Custom Solutions Group LLC
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Industrial and Specialty Gases

Industrial and specialty gases are high purity gases and gas blends manufactured specifically for use in industry. The bulk gases include, but are not limited to: helium, hydrogen, argon, oxygen, nitrogen, air, methane, carbon monoxide, carbon dioxide, nitrous oxide, ammonia, and acetylene, to name a few. These gases have a variety of uses across a variety of industries.

Liquefied forms are commonly used for cryogenic cooling. These include helium, hydrogen, argon, oxygen, nitrogen, and carbon dioxide. Industrial and specialty gases also include gas blends, such as those used for reference standards in measurement and instrumentation, or highly specialized bulk gases for narrow market niches. Medical gases, refrigerant gases, and welding gases are all examples of industrial and specialty gas.

Custom Solutions Group LLC provides a wide variety of high quality solutions for industrial and specialty gas chromatography. Our customized gas chromatographs meet and exceed the standards set by the Gas Processor Association (GPA), the American Society of Test and Measurement (ASTM), the Compressed Gas Association, U.S. Pharmacopeia (USP), and the Air Conditioning, Heating, and Refrigeration Institute (AHRI).

For the analysis of trace impurities in high purity gas, the Pulsed Discharge Helium Ionization Detector (PDHID) is the preferred, universal, trace detector. Other more selective trace detectors, such as the Flame Ionization Detector (FID), the Electron Capture Detector (ECD), and element-specific detectors, are also used for more selective trace analysis.

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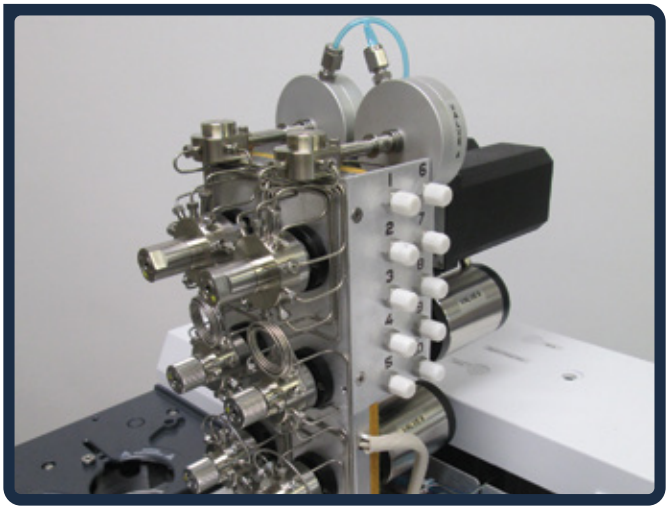
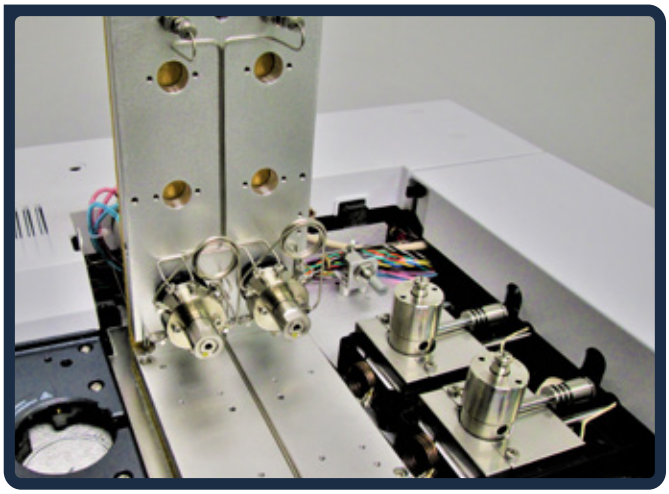
Fractional percent and percent level blends are often analyzed via Thermal Conductivity Detector (TCD). Special separation techniques and special detection techniques are used depending on the bulk gas, and multi-purpose trace analyzers are available. Special services for FDA and USP regulated systems are also available. All systems emphasize simplicity, serviceability, functionality and the highest quality construction, Made-in-the-U.S.A.



Trace Impurities Analysis via Pulsed Discharge Helium Ionization Detector (PDHID)

The Pulsed Discharge Helium Ionization Detector (PDHID) is the premier, trace gas detector in use in the world today. The PDHID is a non-radioactive, mostly non-destructive, universal detector that can analyze permanent gas impurities down to low parts-per-billion. For organics, the PDHID can achieve linearity of up to five orders of magnitude, and because it operates via the well-known Hopfield emission, it can detect almost any compound, except for neon. For neon, Custom Solutions Group modifies the operation of the PDHID for greater neon ionization efficiency. The Model D2 also has a non-radioactive electron capture mode for the selective analysis of trace electron capturing compounds.

