

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Alphasense/OPC-R2

Pollutants:
PM_{1.0} (only analyzed from field evaluation), PM_{2.5}, and PM₁₀ mass concentration

Time Resolution:
30-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:

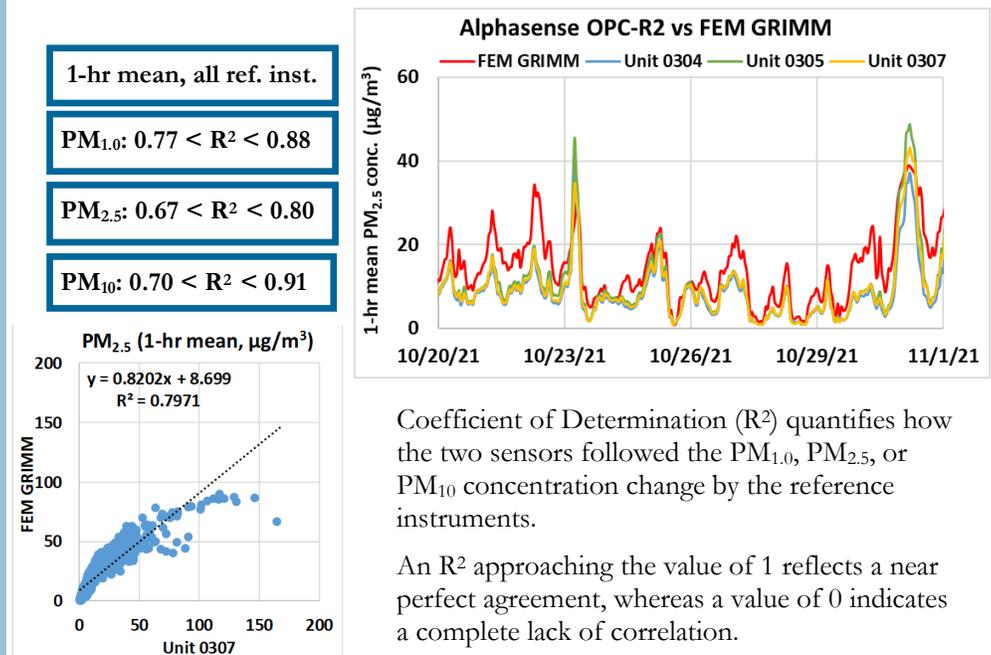
<http://www.aqmd.gov/aq-spec>

Evaluation Summary

- The accuracy of the Alphasense OPC-R2 sensors for PM_{2.5} was 15.1% to 24.9% and for PM₁₀ was 36.8% to 69.8% in the lab. The Alphasense OPC-R2 sensors underestimated PM_{2.5} and PM₁₀ measurements compared to the T640x and the APS in the lab.
- The Alphasense OPC-R2 sensors exhibited high precision for all conc., T/RH combinations for PM_{2.5}. Precision for PM₁₀ mass conc. cannot be determined due to the inherent variability of the test dust used.
- The Alphasense OPC-R2 sensors showed high and moderate intra-model variability for PM_{2.5} and PM₁₀ in the lab, respectively.
- Data recovery was 100% from all units tested in the field and laboratory evaluations.
- For PM_{1.0}, Alphasense OPC-R2 sensors showed strong correlations, moderate to strong correlations for PM_{2.5} and strong to very strong correlations for PM₁₀ with GRIMM and T640 from the field; and very strong correlations with the reference instruments in the laboratory studies ($R^2 > 0.97$ for PM_{2.5} and PM₁₀).
- The same Alphasense OPC-R2 units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing) against reference PM instruments.

Field Evaluation Highlights

- Deployment period 10/16/2021 - 12/15/2021: the Alphasense OPC-R2 sensors showed moderate to strong correlations with the PM_{1.0} and PM_{2.5} mass concentration as recorded by GRIMM and T640 and strong to very strong correlations with the corresponding GRIMM and T640 data for PM₁₀ mass conc.
- Data recovery from the units was ~100%.



