

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Evaluation Summary

Sensor Description

Manufacturer/Model:
Alphasense/
OPC-N3

Pollutants:
PM_{1.0}, PM_{2.5} and PM₁₀ mass
concentration

Time Resolution:
10-sec

Type: Optical



- Overall, the accuracy of the Alphasense OPC-N3 sensors was fairly constant over the range of PM_{1.0} (11% to 14%), PM_{2.5} (17% to 24%) and PM₁₀ (~4% to 5%) mass conc. tested. The Alphasense OPC-N3 sensors underestimated PM_{1.0}, PM_{2.5} and PM₁₀ measurements as recorded by the reference instruments.
- The Alphasense OPC-N3 sensors exhibited high precision for all PM conc., T/RH combinations for PM_{1.0} and PM_{2.5}. Precision for PM₁₀ mass conc. cannot be determined due to the inherent variability of the test dust used.
- The Alphasense OPC-N3 sensors (IDs: 0217, 0218 and 0219) showed low to high intra-model variability.
- Data recovery was ~ 100% from all units.
- For PM_{1.0}, Alphasense OPC-N3 sensors showed strong correlations with GRIMM (R² ~ 0.80), weak to moderate correlations for PM_{2.5} and PM₁₀ with BAM, GRIMM and T640 from the field; and very strong correlations with the reference instruments in the laboratory studies (R² > 0.99 for PM_{1.0}, PM_{2.5} and PM₁₀).
- The same three Alphasense OPC-N3 units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

Field Evaluation Highlights

- Deployment period 08/15/2018 - 10/11/2018: the three Alphasense OPC-N3 sensors showed strong correlations with the PM_{1.0} mass concentration as recorded by GRIMM and weak to moderate correlations with the corresponding GRIMM, BAM and T640 data for PM_{2.5} and PM₁₀ mass conc.
- The units showed low to moderate intra-model variability and data recovery was ~100%.

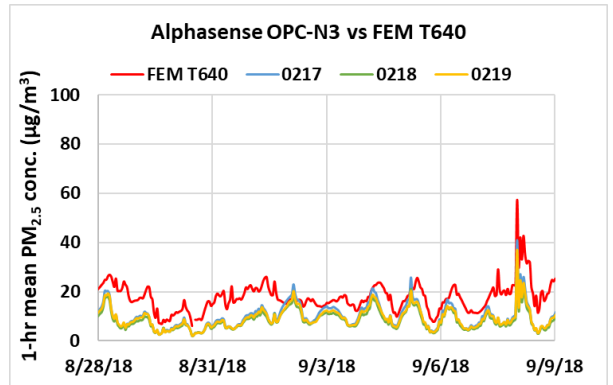
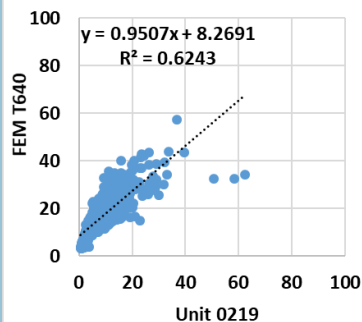
1-hr mean, all ref. inst.

PM_{1.0}: R² ~ 0.80

PM_{2.5}: 0.41 < R² < 0.69

PM₁₀: 0.28 < R² < 0.53

PM_{2.5} (1-hr mean, µg/m³)



Coefficient of Determination (R²) quantifies how the three sensors followed the PM_{2.5} concentration change by the reference instruments.