This model is switchable between the electron capture and helium ionization modes. All helium ionization modes can be doped for greater selectivity, including: (1) argon doping for organics, (2) krypton doping for unsaturates, and (3) xenon doping for polyaromatic hydrocarbons.



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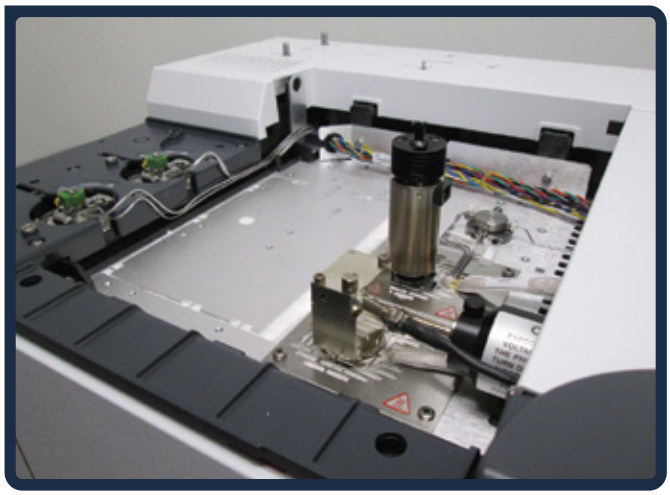
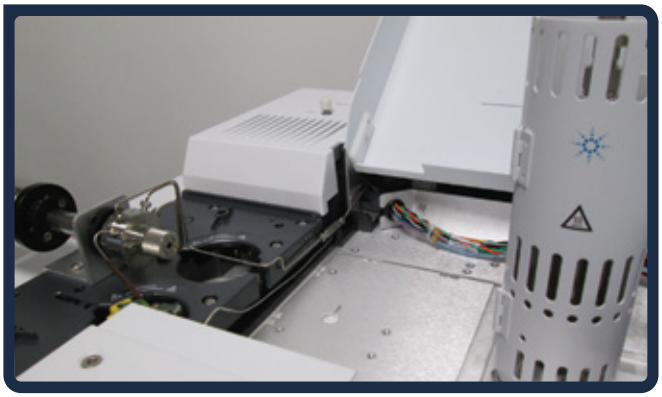
Trace Impurities Analysis via Other More Selective Trace Detectors

Because the PDHID produces such a large response for the bulk gas, it is often necessary to backflush or heart cut the bulk gas to vent. If that is not possible, then a more selective detector must be used. The Flame Ionization Detector (FID), often coupled with a Jetanizer or methanizer for the trace analysis of carbon monoxide and carbon dioxide, is frequently used to provide more selectivity than the PDHID for organic compounds. Methanizers are high temperature, nickel oxide catalysts in a hydrogen atmosphere. They convert traces of carbon monoxide and carbon dioxide to methane. The methane is subsequently analyzed via FID, thus lowering detection limits compared to TCD. The nickel oxide catalyst in the methanizer is protected from contamination by either backflush or methanizer bypass.



Other trace detectors include: (1) The Electron Capture Detector (ECD), which is highly selective toward electron capturing compounds, (2) the Sulfur Chemiluminescence Detector (SCD), which is highly selective toward trace sulfur-containing compounds, and (3) The Nitrogen Chemiluminescence Detector (NCD), which is highly selective toward trace nitrogen-containing compounds. Two other detectors, the Flame Photometric Detector (FPD) and the Pulsed Flame Photometric Detector (PFPD) are commonly used in the sulfur and phosphorous modes, but the PFPD has a couple of dozen unique, elemental operating modes. Each of these detectors has its own advantages and disadvantages. Custom Solutions Group listens to our clients and works with our clients to determine what combination of detection is best to meet the client's analytical needs and budget.



