



# Custom Gas Solutions, LLC

Providing customers with practical and precise gas mixtures

By Agnes H. Baker

Situated in North Carolina's Research Triangle, the largest high technology research and science park in North America, is a busy lab which produces specialty gases for a wide range of customers — Custom Gas Solutions ([customgas.com](http://customgas.com)).

The company was founded by Dr. Stephen Vaughan in 2001 when Dr. Vaughan, who has many years of experience in materials engineering and production, R&D, and QC management, learned of a start-up pharmaceutical company whose primary target drug was a true gaseous drug formulation. To support that company's needs, he

developed Custom Gas Solutions and custom solutions have been the business' focus ever since. "All of our activities are designed to be reduced to practical and workable results," says Dr. Vaughan.

Recognizing that many small start-up pharmaceutical companies do not necessarily become long-term customers, Custom Gas Solutions developed a three-pronged business plan. "Our primary initiative was the support of our initial pharmaceutical product," Dr. Vaughan explains. "Our secondary initiative was the development and production of extremely high-quality gas standards with an emphasis

on manufacturing a line of highly stable reactive gas mixtures, such as the air quality standard known as an EPA TO-15. Our tertiary initiative was the offering of specialized expertise in a consulting and/or partnering capacity, by providing analytical methods-development assistance, third party testing and verification, and the building and supply of specialized gas distribution manifolds."

### Evolving requirements

The specialty gas industry today is driven by demand for highly accurate low concentration gas mixtures, and



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the definition of “low” is constantly changing. Dr. Vaughan says, “Whereas, a standard in the past may have been considered ‘low concentration’ at 1 ppm (parts-per-million) levels, newer customer demands have taken that down to the parts per trillion range. The challenge of supplying these mixtures is in improving and maintaining the integrity of the manufacturing processes to support the required accuracy and stability.”

As Dr. Vaughan sees it, “The quality and accuracy of the final product is dependent on each and every step, beginning with the selection of cylinders

and valves, to the preparation of the package (including any additional cylinder cleaning and passivation processes), the gravimetric preparation of pre-mixtures and finally to the analytical verification in the quality control laboratory.”

The hazardous gas monitoring and environmental testing markets are driving the demand for more stable and accurate low-level standards to support today’s increasing sophisticated analytical equipment. Electronic fabrication facilities also continue to tighten requirements for gas purity to support lower defect material production, according to Dr. Vaughan.

Custom Gas Solutions’ customer base is growing in many markets. “Every segment seems to be increasing its usage of specialty gases. We service a diverse group of users that includes university researchers, beverage gas producers, environmental test labs, microelectronic fabs, and pharmaceutical companies. All have registered increased demand for our products in the past six months.”

#### Custom solutions

One of Custom Gas Solutions’ largest projects involves support for a gaseous drug product which is now moving into FDA Clinical Trials. The project has been ongoing since 2004 when Custom Gas Solutions began manufacturing the active pharmaceutical ingredient for its client and provided the subsequent creation and validation of the gaseous drug mixture.

The company also designed and built the drug’s turnkey gas delivery system, which is capable of supplying multiple concentrations of the drug in various concentrations of oxygen and nitrogen. Custom Gas Solutions partnered with TriE Medical to refine and document the design per FDA Device Compliance and clinical use requirements. Most recently, this drug was licensed to a major pharmaceutical company for further development and Custom Gas Solutions has been contracted to manufacture it for use in human clinical trials.

Dr. Vaughan says, “We spent the last

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five years in the design, construction, and validation of a cGMP qualified cleanroom facility for the manufacturing support of that drug. That facility is now a fully functioning component of Custom Gas Solutions manufacturing operations that includes a full specialty gas plant within the clean room.”

Another interesting Custom Gas Solutions project involved the supply of a specialty material that was needed in the wake of the Fukushima nuclear disaster in 2011. “We were asked to supply the high purity Hydrogen Iodide (HI) gas necessary to the manufacture of crystals used in radioactivity detectors,” explains Dr. Vaughan. “We refined our existing process and provided (and continue to provide on an as-needed basis) the manufacture of anhydrous HI to meet customer requirements.”

Custom Gas Solutions also provides delivery system gas purity verification services on-site for new installations, systems that have been opened for repair or reconfigure, or to resolve manufacturing problems due to suspected contaminants. The company can provide sampling and analysis systems at customer sites and also verify gas purity for a number of standard bulk gases.

By partnering with several different gas cylinder manufacturers, Custom Gas Solutions is also able to assist with the assessment of manufacturing processes and new product development for its clients. The company has the capability to analyze cylinders on a recurring basis to assess the stability of a specific product over time.

In another example of how his company provides custom solutions, Dr. Vaughan describes his partnership with a developer of gas filter bed reactors designed to remove sulfur from hydrogen obtained from natural gas ▶

## SPECIAL FEATURE – CUSTOM GAS MIXTURES



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wells. The companies worked together to assist a customer in designing specific filter units for laboratory use, as well as to understand the functional efficiency of the filter and the amount of material the filter could adsorb prior to breakthrough.

A current project involves Custom Gas Solutions working with a partner on the design and implementation of a helium purification unit. The unit, located at Custom Gas Solutions' facility, will be capable of purifying helium from wells to a level of UHP or above.

### Product demand

Custom Gas Solutions reports that high purity oxygen, nitrogen, and synthetic air are consistently in demand.

"We are seeing an increase in the demand for ultra-pure materials, usually designated as research grade or electronic grade," says Dr. Vaughan. "We can meet the demand for that level of cleanliness through a combination of material specification, ultraclean gas manifolding systems within the facility, and sensitive analytical capabilities designed for the characterization of impurities on those materials."

The company also supplies other UHP and research grade materials on an as-needed basis including helium, argon,

and methane. Some of these materials are purified in-house and some are sourced from other companies and carefully analyzed by Custom Gas Solutions to prove they meet Dr. Vaughan's demanding standards.

In addition to gas products, the company also provides compressed gas cylinder passivation technology development services and has a number of specialty gas passivation systems at various levels of development. Passivation is a process designed to modify or prepare the internal surfaces of a gas cylinder so that a non-reactive storage environment is created for gas packaging at high pressure. To maintain the purity of UHP grade gases, the cylinder must be prepared in such a way as to not contribute contaminants to the gas packaged in that cylinder.

Custom Gas Solutions has spent many years evolving passivation techniques and ideas to create a set of passivation strategies specific to the materials to be packaged. Its techniques include single step and multiple step processes, including cleaning technologies and unique surface modifications.


### The business today

Custom Gas Solutions' business is based

largely in North America with sales and shipment of compressed gas products representing about 90% of its revenue.

The company recently entered into an agreement with Harris Equipment to distribute its regulators and gas handling equipment. Designing and building custom gas handling systems is a growing market for Custom Gas Solutions and the Harris agreement compliments that.

Vaughan reports that the company is in a growth mode. "The merger and acquisition of many gas companies have left customers with fewer suppliers. Many of our customers are sourcing products from us because the larger gas companies don't offer the level of expertise and technical support they need for the more exotic products that are being developed today."

"At Custom Gas Solutions customers can speak directly with the experts, including me, and we believe this is a big part of our success." 

### ABOUT THE AUTHOR

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