

Laboratory Evaluation: Aeroqual S500-GSS

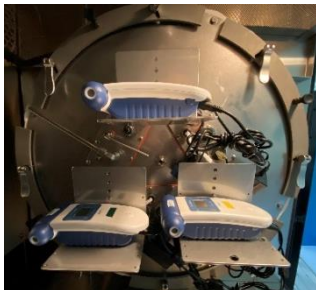


Background

Three **Aeroqual S500-GSS** sensors (units IDs: 1, 2, 3) were evaluated in the South Coast AQMD Laboratory under controlled Volatile Organic Compound (VOC) concentrations and climate conditions. The sensor measurements were compared with a reference instrument (Thermo Fisher Scientific, Model 55i; hereinafter **Thermo 55i**).

Aeroqual S500-GSS (3 units tested):

- VOC Sensor – Gas Sensitive Semiconductors (**GSS, Aeroqual, non-FEM**)
 - TVOC output range: 0-25 ppm
 - Accuracy of Factory Calibration: $< \pm 0.1 \text{ ppm} + 10\%$
 - Minimum Detection Limit: 0.1 ppm
 - Measurement interval: 1-min
- Each unit measures: VOC (ppb)
- Unit cost: ~\$1,650
- Units IDs: 1, 2, 3



Aeroqual S500-GSS

Reference Instrument*:

- **Thermo Fisher 55i**
 - Measures: methane (CH_4) and non-methane hydrocarbon (NMHC)
 - Unit cost: ~\$27,000
 - Specifications:
 - Measurement ranges: 0-50 ppm
 - Limit of Detection (LOD): 50 ppb
 - Analysis time: ~70 seconds
 - Accuracy: $\pm 1\%$ of range
 - Repeatability: $\pm 2\%$ of measured value or 50 ppb (whichever is larger)
 - Drift: $\pm 2\%$ of span over 24 hours
 - Ambient operating temperature: 15-35 °C
 - Sample temperature: ambient to 35 °C



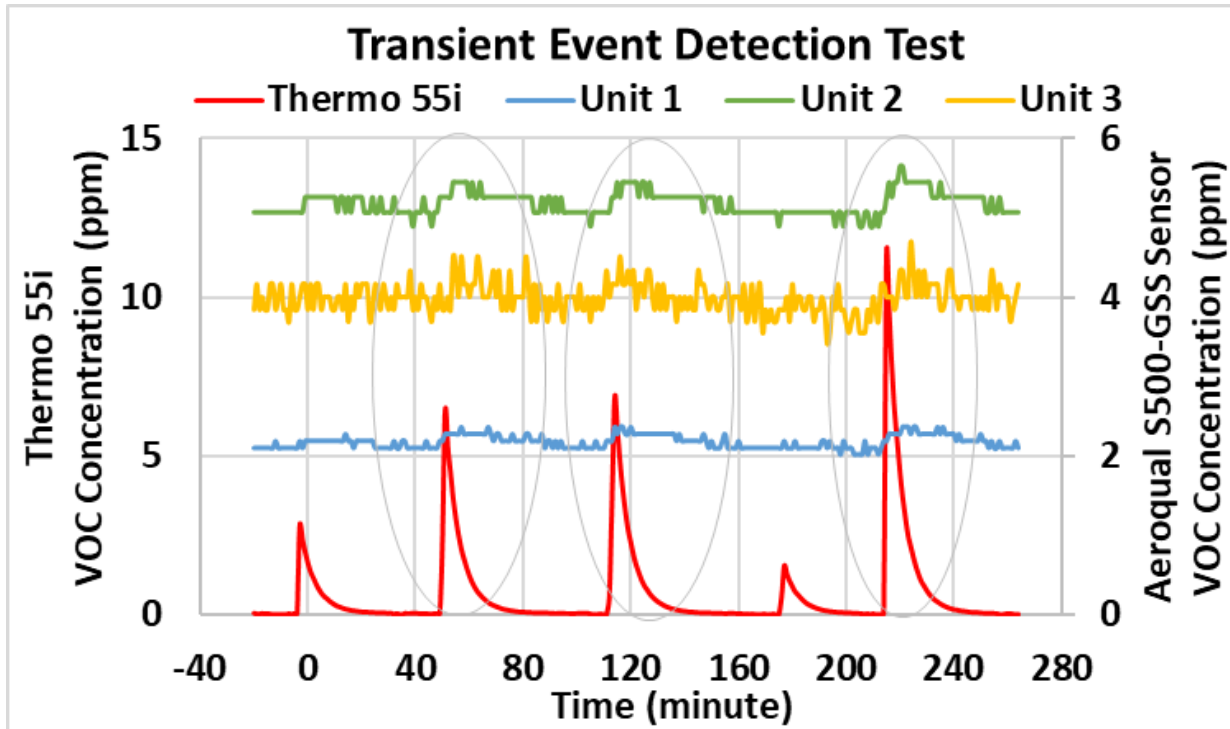
Thermo 55i

*An Agilent GC-FID is typically also used for reference measurements in the AQ-SPEC VOC sensor laboratory testing protocol. However, it was not needed for this evaluation as the testing was prematurely completed.

Phase 1: Transient Plume Detection

Testing Phase #1	Method	Parameters Evaluated
Transient Plume Detection	5 VOC plume events at various concentrations in randomized order	<ul style="list-style-type: none">• Response time• % of peak detection

Aeroqual S500-GSS vs Thermo 55i



- Sensor response to a transient event was determined to be successful if the sensor peak amplitude was at least 3 times the standard deviation of 20 consecutive pre-peak sensor values.
- The Aeroqual S500-GSS sensors responded to three of the five transient events (circled in the plot), which had VOC concentrations of at least 6 ppm as recorded by the Thermo 55i; there was no apparent response to VOC concentration events lower than 6 ppm by the Aeroqual S500-GSS sensors.

VOC Concentrations for Subsequent Test Phases

Testing Phase	VOC Concentration
1. Transient Event Detection	5 events at various concentrations up to 10 ppm in randomized order
2. Initial Concentration Ramping	Concentration ramping from 15 ppb to 8 ppm
3. Effect of Temperature and RH	Concentration held at 4 ppm while varying T and RH conditions
4. Effect of gaseous interferents	Concentrations held at either 4 ppm (with CO or CO ₂ as interferent) or 200 ppb (with O ₃ as interferent)
5. Outdoor Simulation	Concentrations from 200 to 400 ppb
6. Final Concentration Ramping	Concentration ramping from 15 ppb to 8 ppm

- The VOC concentrations used in most subsequent testing phases are less than 6 ppm. Based on the results from the Phase 1 Transient Event Detection test, the sensors did not proceed further to Phase 2 testing, which exposes sensors to VOC blend concentrations of 0.06, 0.2, 0.4, 1.6, 2, 4, 6, and 8 ppm.

Discussion

- **Data Recovery:** The Aeroqual S500-GSS sensors showed 100% data recovery for all experiments
- **Phase 1: Transient Event Detection**
 - The sensors responded to three of the five transient events. The sensors did not appear to show responses to VOC concentrations lower than 6 ppm as recorded by Thermo 55i.
 - The VOC concentrations required in the subsequent testing phases are generally lower than 6 ppm; based on the results from the Transient Event Detection test, the sensors will not proceed to further testing.