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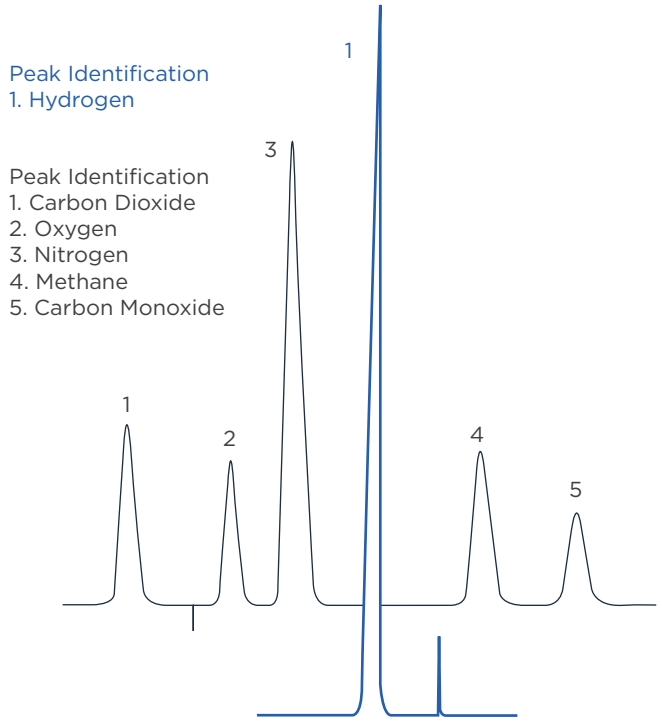
Permanent Gas Analyzer and Permanent Gas Analyzer with Hydrogen Analysis

Permanent gas analyzers are used to analyze blends of fractional percent and percent level organic and inorganic gases. This is especially relevant to calibration gas blends, medical gas blends, and other gas mixtures. The Permanent Gas Analyzer with Hydrogen Analysis utilizes a single Thermal Conductivity Detector (TCD) on helium carrier. Common analytes include argon/oxygen, nitrogen, methane, carbon monoxide and carbon dioxide. The C2's, including ethane, ethylene, and acetylene, as well as hydrogen sulfide, propane, and propylene, can be added with the addition of run time in the bypass position.



Hydrogen can also be analyzed in a narrow range of concentrations via TCD on a helium carrier, but due to thermal conductivity effects for binary mixtures of helium and hydrogen, argon and nitrogen are the preferred carriers for hydrogen analysis, especially for high and broad ranges of hydrogen. As a result, the Permanent Gas Analyzer with Hydrogen Analysis utilizes a second TCD on argon or nitrogen carrier. Finally, for systems with high or varying levels of hydrogen and other permanent gas analytes above part-per-million levels, a single channel argon TCD can be used.

For permanent gas analysis, backflush and series-bypass are used to: (1) protect the molecular sieve columns from contamination, (2) allow elution of all desired components to TCD, and (3) speed run time. Materials are used to allow the simultaneous bake-out of molecular sieve materials without the need for a second bake-out oven and without the need to remove porous polymer columns from the same temperature zone, thus making molecular sieve maintenance simple and easy.

Custom Solutions Group's Permanent Gas Analyzer and Permanent Gas with Hydrogen Analysis Analyzer meet or exceed the performance criteria as specified in ASTM D1946.

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Trace Impurities in Helium

Because the PDHID is a helium ionization detector and it does not produce a response for helium in the sample, trace impurities in helium are the easiest of all the bulk gases. Only one detector is required, the PDHID, but two PDHID's can be used to speed the run time and enhance separation selectivity.

Trace Impurities in Hydrogen

The preferred analytical solution for the analysis of trace impurities in bulk hydrogen is through the use of a Hydrogen Diffusion Device (HDD). The HDD removes hydrogen from the effluent stream downstream of the gas injection valve, thus eliminating interference for analysis of argon and nitrogen, which elute after hydrogen on a molecular sieve. This greatly simplifies hydrogen analysis and shortens analytical cycle times, negating the need for any column oven cryogenics when argon and nitrogen must be analyzed down to single-digit parts-per-billion.

Trace Impurities in Nitrogen

Similar to trace impurities in argon, a dual channel system can be used with PDHID and Jetanizer or methanizer/FID. No cryogen is necessary. Argon and oxygen separations are available on request.

Trace Impurities in Argon

This analyzer utilizes both PDHID and Jetanizer or methanizer/FID. No cryogenics are necessary to separate trace nitrogen from bulk argon. Oxygen may be analyzed via Oxygen Analyzer or via Plasma Emission Detector (PED) in the argon ionization mode. The Jetanizer/FID is used to gain selectivity for carbon monoxide, methane, and carbon dioxide.

Trace Impurities in Oxygen

The preferred analytical solution for the analysis of trace impurities in bulk oxygen is via the use of the DeOxy Device (DOD). The DeOxy Device removes oxygen from the effluent downstream of the gas injection valve, thus eliminating interferences for analysis of trace argon down to single digit parts-per-billion. Again, no column oven cryogenics are required.