An R² approaching the value of 1 reflects a near perfect agreement, whereas a value of

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>

Laboratory Evaluation Highlights

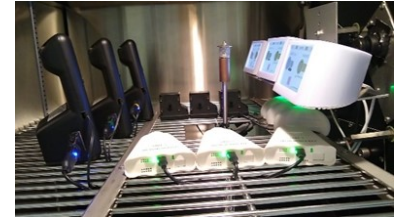
Accuracy (PM_{2.5})

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

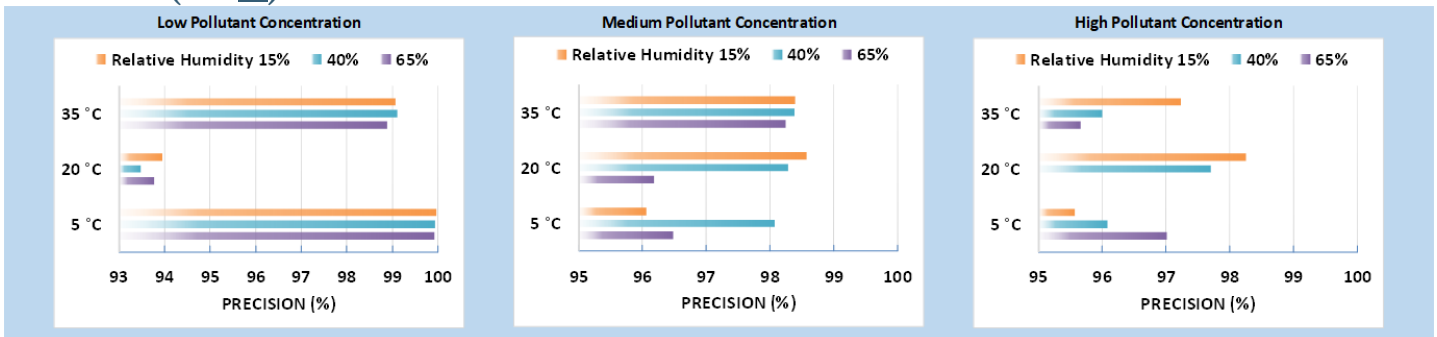
Steady state #	Sensor Mean (µg/m ³)	FEM GRIMM (µg/m ³)	Accuracy (%)
1	1.7	10.2	16.6
2	2.9	15.2	18.9
3	11.4	59.6	19.1
4	33.3	153.1	21.7
5	65.3	270.1	24.2

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40%. 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.



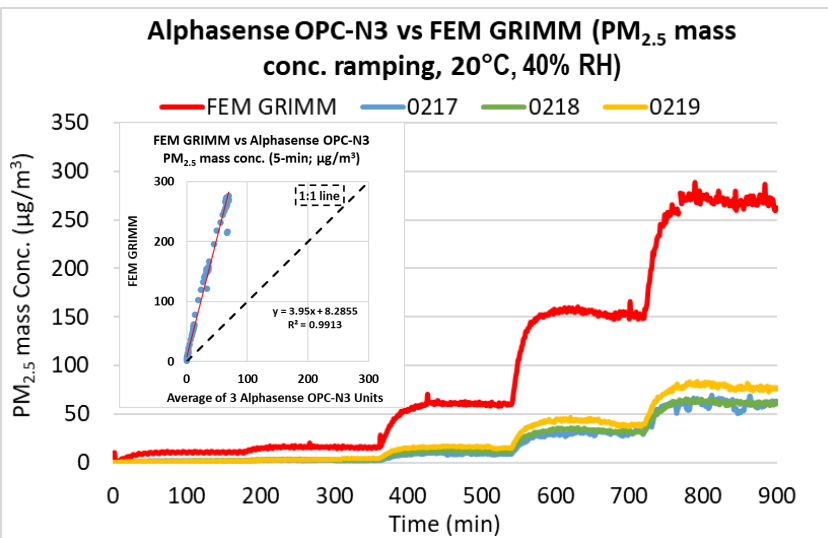
Precision (PM_{2.5})



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%) cold and humid (5 °C and 65%), hot and humid (35 °C and 65%), or hot and dry (35 °C and 15%).

Coefficient of Determination



The Alphasense OPC-N3 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 the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Alphasense OPC-N3 sensors except that the sensors showed significant variations in PM conc. at 65% RH at 5 °C.

Observed Interferents

N/A



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