Tech Talk

What's So Special About Specialty Gases?

by Mike Lee, Middlesex Gases & Technologies

Lab gases will always play a significant role in the everyday life of those in labs across the country and worldwide. A gas chromatograph (GC) or a mass spectrometer (MS) is just a sizable paperweight without gases. There are a myriad of gases and gas grades to choose from and the gas company representatives are not always up to speed with the upper end of the Specialty Gas spectrum.

First things first. What makes a Specialty Gas special? Standard, everyday gases used in industrial processes such as welding or metal cutting are called Industrial Gases. The tanks are filled with the gas of choice for the application and shipped to the customer. When the tank comes back empty it is simply re-filled and out the door it goes again.
Such is not the case with Specialty Gases. A Specialty Gas must meet or exceed a particular set of specifications and should never be allowed to leave the gas company's Gas Lab until the gas cylinder in question has proven its worth under great scrutiny.

Using Ultra High Purity (UHP) Helium as an example, let's walk through the process that results in the coveted "Ultra High Purity" status. First, the cylinder is fitted with a positive open/close valve which will ensure a high level of leak integrity. Second, the cylinder is placed in an oven and baked for eight hours at 140°F to remove any contaminants from the inside of the cylinder walls.

During the baking process the tank is purged with an inert Ultra High Purity gas and then quickly placed under vacuum. This purge/vacuum sequence is repeated seven times during the eight-hour baking period. The intent with this process is to break the polar bond of any existing moisture molecules that have affixed themselves to the inside of the cylinder walls. Trapped within these moisture molecules are other harmful contaminants such as hydrocarbons, particulates etc. This thermal energy transfer frees the molecules from the cylinder walls and the purge/vacuum process removes the moisture molecules and entrapped contaminants from the tank.

When the baking process is complete, the cylinder is clean enough on the inside to accept and maintain the integrity of an Ultra High Purity gas. Once the cylinder is filled, it goes to the lab where our chemists will put the cylinder through a battery of tests, checking for contaminants such as moisture, total hydrocarbons and oxygen. Should a cylinder be "rejected" at this point, it is purged and returned for a repeat of the baking process. Cylinders that "pass" the first round of testing proceed to the GC for verification of the initial results. Passing the GC analysis earns the tank a shrink-wrapped valve and a place among the "Specialty Gas" family.

Our Ultra High Purity Helium must meet the following specifications:

Moisture (H_2O)……<1.0 ppm
Total Hydrocarbons (THC)……..<0.5 ppm
Oxygen ……<1.0 ppm

By contrast, Industrial Grade Helium may have many hundreds or even thousands of ppm of each contaminant.

Saving a few dollars on gas purchases might seem like a wise decision but replacing a Specialty Gas with an Industrial Gas in order to save a few dollars upfront may end up costing the user more money downstream. To continue with our helium example, using Industrial Grade Helium in a GC can jam the columns with moisture in the hundreds or thousands of parts per million and render the test results useless. Hydrocarbon contamination in excess of Ultra High Purity levels may cause additional problems. This scenario may necessitate any or all of the following: a repeat of the failed GC analysis, repeat processes and repair work on the GC, along with replacement of the gas cylinder and a considerable dose of aggravation for the end user.

So we now have the right Ultra High Purity Helium in our lab and we are ready to deliver it to our process. What about the pressure regulator that goes on the tank? Industrial Grade regulators commonly use neoprene diaphragms that can contribute hydrocarbon contamination. They also have very low leak integrity and can draw atmospheric moisture and oxygen into the gas stream.

A good choice for our UHP Helium is a pressure regulator that has a leak integrity of 1×10^{-9}. It will also have stainless steel diaphragms and Teflon and Tefzel seats and seals. This regulator will maintain the integrity of the UHP Helium and deliver it to the process without a degradation in quality. Lastly, don't forget the process line. For our UHP Helium we would require a stainless steel-cored, stainless steel hose. A standard stainless steel pigtail is commonly Teflon-lined and our very fine helium molecules will find their way right through the Teflon.

In summary, the following table presents a quick comparison of Specialty and Industrial Gases:

	Specialty Gas	**Industrial Gas**
Contaminants	Moisture <1.0 ppm THCs <0.5 ppm Oxygen <0.5 ppm	no specifications; moisture, THCs & oxygen levels vary widely
Cylinder Prep	eight-hour bake and purge process with final high vacuum	none
Regulator	machined & polished body, stainless steel diaphragms, Teflon & Tefzel seats and seals; 1×10^{-9} helium leak integrity	forged brass body, neoprene diaphragms, rubber seats and seals; bubble-tight leak integrity
Process Line	stainless steel or appropriate grade of metal tubing	rubber hose

Now, you have the right grade of gas, the right regulator and the right hose to deliver the gas to the process. What's left to do? Partner your business with a gas company that has the answers to your questions and people in the field with a broad knowledge base regarding the products they sell and the equipment you use; and be sure there is an elevated level of service that goes along with your gas purchases.

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