	EU	9 x 59	229 x 1498	2,900	200	50	125	57
Aluminum	Dedicated low concentration reactive gas mixes, high purity pure and mixtures	AT	US	10 x 52	249 x 1313	2,200	151	48.1	93	42
		50HA	EU	10 x 59	250 x 1500	2,900	200	50	123	56
Aluminum	Dedicated low concentration reactive gas mixes, preferred cylinder for environment monitoring gases	AS	US	8 x 48	203 x 1214	2,000	137	29.5	50	23
		20HA	EU	8 x 38	203 x 955	2,900	200	20	55	25
Aluminum	Research quantity reactive products, low concentration reactive gas mixtures	AQ	US	7 x 33	184 x 836	2,200	151	15.7	33	15
		10A	EU	7 x 27	176 x 695	2,900	200	10	30	13
HP Steel	Non-reactive mixtures and pure gases	Q	US	7 x 33	178 x 836	2,000	137	14.7	63	29
		20H	EU	8 x 31	203 x 795	2,900	200	20	59	27
		10H	EU	5.5 x 32	140 x 813	2,900	200	10	25	11
HP Steel	Research quantity pure gas products	G	US	6 x 20	152 x 508	2,000	137	7.3	28	13
		3H	EU	4 x 20	100 x 500	2,900	200	3.0	10	5
Aluminum	Low volume reactive gas mixtures – shelf life concerns	A3	US	7 x 16	175 x 396	2,200	151	5.9	16	7
		5HA	EU	6 x 21	150 x 525	2,900	200	5.0	15	7
		2HA	EU	4 x 15	102 x 385	2,900	200	2.0	7	3
HP Steel	Small capacity pures (toxic and corrosive)	F	US	4 x 17	104 x 432	2,000	137	2.8	10	4

*List is not exhaustive

Cryogenic Containers

Designed to store gases in a liquid state at cryogenic temperature, these “dewars” can provide either liquid or gas withdrawal at either low (~20 psig) to high (up to 450 psig) pressure. High performance dewars also exist for liquid helium usage with multi-layer insulation to reduce evaporation losses.

In addition, Praxair can help source all necessary equipment in the cryogenic space: from liquid withdrawal to cryopreservation to storage systems.

Portable Cylinders

Portable Cylinders

From calibrating instruments in industrial hygiene applications to bar mixtures in emissions monitoring or for laboratory and university research, portable cylinders offer the best solution.

Products Applications

- High blend accuracy
- Product traceability
- Customized blends upon request

Applications

- Workspace air / toxic emissions monitoring
- Safety / Emergency response kits
- Laboratory field analysis

Disposable Cylinders

Cylinders can be offered in steel for pure gases and non-reactive mixes or aluminum for reactive mixes and can accommodate as little as 4 liters to over 550 liters of gases and mixtures. The cylinders are traditionally disposed of after use.

Reusable Cylinders

Within the *Portagas*™ family of transportable cylinders, the *Portagreen*™ line offers a complete reusable sustainable solution along with extended shelf life. With the unique *Strip & Ship*™ packaging option, cylinders can easily be returned back to Praxair. In addition, cylinders are individually serialized and combined with ISO 17025 and Grade 34 certification offer high quality product. The *Portagreen* line is available in the most common cylinder sizes and, with global stocking locations, offers expedited shipping solutions wherever it is needed.

PortaCYL™ Compact Reusable Integrated Package

Permanently mounted on a refillable high pressure cylinder, the *Portacyl* package offers the value-added features of an integrated pressure regulator valve. Designed with an ergonomic easy to carry handle, it offers optimal portability and ease of use. It can be used with a wide variety of gases and mixtures applicable in many industries including hydrocarbon and chemical processing, automotive, aerospace, utilities and power plants, or waste management.

Equipment for Specialty Gases

Role of equipment in your gas applications

All the care that has been taken to provide a calibration mixture's stability or a specified maximum impurity level in your high purity gases should not be jeopardized by using improper equipment. The equipment has to respond to all functional, safety, and quality aspects of the corresponding gas application.

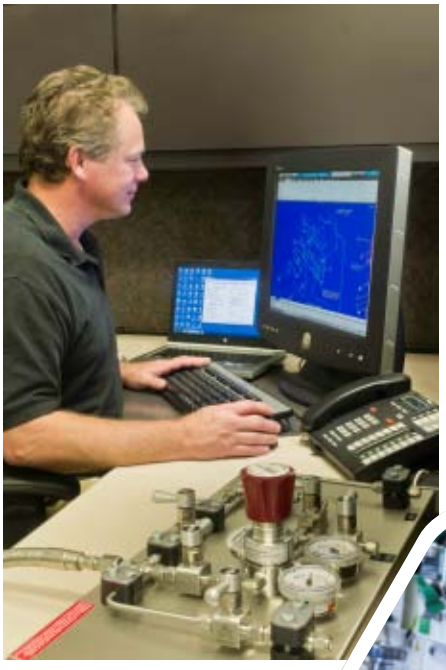
Praxair has decades of experience in the sourcing, equipment selection, assembly and installation of gas handling systems as used in laboratories, universities and research, semiconductor, chemical, pharmaceutical and many other high demanding industries.

Functional aspects

For safety and local regulations, gas cylinders are mostly installed at a central location. The gas or gas mixture should be transfered from the cylinder to the point of use, not only at the specified pressure and flowrate but also with its original specifications.

