

Gases That Carry a Guarantee

Understanding the Specialty Gas Business for the Make or Buy Decision Maker

By Ray Borzio & Paul Matlock

Manufacturing and selling high-purity specialty gases requires complex resources and represents a significant investment for industrial gas distributors. The profitability of specialty gases makes them a highly desirable product line, and many distributors today are considering entering this business, which has been largely dominated by the major gas companies.

With this feature, *CryoGas International* begins the first in a series of articles that is intended to provide a framework to assist distributors with a make-or-buy decision regarding specialty gases. This feature serves as a primer on specialty gases — what they are, the skills required in their production, and the commitment to quality and service that underpins a specialty gas business. Future articles will cover market analysis techniques, the analytical equipment that is required to manufacture specialty gases, training a staff to support a specialty gas product line, and evaluating the economics of the specialty gas market vis-a-vis your business.

ENTRY POINTS FOR THE SPECIALTY GAS BUSINESS

Many distributors enter the specialty gas business by responding to a customer's needs. Distributors often begin by purchasing specialty gas requirements from another sup-

plier, then servicing them to their customer. This often turns into a profitable venture with distributors discovering that you can make some of these gases, such as pre-purified nitrogen. Distributors can enter the specialty gas business by repackaging product into specialty gas cylinders and by following specialty gas protocols. From here, the distributor looks for more points of entry and greater vertical integration of his gas production process into specialty gas sectors.

Before a distributor considers becoming a larger producer of specialty gases, however, he must carefully consider his commitment to the business. Is his existing specialty gas business profitable without manufacturing capabilities on board? Is the company buying specialty gases for resale and selling them at a reasonable margin sufficient to cover the distribution expenses? Is there a dedicated salesperson to the product line and a loyal customer base that continues to re-order products based on the quality and service provided? Manufacturing capabilities should only serve to improve a profit margin, not create one. Be sure to understand the competitive environment you are entering. For distributors of specialty gases, knowledge of the products you wish to serve to your customer is more important than understanding the equipment technology needed to produce the line.

DEFINING SPECIALTY GASES

Our favorite definition of a specialty gas is — any gas that carries with it a guarantee. Specialty gases are not necessarily the most sophisticated, pure, accurate, or chemically complex gases in your product line-up, but they must be the most consistent in quality and performance. Consistency makes specialty gases suitable for a particular application and each gas must be guaranteed to perform upon investigation through appropriate analysis. Each gas' application criteria defines the acceptance parameters of the gas and the suitability of the product. Another good definition of specialty gas from the supplier's perspective is — however my customer defines a specialty gas.

THE TOTAL SOLUTION

Investing in the specialty gas business involves a logical "Total Solution" approach. You need to determine your customers' needs and have a basic understanding of their applications so that you fully understand the solutions. Technology plays a large role in this business, and as specialty gases applications move up the customer tower of market segments (see illustration), technology and capital investment costs increase.

At the level of industrial and welding gases, technical requirements are low, and the purchasing decisions are based on price, availability, service, quality, consistency, and consequences — in that order. As you move up the tower, the purchasing priorities start to reverse and the consequences of bad product become far more important than price. In fact, in some industries the price of the product is almost insignificant as compared to dollars lost due to rejected gases, law suits, or fines for failure to comply with federal regulations. As you progress to the top of the tower you rarely get second chances when your products cause a problem. Costs to supply start increasing fast for higher quality and greater reliability. Many groups cross over into the adjacent tower block, either above or below. As you ascend the tower, the technical difficulty of production, as well as the importance of quality and service to the customer, increases. By buying products for resale from reputable vendors, a distributor can successfully supply the top markets without having in-house production operations.

INDUSTRIAL AND MEDICAL GASES

Most businesses contemplating an increase in their specialty gas operations are already serving the industrial and welding gases markets. Applications in these markets typically require oxygen and acetylene for welding and cutting. Most distributors fill their own oxygen but purchase acetylene for resale. Even at this low-tech end of the tower, gases are bought for resale. At this level, many distributors also have liquid nitrogen and liquid argon on board to be sold either as cryogenic



liquids, nitrogen purge gases for inerting atmospheres, or argon as a shield gas. Many also offer refrigerated carbon dioxide to service the beverage industry, commonly in 20 or 50 pound cylinders, or more recently as small bulk delivery accounts (micro-bulk).

Your customers may be ascending the tower as they fill the needs of their customers, whether you serve those markets or not. For example, regular welding customers may begin asking for helium to support stainless steel TIG welding applications, or begin to require special combinations of these gases as mixtures. Mixtures require a binary gas analyzer to check the accuracy. If you invest in one, you can build on this product line. As you move into more complex products, your sales staff becomes more consultative as you are now selling solutions, not just peddling prices. And so it goes up the tower.

