An Overview of Trace Analytics, LLC

an A2LA Accredited Laboratory

The Advantages of Selecting Trace

Trace Analytics, LLC is a small, minority- woman-owned corporation that was established in November of 1989. Our accredited laboratory facilities and personnel are dedicated to the sole purpose of providing compressed air quality analyses to dive facilities, fire departments, government, and general industry users. This focus allows us to dedicate all of our resources to constantly improve services to our customers.

Since we do not sell compressors, filters, or provide maintenance services to our customers, you can be assured that Trace does not have a conflict of interest and will provide an unbiased, third party analysis. We currently provide air quality analyses to over 3000 customers worldwide, and we have over 100 service distributors nationwide. And all the major high pressure compressor manufacturers use Trace as their testing laboratory.

Accredited Laboratory Facilities

Trace's laboratory is accredited by the *American Association for Laboratory Accreditation*, certificate #0322-01. Accreditation is in accordance with *ISO 17025: General Requirements for the Competence of Testing and Calibration Laboratories*.

Trace's laboratory facilities are located at 15768 Hamilton Pool Rd. on 25 acres outside of Austin in the beautiful hill country. The 2400 sq. ft. of facilities include offices, shipping and receiving, and laboratory areas. We have an additional 2000 sq. ft. housing a kitchen and gym for employee use and additional storage facilities.

Trace's laboratory equipment is exclusively used for the analysis of compressed air quality samples. We use the following analytical equipment:

- Agilent Model 5973 Gas Chromatograph-Mass Spectrometer
- Agilent Model 5840 Gas Chromatograph
- Sartorius Analytical Micro Balance
- Mettler Model SAG340 Analytical Balance
- Meiji Techno Model ML 7000 Microscope.

Analytical Techniques & QC Procedures

Trace's Quality Assurance program has been established in accordance with the requirements of *ISO 17025: General Requirements for the Competence of Testing and Calibration Laboratories*.

In selecting analytical techniques for compressed breathing air testing, Trace considered the full range of available options in state-of-the-art analytical equipment. To meet our goal of providing the customer with a superior service while remaining cost-effective, we established criteria for the analytical techniques to be utilized.

The Analytical Techniques must:

1. Provide selectivity sufficient to analyze all standard air components;
2. Provide acceptable accuracy and precision;
3. Provide the capability to analyze a broad range of air components and contaminants as required by the customer;
4. Provide sensitivity sufficient to measure at least to 1/10 of the lowest standard;
5. Use as little of sample as possible to reduce shipping constraints;
6. Be capable of calibration traceable to *National Institute of Standards and Testing (NIST);*
7. Be quick enough to allow a full complement of quality control (QC) samples to be run daily; and
8. Allow for rapid turnaround of samples.

Of all techniques surveyed, only one combination would allow us to accomplish these goals; gas chromatography (GC) coupled with two different detectors in parallel; a ionization detector (FID) and a mass spectrometer. The robotic features of the autosampler attached to the GCMS allows us to process hundreds of samples daily.

Trace's laboratory complies with *NFPA 1989 Standard on Breathing Air Quality's* requirements for accreditation, sampling and analytical techniques/procedures, and *OSHA 29 CFR 1910.134* for recommended analytical techniques for the analysis of compressed breathing air, which refers to the *CGA G-7.1 Commodity for Air*.

Gases/Vapors: In complying with the CGA standard, Trace uses a modification of the analytical method employed by the *Mine Safety and Health Administration (MSHA)* for breathing air to include analysis of oxygen, nitrogen, argon, krypton, carbon monoxide, carbon dioxide, methane, total hydrocarbons, halogenated solvents, and water vapor. This method employs the analytical technique of gas chromatography by *CGA G-7.1*.

Oil Mist: The CGA refers to a gravimetric method for the determination of oil mist, for which Trace employs a modification of NIOSH method 0500. This method involves weighing the before and after sampling. Since this method determines all material collected on the (not only oil mist) Trace offers an alternative method, a modified NIOSH 5026, in which oil mist alone is determined by extracting the air with a solvent and re-weighing. This additional test is performed whenever the

initial sample results are > 5.0 mg/m³. This test, which is required by NFPA 1989 (but not by CGA) is included in our routine analysis at no extra cost. This provides our customers with additional help in determining the source of contamination.

Particle Size: Particle size is determined by optical microscopy using a of NIOSH 7400 with size calibration performed with each set of analyses on certified 2.0 mm diameter spheres. Qualitative analysis based on morphology and other appearance factors is performed at the customer's request for an additional cost. While not conclusive this process may give a good indication as to the types of particles present. Particle size is one of the requirements for *American Nitrox Divers International (ANDI)* air specification and is not a routine test.

Internal Quality Control: Prior to sample analysis, analytical instruments are calibrated with NIST-traceable standards over the entire range of interest. Media blanks are analyzed in exactly the same manner as samples to ensure contamination-free results. With each set of calibration data, a separate set of certified NIST-traceable standards are employed to determine an estimate of uncertainty (derived from accuracy and precision data) for samples analyzed.

Estimate of Uncertainty: Estimate of uncertainty is determined in an ongoing manner and updated daily to ensure that the quality of the data provided to customers is sustainable and ongoing. Estimate of uncertainty combines accuracy and precision data to provide a confidence interval in which the analytical data falls 95% of the time (95% interval).

Method Validation: A series of exhaustive experiments are carried out to ensure that both the sampling and analytical methods are acceptable. Sampling media are with NIST-traceable standards, subjected to the same travel and holding conditions as real world samples, and results are determined for a whole range of parameters used to validate the methods.

The method validation determines accuracy, estimate of uncertainty, limit of detection, limit of quantitation, linearity, precision, range, robustness, ruggedness, and specificity.

SUMMARY CHART OF TECHNIQUES

Component	Analytical Technique[1]	Typical Accuracy[2] Rel. / Abs.		Lower Limit of Detection
Carbon Dioxide	GC-M-FID	3%	30 ppmv	4 ppmv
Carbon Monoxide	GC-M-FID	3%	0.3 ppmv	0.1 ppmv
Halo. Hydrocarbons[3]	GC-MS	5%	0.2 ppmv	0.1 ppmv
Ind. Hydrocarbons[3]	GC-MS	5%	0.2 ppmv	0.02 ppmv
Methane	GC-FID	3%	0.7 ppmv	0.2 ppmv
Nitrogen	GC-MS	.7%	0.9%	0.2 Vol%
Oil Mist & Particulates	Gravimetry	0.2%	0.02 mg/m³	0.01 mg/m³
Particle Size[4]	Microscopy	n/a	n/a	0.5υm
Oxygen	GC-MS	0.4%	0.08%	0.03 Vol%
Total Hydrocarbons	GC-FID	3%	0.7 ppmv	0.2 ppmv
Water Vapor	GC-MS	9%	2 ppmv	3 ppmv

1 1GC-Meth-FID: Gas Chromatography Methanizer/-Flame Ionization Detection
GC-MS: Gas Chromatography-Mass Spectrometry
GC-FID: Gas Chromatography-Flame Ionization Detection

2 Typical Accuracy Levels: Relatative / Absolute

3 Halogenated Hydrocarbons: The above Summary Chart includes additional analytes (halogenated solvents and individual hydrocarbons such as Freon® and trichloroethylene). These analytes are not required by CGA or NFPA. They are listed because they can be routinely analyzed by Trace without additional sampling containers or preparation.

4 If particle size determination is required, prior arrangements must be made since it requires a different filter, air specification, and an additional analysis. The Lower Limit of Detection is expressed in microns (µm).