

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Evaluation Summary

Sensor Description

Manufacturer/Model:
APT/MINIMA

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

Time Resolution:
15-sec

Type: Optical



- Overall, the accuracy of the APT MINIMA sensors increased from ~ 82% to 96% as PM_{2.5} conc. increased over the tested concentration range. The APT MINIMA sensors overestimated PM_{2.5} measurements from FEM T640x in the laboratory experiments at 20 °C and 40% RH.
- The APT MINIMA sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The APT MINIMA sensors (IDs: BW28, BW29, BW31) showed low intra-model variability in both the field and laboratory evaluations.
- Data recovery was ~ 100% from all units in both field and laboratory evaluations.
- For PM_{1.0}, the APT MINIMA sensors showed strong to very strong correlations ($0.87 < R^2 < 0.92$) with the corresponding T640 data. For PM_{2.5}, the sensors showed strong to very strong correlations with the corresponding FEM T640 and FEM BAM data ($0.80 < R^2 < 0.91$) and very strong correlations with the FEM T640x in the laboratory evaluations ($R^2 > 0.99$). For PM₁₀, the sensors showed very weak to weak correlations ($0.23 < R^2 < 0.42$) with T640 and FEM BAM data in the field evaluations.
- The same three APT MINIMA units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

Field Evaluation Highlights

- Deployment period 10/30/2020 to 12/29/2020 : the three APT MINIMA sensors showed strong to very strong, strong to very strong, and very weak to weak correlations with the corresponding reference instruments for PM_{1.0}, PM_{2.5} and PM₁₀ mass concentrations, respectively.
- The units exhibited low intra-model variability and data recovery for all PM fractions was 100% from all units.

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:

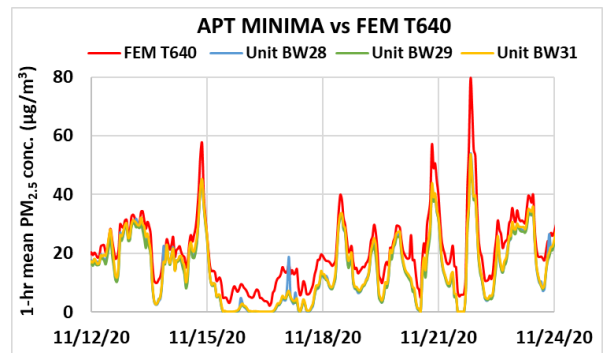
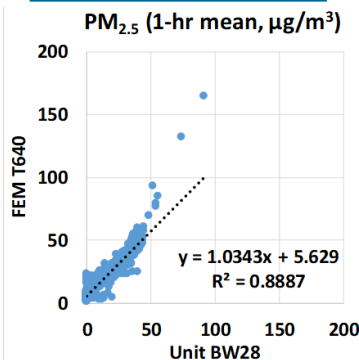
<http://www.aqmd.gov/aq-spec>

1-hr mean, all ref. instr.

PM_{1.0}: $0.87 < R^2 < 0.92$

PM_{2.5}: $0.80 < R^2 < 0.91$

PM₁₀: $0.23 < R^2 < 0.42$



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})

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

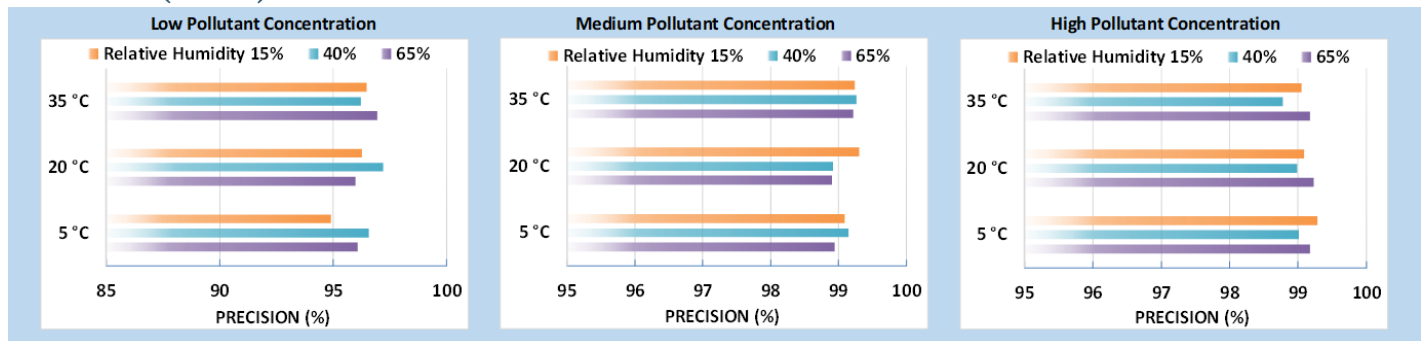
| Steady state # | Sensor Mean (PM _{2.5} , µg/m ³) | FEM T640x (PM _{2.5} , µg/m ³) | Accuracy (%) |
|----------------|--|--|--------------|
| 1 | 13.3 | 11.3 | 82.2 |
| 2 | 57.1 | 50.4 | 86.6 |
| 3 | 112.4 | 100.1 | 87.7 |
| 4 | 154.5 | 145.6 | 93.9 |
| 5 | 280.9 | 291.9 | 96.2 |

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.



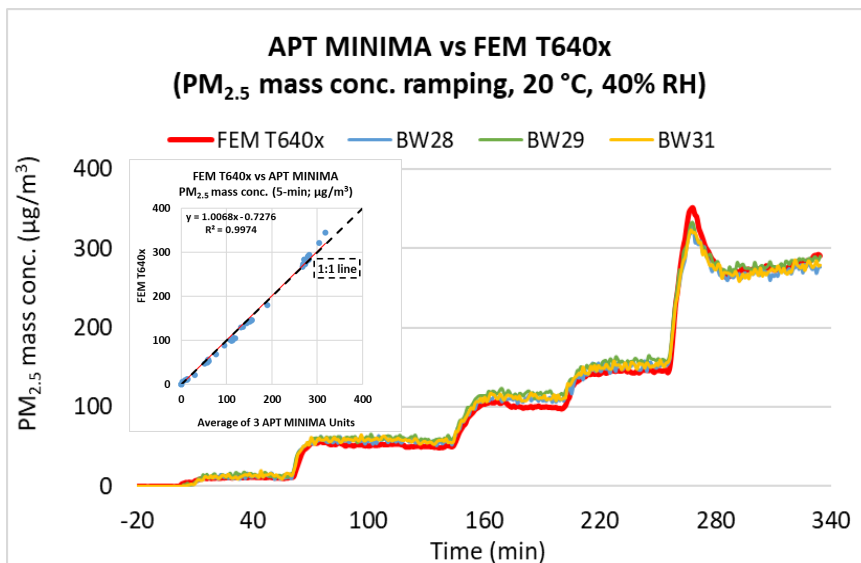
Precision (PM_{2.5})



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%) 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 APT MINIMA sensors showed very strong correlations with the corresponding FEM T640x PM_{2.5} data ($R^2 > 0.99$) at 20 °C and 40% RH.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the APT MINIMA sensors; at the set-points of RH change, the sensors showed some small spiked conc. changes.

Observed Interferents

N/A



All documents, reports, data, and other information provided in this document are for informational use only. Mention of trade names or commercial products does not constitute endorsement or recommendation. As a Government Agency, the South Coast AQMD and its AQ-SPEC program highly recommend interested entities to make use and purchase decisions based on the requirements of their study design, the technical aspects and features of their specific project applications.