

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Evaluation Summary

Sensor Description

Manufacturer/Model:
Aeroqual/
S500 Particulate Matter Head

Pollutants:
PM_{2.5} and PM₁₀
mass concentration

Time Resolution:
1-min

Type: Optical



Additional Information

Field evaluation report:

<http://www.aqmd.gov/aq-spec/evaluations/field>

Lab evaluation report:

<http://www.aqmd.gov/aq-spec/evaluations/laboratory>

AQ-SPEC website:

<http://www.aqmd.gov/aq-spec>

- Overall, the accuracy of the Aeroqual S500-PM sensors was fairly constant (~30% to 53%) over the range of PM_{2.5} mass concentration tested. Overall, the Aeroqual S500-PM sensors overestimated PM_{2.5} measurements from FEM GRIMM in the laboratory experiments at 20 °C and 40% RH.
- The Aeroqual S500-PM sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The Aeroqual S500-PM sensors (IDs: 1, 2 and 3) showed low to moderate intra-model variability for the field and laboratory evaluations.
- Data recovery was ~ 100% from all units in the field and laboratory evaluations.
- For PM_{2.5}, the Aeroqual S500-PM sensors showed weak to moderate correlations with the corresponding FEM GRIMM and FEM T640 data in the field evaluations ($0.46 < R^2 < 0.70$) and very strong correlations with FEM GRIMM in the laboratory evaluations ($R^2 > 0.99$ for PM_{2.5}). For PM₁₀, the sensors showed very weak correlations with the corresponding GRIMM and T640 data ($0.19 < R^2 < 0.31$).
- The same three Aeroqual S500-PM units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

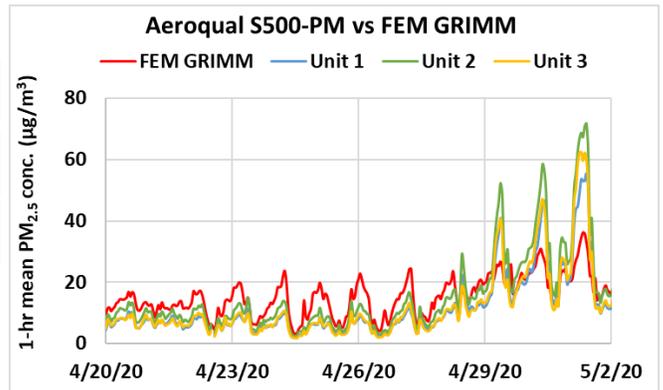
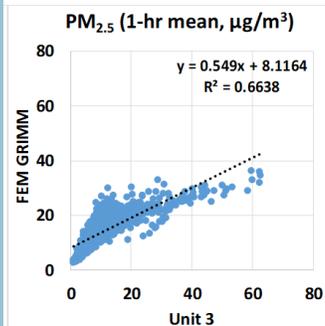
Field Evaluation Highlights

- Deployment period 04/17/2020 - 06/24/2020: the three Aeroqual S500-PM sensors showed weak to moderate correlations with the corresponding FEM GRIMM and FEM T640 for PM_{2.5} mass concentrations and very weak correlations with the corresponding GRIMM and T640 for PM₁₀ mass concentrations..
- The units showed low intra-model variability and data recovery was ~ 100%.

1-hr mean, all ref. inst.

PM_{2.5}: $0.46 < R^2 < 0.70$

PM₁₀: $0.19 < R^2 < 0.31$



Coefficient of Determination (R^2) quantifies how the three sensors followed the PM_{2.5} concentration change by the reference instruments.

An R^2 approaching the value of 1 reflects a near perfect agreement, whereas a value of 0 indicates a complete lack of correlation.

