

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Purple Air PA-I

Pollutants:
PM_{1.0}, PM_{2.5}, PM₁₀

Measurement Range:
0 - 500 µg/m³

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>

Evaluation Summary

- Overall, the three Purple Air PA-I sensors showed low accuracy, compared to the reference instrument for PM_{1.0}, PM_{2.5}, and PM₁₀, for a concentration range between 0 to 320 µg/m³.
- The three PA-I sensors exhibited high precision during all tested environmental conditions.
- PA-I sensors showed low intra-model variability as well as good data recovery (99.9%).
- For PM_{1.0} and PM_{2.5}, the PA-I sensors showed strong correlations with the reference instrument from the field (PM_{1.0} R² > 0.85, PM_{2.5} R² > 0.90) and very strong correlations in laboratory studies (PM_{1.0} R² > 0.95, PM_{2.5} R² > 0.99). For PM₁₀, the PA-I sensors did not always follow the concentration change recorded by FEM instrument in the field (PM₁₀ R² > 0.39), however in the laboratory, the PA-I sensors followed the concentration ramping (increasing) change, reporting (PM₁₀ R² > 0.97).

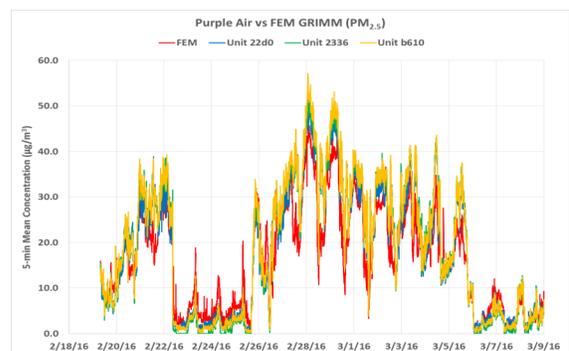
Field Evaluation Highlights

- Deployment period 02/19/2016- 04/19/2016: the three PA-I sensors showed strong correlations with the PM_{1.0}, PM_{2.5} concentration change as monitored by FEM instrument. PA-I sensors did not always follow the FEM PM₁₀ concentration change.
- The units showed 99.9% data recovery as well as low intra-model variability.

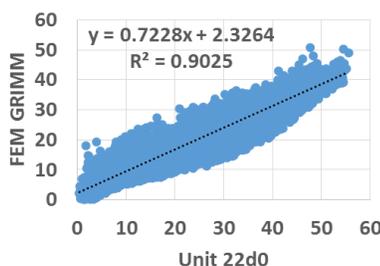
PM_{1.0} R² > 0.85

PM_{2.5} R² > 0.90

PM₁₀ R² > 0.39



PM_{2.5} (5-min Mean; µg/m³)



Coefficient of Determination (R²) quantifies how the three sensors followed the ozone concentration change by FEM.

An R² 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 $A (\%) = 100 - \frac{|\bar{X}-R|}{R} * 100$

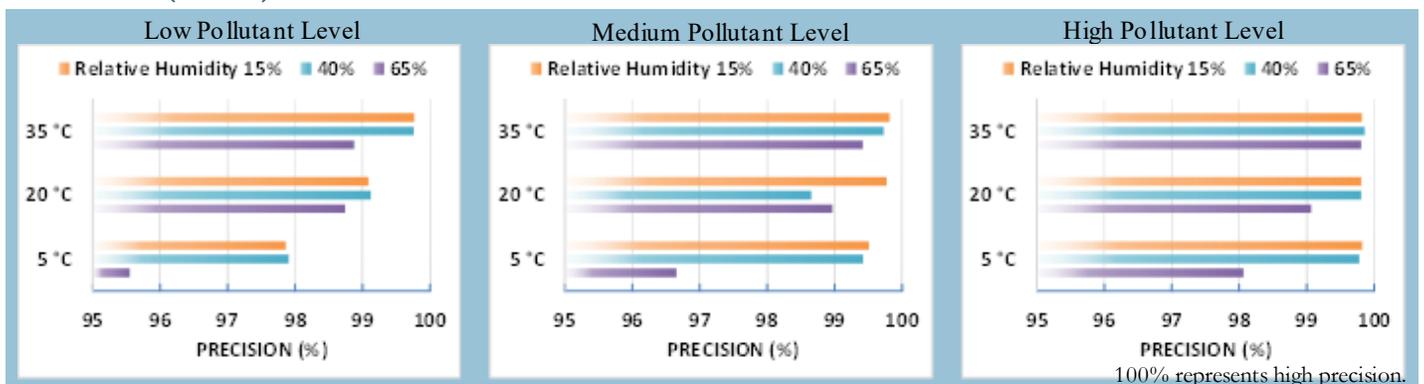
Steady State (#)	Sensor PM _{2.5} (µg/m ³)	FEM PM _{2.5} (µg/m ³)	Accuracy (%)
1	43.8	15.9	-74.8
2	96.5	33.4	-88.6
3	187.0	62.4	-99.7
4	505.4	167.6	-101.6
5	796.2	282.6	-81.7
6	866.9	322.1	-69.1

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

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

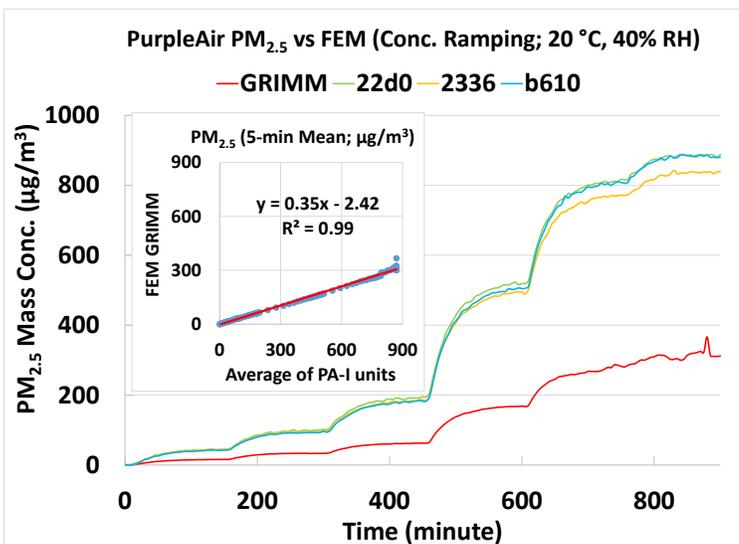


Precision (PM_{2.5})



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

Coefficient of Determination



The three PA-I sensors showed very strong correlations with the corresponding FEM PM_{2.5} data ($R^2 = 0.99$) at 20 °C and 40% RH.

For conc. ramping experiments of PM_{1.0} and PM₁₀, please see full length lab reports.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Purple Air PA-I units' precision in most cases. At the set-points of RH changes, PA-I reported spiked changes in concentrations.

Observed Interferents

Not tested for PM sensors



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