Coefficient of Determination (R^2) quantifies how the two sensors followed the PM_{1.0}, PM_{2.5}, or PM₁₀ 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})

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

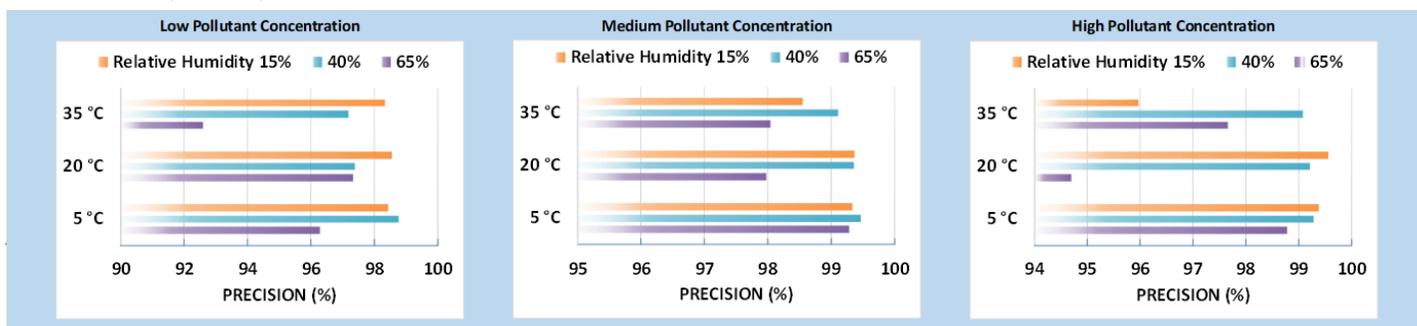
| Steady State # | Sensor Mean (µg/m ³) | FEM T640x (µg/m ³) | Accuracy (%) |
|----------------|----------------------------------|--------------------------------|--------------|
| 1 | 1.4 | 9.1 | 15.1 |
| 2 | 7.8 | 50.4 | 15.5 |
| 3 | 15.6 | 99.3 | 15.7 |
| 4 | 42.5 | 197.5 | 21.5 |
| 5 | 75.2 | 301.6 | 24.9 |

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



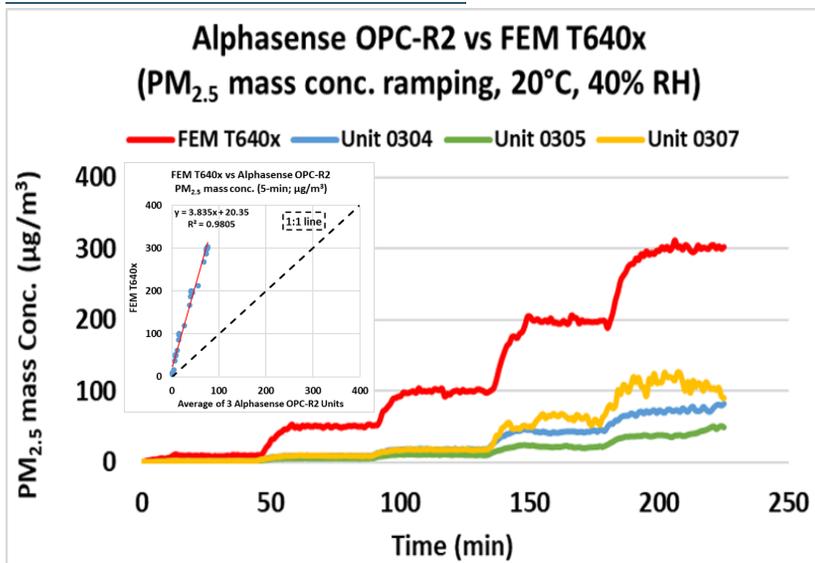
Precision (PM_{2.5})



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 Alphasense OPC-R2 sensors showed very strong correlations with the corresponding FEM PM_{2.5} data ($R^2 \sim 0.98$) at 20 °C and 40% RH.

At the time of testing, the reference monitor did not report PM_{1.0}. For conc. ramping experiments of PM₁₀, please see the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Alphasense OPC-R2 sensors' precision.

Observed Interferents

N/A



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