Laboratory Evaluation Highlights

Accuracy (PM_{2.5})

$$A (\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

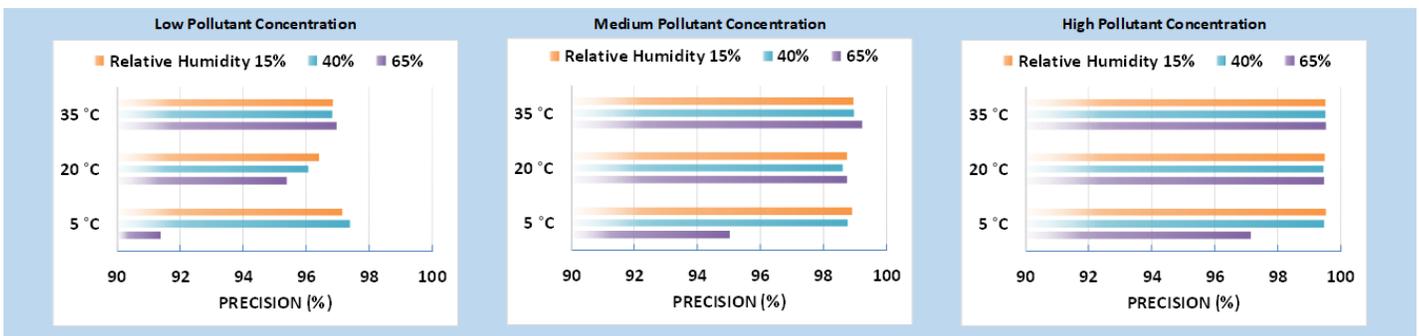
Steady state #	Sensor Mean (µg/m ³)	FEM GRIMM (µg/m ³)	Accuracy (%)
1	14.4	8.7	34.6
2	25.2	14.8	30.2
3	73.9	48.1	46.3
4	219.3	149.4	53.2
5	384.2	250.3	46.5

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40% RH. The sensor's readings at each ramping steady state are compared to the reference instrument.

A negative % means sensors' overestimation by more than two fold. The higher the positive value (close to 100%), the higher the sensor's accuracy.



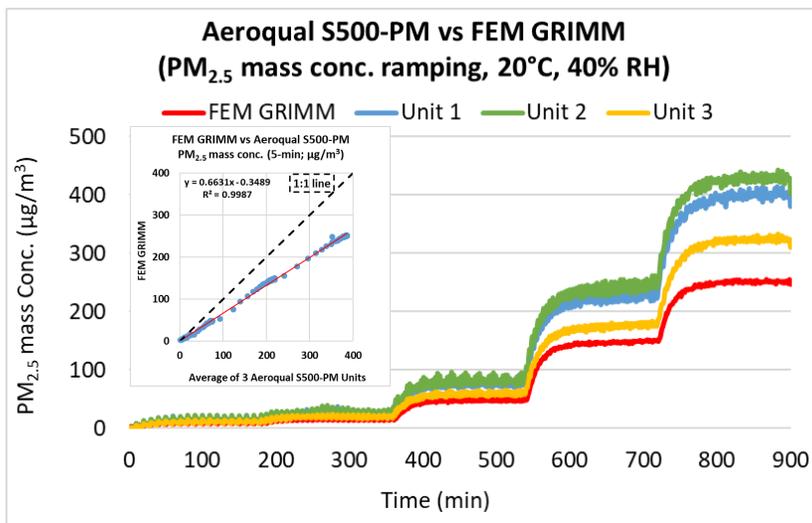
Precision (PM_{2.5})



100% represents high precision.

Sensor's ability to generate precise measurements of PM_{2.5} concentration at low, medium, and high pollutant levels were evaluated under 9 combinations of T and RH, including extreme weather conditions like cold and dry (5 °C and 15% RH), cold and humid (5 °C and 65% RH), hot and humid (35 °C and 65% RH), or hot and dry (35 °C and 15% RH).

Coefficient of Determination



The Aeroqual S500-PM sensors showed very strong correlations with the corresponding FEM PM_{2.5} data ($R^2 > 0.99$) at 20 °C/40% RH.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Aeroqual S500-PM sensors' precision. At the set-points of RH changes, the sensors showed spiked conc. changes for all PM levels at 5 °C and showed significant concentration variation for all PM levels at 5 °C/65% RH.

Observed Interferents

N/A



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