Safety aspects

Starting from the high pressure in the gas cylinder, the equipment has to provide a constant reduced pressure at the point of use, while assuring leak tightness to avoid contamination of the work environment by the characteristics of the gases in use (flammability, toxicity, corrosivity).



Quality aspects

Intrusion of ambient impurities, for example O_2 and H_2O (retrodiffusion), in a gas handling system will lead to detoriation of the stability of certain calibration mixtures and contamination of high purity gases. Leak tightness of the equipment and the overall installation (piping, connection points, welded joints, etc..) should be verified.

Equipment Program

Equipment Program

A comprehensive program covers all basic requirements for the safe and qualitative handling of all your specialty gas applications. It includes a range of pressure regulators (single stage and double stage) panels based on the gas type, switch-over systems, and point-of-use regulators. In addition, Praxair can source all the necessary equipment for your gas uses, including gas filters, flow meters, controllers, and cryogenic apparatus.

Pressure regulators

Available in single stage and double stage design, the latter being used in applications where constant outlet pressure is required independent of decreasing inlet pressure.

Critical purity: These stainless steel and brass regulators are used where purity and contamination requirements are critical. They are typically used with high purity gases and toxic or flammable gases.

High Purity: These nickel-plated brass/stainless steel regulators are used for applications where diffusion resistance is an important factor in ensuring purity.

High Purity Economical: These chrome-plated brass regulators have similar features to the high purity series. They are most often used with high purity gases when higher flow rates are required and cost is the most important issue.

Gas Distribution Panels

Praxair offers standard solutions that cover most of the gas applications: wall mount design, connection with the cylinder by a stainless steel winded ("pigtail") or flexible tubing.

- Panel to connect one cylinder of an inert non flammable gas of medium quality. Without purging capability.
- Panel to connect one cylinder of an inert or flammable gas of medium to high quality. With purging capability using the connected gas.
- Panel to connect one cylinder of a toxic, corrosive or flammable gas of medium to high quality. With cross purging capability using an inert assist gas (typically N_2 6.0).

In addition, Praxair can source fully enclosed gas cabinets for hazardous gases in compliance with local safety codes.

Switchover Systems

Gas supply panel for connecting 2 times 1 cylinder, with automatic switch-over for continuous gas supply, extendable to connect more cylinders at each side. For gases and gas mixtures of medium to high purity, equipped with process-gas purging. These switchover stations can be equipped with a power supply/remote alarm to provide both local and remote indication of status.

Quality & Safety

Not just a label but a tradition of excellence

Leading in Safety

Safety is one of Praxair's primary concerns. This concern starts with our own suppliers, continues with internal plant security, to structures is the safe application of specialty gases at our customer's premises. The potentially hazardous properties of Specialty Gases, such as pressure, flammability, toxicity and corrosiveness, require handling with a combination of safety awareness training, know-how, skilled resources and personal commitment at all levels within an organization.

Quality

Cylinder preparation, analytical capabilities and qualitative laboratory practices are key elements in the production of Specialty Gases.

Praxair facilities worldwide have obtained various quality certifications such as:

- EN 14001
- ISO 9001-2008
- TS 16949
- ISO17025

GHS (Global Harmonization System) Product Labeling

Under the recently adopted GHS rules, each product label requires the following:

- Product identifier
- Pictogram (see below)
- Signal word (DANGER, WARNING if needed)
- Hazard statement(s)
- Precautionary statement(s)
- Name, address, and telephone number of the responsible party.

Pictogram Identification

Flammable
(Flammable, self reactive, Pyrophoric, Self-heating, Emits flammable gas, Organic Peroxide)

Acute toxicity (oral, dermal, inhalation)

Acute toxicity (oral, dermal, inhalation), Skin irritation
Eye irritation, Skin sensitization,
Specific target organ toxicity
Respiratory tract irritation,
Narcotic effects

Oxidizer

Skin corrosion, serious eye damage

Acute and chronic hazards to the aquatic evironment

Compressed gases
Liquefied gases
Refrigerated liquefied gases.

Respiratory sensitization, Germ cell mutagencitiy,
Carcinogenicity,
Reproductive toxicity,
Specific traget organ toxicity, Aspiration hazard.

Transport labeling

ADR Rules are issued by the United Nations and are valid for the road transport in most countries in Europe while DOT Rules are issued by the U.S. Department of Transportation and applicable mostly in Americas.

	ADR / GHS	DOT
Compressed Gases		
Flammable Gases		
Toxic Gases		
Oxidizing Substances		
Corrosive Substances		
Environment Toxicity		

Color Code Identification

Cylinders contents are identified by a unique color according to internation regulations like norm EN 1089-3 applicable for industrial and medical gas cylinders, or CGA C-9 for medical cylinders. Color identification varies per regional regulations and are generally based on the following attributes:

- Toxic and / or corrosive
- Flammable
- Oxidizing
- Inert (asphyxiant)

Safety Data Sheets

Safety data sheets are used to communicate and report the hazards of chemical products. Their contents, recently standardized by the GHS rules, include the following 16 sections:

1. Product and company identification
2. Hazard(s) identification
3. Composition / information on ingredients
4. First aid measures
5. Firefighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls / personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal information
14. Transport information
15. Regulatory information
16. Other information

As a Fortune 250 company, and one of the largest industrial gas companies in the world, we operate in more than 50 countries and serve over one million customers representing a wide array of industries including: energy, manufacturing, chemicals, metal production, and healthcare.

To learn more about Praxair's expertise with specialty gases, call us at **1-800-PRAXAIR** or visit our website at **www.praxair.com**.

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