THE MEDICAL GAS AND MEDICAL MIXTURE LEVELS

At the medical gas level you are required to meet certain purity requirements for USP oxygen, carbon dioxide, and nitrous oxide, and NF nitrogen. You must follow government regulations that describe how you will manufacture and certify these products. Failure to follow the regulations is punishable by federal law and compliance is governed by the FDA.

In the medical gas mixture category, you are manufacturing mixtures that, by all rights, can reside in the specialty gas mixture section as well. These are usually referred to as "Medical Device Mixtures" and include calibration gas mixtures for blood gas analyzers, pulmonary function diagnosis, and medical laser gas mixtures. What may look like a beer gas mixture can now show up in a microbiology lab as an incubator anaerobic atmosphere essential for growing microbial cultures to support a diagnosis. Due to their very tight mixture tolerances and the degree of analytical accuracy required, more application knowledge as well as a sufficient sales competence is needed for medical gas mixtures.

ULTRA-HIGH-PURITY AND ZERO GRADE

Ultra-high-purity (UHP) and Zero Grade (hydrocarbon free) gas production, offer the distributor the first real opportunity to produce a significant specialty gas line. As the group product names imply, their assayed purities make them suitable for their intended applications.



One of the simplest applications at this level is high-purity inerting atmosphere or purge gas. These gases keep out atmospheric air that can carry many contaminating components detrimental to sensitive chemical reactions or applications. These reactions and applications may be harmed by particles in the air, resulting in rejected components or products. Many chemical reactions can be affected by oxygen or water vapor present in air. These contaminants are highly reactive and can interfere with the desired chemical reaction taking place. In addition, water has the characteristic of being a good transport vehicle for particles, making water a double-edged contaminant sword, especially in the semiconductor industry. Particle sensitive fabrication operations are typically performed in closed environments under constant positive pressure purge by a high-purity inert atmosphere, like nitrogen or argon.

Other large applications for products at this level are gases used as instrument carrier gases and fuel gases. For example, high-purity helium is widely used as a carrier gas in gas chromatographs and mass spectrometers. Here, specific impurities like oxygen and water can interfere with analytical results or prematurely degrade a chromatograph's column efficiency resulting in increased down time. One of the most common gas chromatograph detectors is called the flame ionization detector, which has the ability to detect sub-ppm levels of hydrocarbons in other gases. Zero air and zero hydrogen are essential to the detector burner.

Opportunities for distributors to enter the UHP and Zero Grade level have increased with the availability of products like LOX, LIN, LAR, and helium and hydrogen in tube trailers at purity levels well above 99.999 percent minimum. These gases are commonly supplied to the electronics industry by the major players. While most distributors do not sell into the electronics markets (see discussion below), they can purchase these high-purity products from the majors and repackage them for sale at the UHP and Zero Grade level.

However, the repackaging must be done without recontamination. Recontamination typically comes from inboard atmospheric leaks during the evacuation process at the distributor's fill plant and is typically detected as high oxygen content in the finished product. Oxygen is one of the bad guys. These deficiencies are easy to correct at the fill plant, however, and this is the one area where simple capital investment is curative.

Water in the atmosphere can also leak in like oxygen, or can reside in the cylinder wall itself, contaminating the gases. The cylinder wall can become saturated with water when left open to the atmosphere or when filled with water during periodic requalification via the hydrostatic retest process. This is also an easy fix with the installation of a heated cylinder bake-out system coupled with appropriate vacuum technology. Though UHP and Zero Grade gas repackaging investment can be as high as \$150,000, commitment here is vital to continued growth.

SPECIALTY GAS MIXTURES

Once customers learn about new capabilities, they start asking for more products, some of which you can produce, some of which you will purchase for resale. Products you here-to-fore purchased for resale, reside in the next block in the tower — Specialty Gas Mixtures. At this level, the gas handling is the same as at lower levels but new techniques must be mastered. A distributor is technically capable of moving into this level if he has a good cylinder preparation process in place, a basic gas chromatography system in the lab, the trace contaminant instrumentation needed to produce the UHP and zero gases used in many mixtures, and excellent product knowledge. This package may present new challenges and we suggest you hire a consultant to guide you through the techniques needed to produce a basic line of non-reactive, non-toxic specialty gas mixtures at this level, where the product line expands to include three component mixtures of carbon dioxide, hydrogen, and nitrogen. Methane and argon are mixed at the 5–10 percent methane level to be used as specialized chromatograph detector carriers or for nuclear counter instrumentation. Butane and isobutane mixtures can be used as special carriers, calibration gases for portable instrument, or as propellants in aerosol applications. Sulfur hexafluoride mixtures are frequently used in leak detection. Three and four component mixtures of carbon dioxide, carbon monoxide, nitrogen, and helium make up a broad category of laser gas mixtures.

