

# AQ-SPEC

## Air Quality Sensor Performance Evaluation Center

### Sensor Description

Manufacturer/Model:  
Alphasense OPC-N2

Pollutants:  
PM<sub>1.0</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>

Max Particle Count Rate:  
0 - 10,000 particles/sec

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:

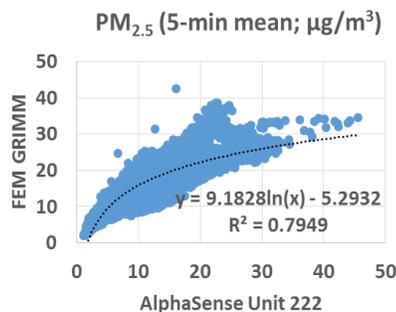
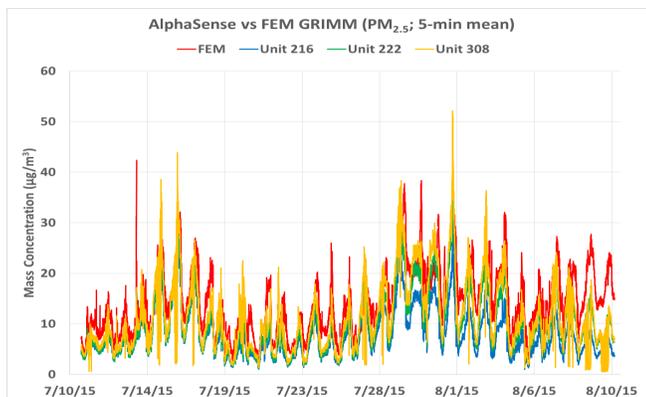
<http://www.aqmd.gov/aq-spec>

### Evaluation Summary

- The OPC-N2 units showed low accuracy for PM<sub>1.0</sub> and PM<sub>2.5</sub> (compared to GRIMM), but high accuracy for PM<sub>10</sub> (compared to APS and GRIMM), in the concentration range of 0 to 300 µg/m<sup>3</sup>.
- The OPC-N2 units exhibited high precision for most of the tested environmental conditions, except at low temperature and high humidity.
- Units 0508 and 1207 showed low intra-model variability as well as good data recovery (> 96%). Unit 1202 had significant data loss (up to 90%).
- For PM<sub>1.0</sub> and PM<sub>2.5</sub>, the OPC-N2 units showed weak to strong correlations with the reference instrument from both the field (PM<sub>1.0</sub>: R<sup>2</sup> ~ 0.63 to 0.82, PM<sub>2.5</sub>: R<sup>2</sup> ~ 0.38 to 0.80) and very strong correlations with GRIMM in the laboratory studies (PM<sub>1.0</sub> R<sup>2</sup> > 0.99, PM<sub>2.5</sub> R<sup>2</sup> > 0.99).
- For PM<sub>10</sub>, the OPC-N2 units did not always follow the concentration change recorded by reference instrument in the field (PM<sub>10</sub>: R<sup>2</sup> ~ 0.41 to 0.60), however in the laboratory, the OPC-N2 units followed the concentration ramping (increasing) change, reporting (PM<sub>10</sub> R<sup>2</sup> > 0.99).

### Field Evaluation Highlights

- Deployment period 07/10/2015- 08/10/2015: the three OPC-N2 units correlated well the PM<sub>1.0</sub>, PM<sub>2.5</sub> concentration change as monitored by GRIMM. OPC-N2 units did not always follow the FEM PM<sub>10</sub> concentration change.
- The units showed 100% data recovery and moderate intra-model variability.



Coefficient of Determination (R<sup>2</sup>) quantifies how the three sensors followed the PM concentration change by FEM.