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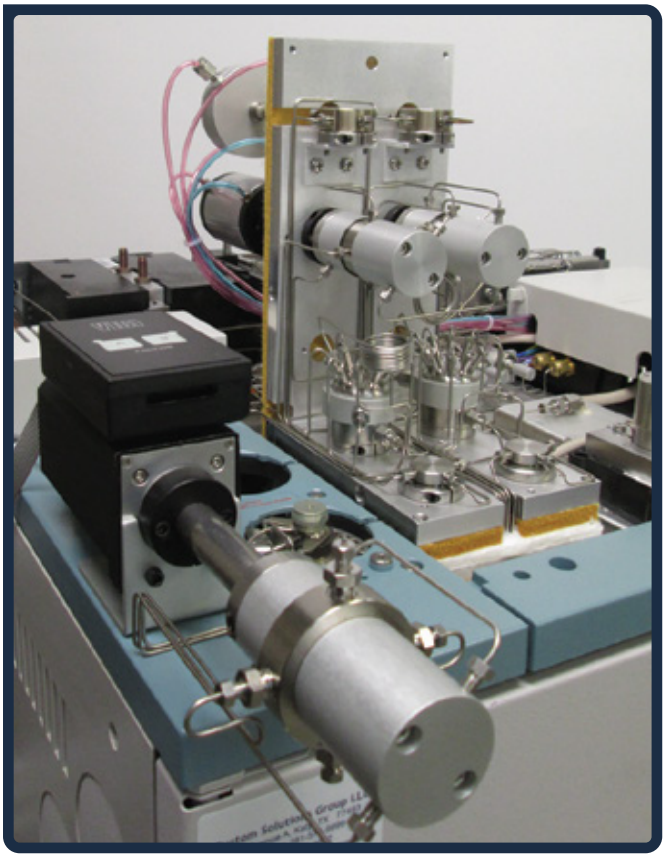
Trace Impurities in Carbon Monoxide

The analysis of trace impurities in carbon monoxide utilizes a combination of fore-flush, backflush, PDHID and TCD detection. The use of the TCD depends on the purity of the carbon monoxide. With PDHID and TCD detection, both crude and ultra high purity can be tested.

Trace Impurities in Carbon Dioxide

The analysis of trace impurities in carbon dioxide is different because carbon dioxide is often analyzed as beverage-grade for the beverage industry. Since this type of high purity carbon dioxide is used for human consumption, special requirements are in effect. Specifically, the Compressed Gas Association specifies action limits for benzene, acetaldehyde, dimethyl ether, and methanol. Total organics, total sulfurs, and total aromatics are also of interest. Although the analysis of trace permanent gases in high purity carbon dioxide only requires one channel with the backflush of carbon dioxide to vent, another channel is required for the analysis of benzene, acetaldehyde, dimethyl ether, and other organics. If sulfur speciation is required, then a separate channel with sulfur-specific detection is required, too.



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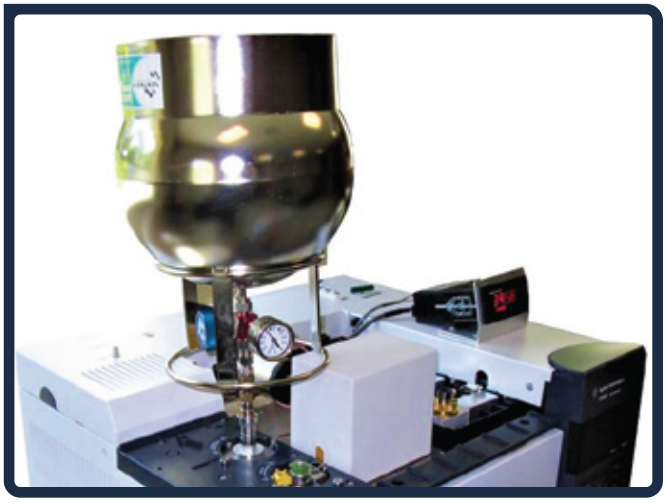
Special Services and Analytical Automation

Custom Solutions Group provides special services and analytical automation for our industrial and specialty gas clients. Special services include statistical gauge repeatability and reproducibility studies, USP-style validations for medical gases, and IQ/OQ certifications for products governed by the FDA. Custom Solutions Group can also provide automated and customized certificates of analysis, thus eliminating data transfer errors, inefficient uses of labor, and delays in reporting and shipments.

All Custom Solutions group gas analyzers can be adapted to automated, unattended operation, multiple stream analysis, and on-line continuous operation. A variety of software and tools are available to serve these purposes. Custom Solutions Group provides the best software, the best tools, and the best solutions in industrial and specialty gas analysis, including analytical automation.



Conclusion

Custom Solutions Group offers the widest variety of high quality solutions in industrial and specialty gas chromatography. Custom Solutions Group analyzers feature simplicity, serviceability, functionality and the highest quality construction, made-in-the-U.S.A.