Specialty gas mixture applications are expanding daily and are easily within the realm of capability for distributors already in the UHP and zero gas business. The new capital investment required is typically in the \$100–130,000 range and involves a dedicated mix panel that allows for the convenient addition of up to 10 gases that are compatible with each other. These systems typically are all stainless steel and are equipped with high accuracy pressure and vacuum gauges. The system is piped to allow for the filling of mixtures by placing the candidate cylinder on a high load, high sensitivity scale. This equipment virtually assures that the technician will hit his target concentration time after time. The savings here are obvious as the reject rate of gas mixtures virtually approaches zero percent. Gas chromatography expertise allows analysis of virtually any mix. The training, and the talents of the individual in the lab, becomes more important as you develop these product capabilities.

ENVIRONMENTAL GASES

Environmental gases include a broad category of mixtures used to calibrate instrumentation that monitors air and water quality, or a production process to provide information to adjust process parameters. There are endless opportunities at this level for the distributor as these mixtures serve a wide range of markets, many of which are growing.

Most of the high-end mixtures in the environmental compliance category deal with components that may react with a steel cylinder's wall. To eliminate this reaction potential, the distributor must apply a special treatment process to an aluminum cylinder's internal surface, effectively inerting the wall to the reactions that would normally occur in a steel cylinder. These processes exist but are usually proprietary in nature, involve a prohibitive capital investment in equipment, and require the handling and abatement of some highly corrosive and toxic gas components. The mixtures routinely contain ppm levels of nitric oxide, nitrogen dioxide, sulfur dioxide, hydrogen sulfide, and carbon monoxide. These mixtures are used to calibrate instrumentation that monitors pollutant effluents from regulated industries.

A unique class of certified gas mixtures, known as EPA Protocol mixtures, are required by the government to be used as primary standards to calibrate the instrumentation for source monitoring of industries that burn fossil fuels. Power plants, pulp and paper plants, petroleum refineries, and similar industries fall into this category. Their effluents can contribute to acid rain and elevated levels of atmospheric carbon dioxide and other green house gases that are part of the global warming concept. These are very hot political issues of the day. To produce these materials, a distributor must fully understand the ramifications of failure to supply materials in strict compliance with these protocols. Calibration gas may directly affect data used to regulate an industry that may be subject to federal violations if the process is out of compliance. Capital requirements here will start at \$250,000 and go up in proportion to the sales (and risk exposure). Second chances at this level are rare.

ELECTRONIC AND SPECIALTY GASES

The semiconductor and fiber optics industries drive the business at the top of the tower — the Electronic Specialty Gases block — currently an industrial gas distributor's "No-Mans Land." Products like LOX, LIN, LAR, and helium and hydrogen in tube trailers, are required at purity levels well above 99.999 percent minimum. The major gas producers have traditionally held these accounts as even highly qualified distributors do not have the technical and safety knowledge to properly service them, nor the confidence of major semiconductor gas suppliers/players. With very few exceptions, this remains the case. The few distributors that have been successful in serving electronics specialty gases customers do so in close association with their major gas partner, with the major producer supplying the bulk gases to the distributor. Distributors with this business platform, that receive high quality bulk gases delivered at industrial gas prices, are in a good position to repackage these bulk gases and expand their specialty gas business at the UHP and Zero Grade levels and beyond, as discussed above.

LESSONS FROM THE TOWER

From the customer tower we learn that to acquire specialty gas customers you must focus on quality, service, and consistency. Decisions to invest in new production technology should rely on accurate information brought to you from sales, production, quality control, finance, and executive authorities. Accurate sales forecasts and an honest evaluation of the customers' expectations are key. The specialty gas business is as much about customer perception and satisfaction with service as it is about costs. Production and quality control managers must evaluate the equipment on hand and keep executives apprised of capabilities. Specialty gases is a dynamic business and new customer requirements can often be satisfied by additional training or with minor modifications to existing equipment or techniques. The complex nature of the business makes the expertise of a good consultant invaluable when deciding to enter or expand into specialty gas markets. ■

Ray Borzio is the President of Special Gas Services. He can be reached at rayborzio@specialgas.com; Web: www.specialgas.com.

Paul Matlock is a principal in TAP Resources, a network of Compressed Gas Industry experts. He can be reached at info@tapresources.biz; Web: www.tapresources.biz.