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WBEA – Standard Operating Procedure			
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Introduction and Background

This document is intended to be used as a reference for the maintenance and operation of zero air generators for calibration of ambient air quality monitoring analyzers. This procedure is intended to be used in conjunction with the manufacturer's operations manual.

This SOP adheres to the requirements of the current Air Monitoring Directive (AMD) finalized by Alberta Environment in 1989. In some cases the limits and specifications exceed the requirements of the current AMD. It should be considered that the current and any future amendments or drafts of the AMD will be used as the benchmark for requirements and criteria for ambient air monitoring practices conducted in the WBEA network. Information used to write this procedure was also taken from sources identified in the reference section.

Principle of the Method

Zero Air generators must be able to supply dry, contaminant free air for the use of zeroing and diluting air quality analyzers. The first process to producing clean, high purity zero air is to draw ambient air into the unit and pressurize it. A compressor is used at the rear bulkhead to draw in and pressurize air, this process increases temperature, to reduce the temperature the air is immediately moved through a coil of copper tubing with cool air being drawn past by a fan. As the compressed air cools it becomes super-saturated with water vapor. A two stage water removal process is used to completely dry the air. First a coalescing water filter, then a two stage descant drier system. Once the compressed air has been dried it is stored in a compressed air cylinder with a maximum pressurization limit of 80 PSI. Here, control valves keep the reservoir full by keeping the cylinder at a steady pressure so the out flow is at a constant rate, usually 35 psig. In out flow stages of the unit there are several configurations that may be selected depending on the parameter which the unit is being used for. For hydrocarbons and carbon monoxide a catalytic oxidizer must be used to remove the compounds from the ambient air. These converters are heated to 70° Celsius for conversion of carbon monoxide to carbon dioxide and 300° Celsius for conversion of hydrocarbons to carbon dioxide and water vapor. It should be noted that Hydrocarbon converter temperatures will also scrub Carbon Monoxide. For SO₂, H₂S, NO_x and O₃, a combination of Purafill and activated charcoal will scrub the compounds out providing fresh mediums are being used and replaced at regular 12 month intervals. It is important to remember that Purafill must come before charcoal as it converts NO to NO₂ which can then be scrubbed by the charcoal. Units with converters must also use Purafill and charcoal filter mediums to ensure there are no other compounds which may affect analyzer baseline readings. After the scrubbers in most units a particulate filter with pores of 5 µm or less should be used to ensure no particulate matter from the scrubbers is present as dust from the charcoal may contaminate reaction cells and cause inaccurate readings.

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Measurement Range and Sensitivity

The out flow range of most zero air generators is dependent on the make and model as well as the regulator. The maximum output for the API 701 is 20 liters per minute (lpm) at 29 pounds per square inch gauge (psig). However the optimal use for calibration purposes should be 5 to 10 lpm at 30 psig.

In the WBEA network, these should be set to 50 psi when used for supply air for either the 51i or 55i Hydrocarbon analyzers.

Equipment and Apparatus

Teledyne Advanced Pollution Instrumentation 701 Zero Air Module.

Interferences

As zero air generators are used to give accurate baseline readings with less than 1ppb of compounds being analyzed interferences include any of the compounds to be scrubbed as well as particulate matter that may have been introduced to the air-stream.

To ensure that the scrubbers are functioning properly it is critical to replace filter mediums at semi-annual intervals. Catalytic converters are theoretically free of maintenance, however, in practice should be challenged with gas periodically to ensure efficiency and replaced if necessary. Particulate matter filters should be checked regularly and replaced if excess build up of dust occurs.


Water vapor is a major interference in most analyzers, ensure that coalescing water knock out and the drier are being drained and are functioning properly.

Periodically check connections throughout the system to ensure that there are no leaks. Replace or rebuild the pump annually to ensure steady pressure is provided to the unit.

Precision and Accuracy

The measurement precision is generally considered to be the “repeatability of the measurement”. The precision of the gas generated by the zero air module is maintained by diligent maintenance with scrubbers, filters and converters.

Accuracy is generally considered the “deviation from true”. This means how close it is to what it should be. The benchmark of “what it should be” is provided by the Alberta Environment Audit Program staff and the use of high quality standards such as available from the National Institute of Standards and Technology (NIST). The accuracy of the zero air unit is confirmed by the monthly calibrations and annual audits.

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Site and Installation Requirements

All WBEA stations have a zero air generator with which to calibrate the continuous analyzers. Filter media and thermal oxidizers should be selected to ensure the zero air produced is of calibration qualities with no interferences or analytes present after filtration.

The zero air generators also provide support air for Hydrocarbon analyzers and to switch valves on the 55i analyzer. The air provided as burner air for the hydrocarbon FID must also be of high quality. The pressures required by the Hydrocarbon analyzers are much higher than that required by the Sabio 4010 calibrator. To solve this issue, the zero air generator is set for an output pressure of 50 psi, and the output from the generator is teed at output to send zero air to the two sources. The supply pressure to the Sabio calibrator is reduced to 20 psi at that point using a stand alone regulator.

Zero Air units should be installed so that filter media is easily accessible as these will need to be maintained and regular intervals.

Operational and Maintenance Requirements

Zero Air Generators like most filtration systems need to have regular maintenance and oversight to ensure the system is properly scrubbing and “zeroing” the air. The following describes the basic procedures necessary to ensure high quality data through high quality standards.

Daily Requirements

Zero/Span Check – a zero/span cycle is required every day to verify the analyzer’s performance. Watch for drift during daily data checks, this may be a sign that the filter media is beginning to fail.

Annual Maintenance

Preventative maintenance tasks should be completed on the zero air generator on an annual basis. These tasks are outlined in the operations manual, but should at the least include:


- Verification of converter temperature setting and operation
- Verification of flow settings
- Replacement of Purafill and charcoal scrubbers


A strict regimen of these tasks should be adhered to as they are intended to maintain the high quality of the zero air. Any maintenance must be recorded in the Doc-It system.

Hydrocarbon Converter Maintenance

Catalytic converters are theoretically immune to spoiling, however, this is not true in practice. Watch daily data for signs of zero drift which may indicate the catalyst has become poisoned. Even if the zeros remain stable it is recommended that the catalytic converter be replaced every two years. Please refer to the operator’s manual for hydrocarbon catalytic converter removal and replacement.

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Reference Documents

- *MODEL 701 ZERO AIR GENERATOR*, TELEDYNE-API INC. San Diego, CA
- Alberta Air Monitoring Directive (1989)