

Selection Criteria

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The cornerstone to Trace's air testing and analysis program is its sampling equipment – **the AirCheck✓Kit™**. Providing results that are both accurate and precise are directly related to how well the sample is obtained. In selecting a design for our sampling equipment, we considered the full range of available options in state-of-the-art sampling techniques. The following is a review of typical methods used in the industry.

High pressure cylinders/containers – either full size SCUBA/SCBA (2216/4500 psi), or the smaller version, commonly referred to as pony bottles. These type of containers present several problems. First, they cannot be used to accurately determine condensed hydrocarbons (oil mist and particulate matter). Most air specifications have a limit for oil mist. A few, like the U.S. Navy Diving Standard and NFPA 1989 Standard on Breathing Air Quality also include particulates. This is an important aspect of an analysis of breathing air, even though particulates are not currently included in CGA specifications. Particulates can be present in an air supply and cause difficulty in breathing by the user and/or equipment problems. Particulates commonly found include rust, dirt, small pieces of metal, plastic residue, and packing material found in purification cartridges such as charcoal. Also, if oil mist is being generated by a compressor, it will tend to adhere to the sides of the cylinder wall. Simply passing the air from the sample container/cylinder across a filter is insufficient because the majority of the contamination either did not enter the cylinder or if it did, will not be passed back through across the filter.

Another significant consideration in eliminating this sampling method was the overall size, weight, and related shipping constraints. A pressurized cylinder must be declared as a hazardous material. This increases cost and inconvenience to the customer.

And finally, cylinders used to obtain samples must be sterile to avoid potential contamination from within, especially if the cylinder is provided by the customer. If the laboratory sends its own cylinder (pony bottle) then it must establish and maintain a strict QC procedure to assure that containers are free from contamination which can occur from previously contaminated samples and from introducing excess moisture. If a customer uses their own SCBA or SCUBA bottle as a sample container, they must also assure that the cylinder is free

Review of Air Sampling Methods

from previous contamination. An SCBA or SCUBA bottle is an extremely expensive routine sample container.

Gas sampling bags – such as Teflon®, Mylar®, Tedlar®, or similar bags. Gas sampling bags were ruled out by Trace because they are more prone to loss of the sample due to permeation. This issue was addressed by Jimmy L. Perkins, "Gases & Vapors — Bags, Rigid Container and Impingers" Industrial Hygiene News, July, 1997, p. 4. Another major reason we chose not to use bags is because contents of a single layer bag must be analyzed within 24 hours to assure the integrity of the sample results. Only 10 layer bags are recommended by OSHA for storing samples longer than 24 hours (see "Carbon Dioxide Backup Data Report (ID-172)," Occupational Safety and Health Administration Technical Center, revised June 1990. Bags can also easily rupture during filling, handling and/or shipping, be difficult to purge out adequately, and are bulkier in size than Trace's small 20 ml sampling vials. Using tubing to connect the pre-weighed filter to the sampling bag must be done carefully to maintain the integrity of the sample and the accuracy of the results. Tubing should not be placed between the air source and the filter because it can capture oil mist prior to reaching the filter causing test results for oil mist to be inaccurate.

Detector tube kits – available from numerous manufacturers. These were eliminated immediately since they are not capable of providing the level of accuracy that we believe is necessary when certifying air for life support. Manufacturers of detector tubes frequently state that results are precise within $\pm 20\text{--}30\%$. Many people interpret precision and accuracy to be the same – they are not. Upon reading the major manufacturer's guide book, these precision factors are presented using a 68% Confidence Interval. These numbers are frequently mistaken for accuracy. See the AirCheck✓note on Moisture Analysis for further discussion on accuracy, precision, and Confidence Intervals.

There are some laboratories that use detector tubes for water. Trace does not.

the AirCheck✓Kit - available from Trace

Trace uses a 95% Confidence Interval when determining its accuracy factors. A 95% Confidence Interval means that the Quality Control results lie within the



range noted 95% of the time. This is a standard laboratory method for determining accuracy levels. Using a 68% Confidence Interval gives the appearance that results are much better than they really are. **A 30% result using a 68% Confidence Interval can be extrapolated to approximately ±60% using a 95% Confidence Interval.**

The AirCheck✓Kit allows end users to easily obtain a sample and then conveniently and inexpensively ship to Trace’s laboratory for a complete analysis according to the requested air specifications.

Gases & Vapor Determinations. Trace’s flow- through design allows for a small portion of air (20 ml) to be obtained in a glass vial. Only two ml are required for an analysis of all pertinent gases and vapors. Trace selected a self-sealing proprietary polymer septum (stopper) on the vial to eliminate problems with the customer remembering to use a combination of sampling and sealing caps used by other test kits on the market. This has proven to be beneficial to our international customers sending samples through customs. (Our sample containers are clear and can be inspected without damage.) These septa are discarded after single use to ensure that cross-contamination or inadequate sealing does not occur as with other non-sealing septa. This method reduces the possibility of undetected tampering of the sample. Each septum is visually inspected upon receipt from the customer to ensure the integrity of the sample.

We have performed extensive validation studies that show that the glass vials hold a known quality of air with no serious loss or gain of moisture, as well as other gases of interest. The study tracks results for 0, 7.5, 15, 30, 45, and 60 day holding periods. This validation study is repeated as required by method changes but at least every 5 years. A copy can be provided upon request.

Oil Mist Determination. Trace’s kit utilizes a 37 mm pre weighed polycarbonate track etched (PCTE) membrane filter inside a cassette to obtain condensed hydrocarbons (oil mist) and particulate matter. The polycarbonate filter is hydrophobic which means that it repels collection of water and has been shown to collect >99.99% of 0.3µm aerosol. Trace sample collection and analytical methods comply with NFPA 1989 Standard.

And finally, the kit design uses a flowmeter to accurately measure the volume of air that crosses the filter (a requirement for filter analyses). A flowmeter (NIST traceable) was chosen because unlike inexpensive pressure gauges; a flowmeter will maintain an accurate reading even if dropped, jarred, or over-pressurized. Flowmeters do not require calibration to maintain reliability.

Trace Analytics, Inc. designed **the AirCheck✓Kit** to be simple to use yet sophisticated enough to comply with the best of industrial hygiene sampling methods.

Selection Criteria

Each laboratory that routinely provides air analyses has its own sampling equipment. When selecting a laboratory; carefully evaluate the laboratory and its sampling equipment. Factors to consider include:

Laboratory benefits

- Accreditation per NFPA 1989 requirements
- Report turn-around time
- Accuracy and precision of test results
- Participation in Proficiency Testing Program
- Availability of Method Validation Report
- Expertise in your field of interest

Sampling Kit features

- Technically sound design
- Ease-of-use
- Compliance with air standard requirements
- Ready supply of equipment and sampling media
- Availability of Sampling Validation Report
- If detector tubes used, determine if lower accuracy rates acceptable to your operation
- Shipping ease
- Product Liability Insurance

Please feel free to contact your **AirCheck✓Team of Experts** with your technical questions.

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