An R<sup>2</sup> 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

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

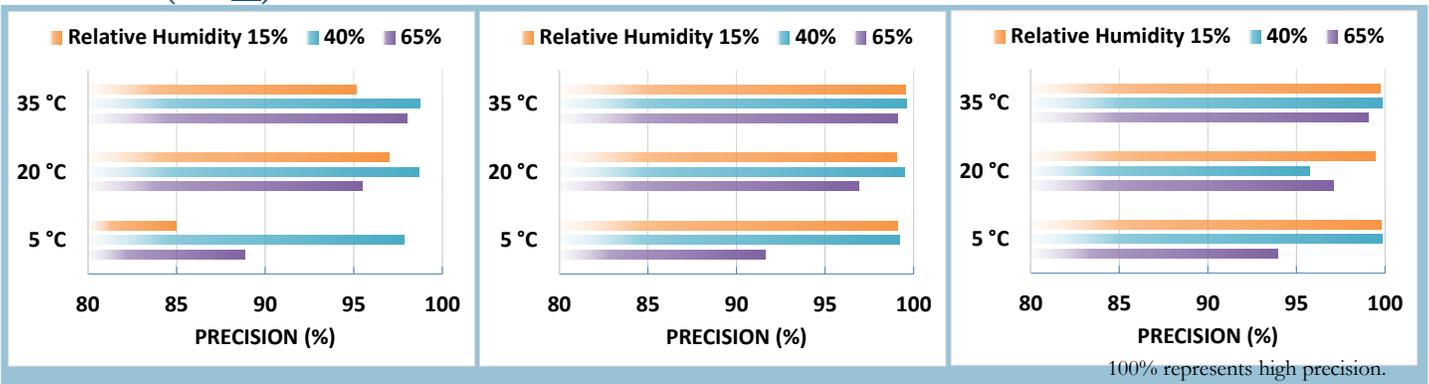
Steady State (#)	Sensor mean ( $\mu\text{g}/\text{m}^3$ )	FEM ( $\mu\text{g}/\text{m}^3$ )	Accuracy (%)
1	32.6	16.0	-3.9
2	93.0	39.9	-33.2
3	171.8	77.8	-20.9
4	382.6	193.3	2.1
5	545.8	299.5	17.8

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.

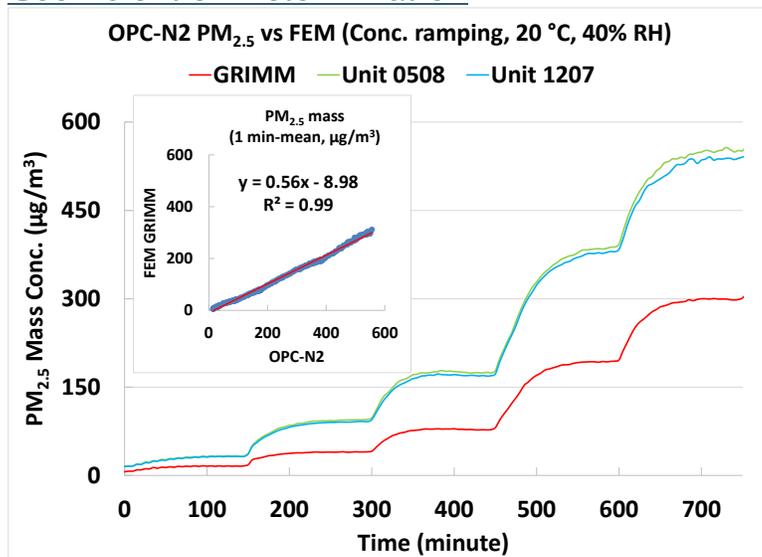


## Precision (PM<sub>2.5</sub>)



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 OPC-N2 units showed very strong correlations with the corresponding FEM PM<sub>2.5</sub> data ( $R^2 = 0.99$ ) at 20 °C and 40% RH.

For conc. ramping experiments of PM<sub>1.0</sub> and PM<sub>10</sub>, please see the full length lab report.

## Climate Susceptibility

From the laboratory studies, low temperature and high RH had negative effect on precision of the OPC-N2 units. In addition, at the set-points of RH changes, OPC-N2 reported spiked changes in concentrations.

## Observed Interferents

Not tested for PM sensors



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