

# AQ-SPEC

## Air Quality Sensor Performance Evaluation Center

### Evaluation Summary

#### Sensor Description

Manufacturer/Model:  
PurpleAir/PA-II-FLEX

Pollutants:  
PM<sub>1.0</sub>, PM<sub>2.5</sub> and PM<sub>10</sub> mass concentration

Time Resolution:  
2-min

Type: Optical



- The accuracy of the PA-II-FLEX sensors was 56.6% to 94.5% and 71.4% to 98.1% for PM<sub>1.0</sub> and PM<sub>2.5</sub>, respectively, in the laboratory evaluation. Overall, the PA-II-FLEX sensors underestimated PM<sub>1.0</sub> levels and overestimated low PM<sub>2.5</sub> levels (10 to 15 µg/m<sup>3</sup>) and underestimated high PM<sub>2.5</sub> levels (50 to 300 µg/m<sup>3</sup>) compared to the T640x in the lab.
- The PA-II-FLEX sensors exhibited high precision for all conc., T/RH combinations for PM<sub>1.0</sub> and PM<sub>2.5</sub>.
- The PA-II-FLEX sensors showed low intra-model variability for PM<sub>1.0</sub> and PM<sub>2.5</sub> in both the field and lab evaluations.
- Data recovery was ~94% and 100% from all units tested in the field and laboratory evaluations, respectively.
- PA-II-FLEX sensors showed very strong, strong and very weak to weak correlations for PM<sub>1.0</sub>, PM<sub>2.5</sub> and PM<sub>10</sub>, respectively, with GRIMM and T640 from the field; and very strong correlations with the T640x in the laboratory studies (R<sup>2</sup> > 0.99 for PM<sub>1.0</sub> and PM<sub>2.5</sub>).
- The same PA-II-FLEX units were tested both in the field (1<sup>st</sup> stage of testing) and in the laboratory (2<sup>nd</sup> stage of testing) against reference PM instruments (except for Unit 7f6d, unit damaged during transport)

### Field Evaluation Highlights

- Deployment period 03/17/2022 - 05/24/2022: the PA-II-FLEX sensors showed very strong and strong correlations for PM<sub>1.0</sub> and PM<sub>2.5</sub>, respectively; and very weak to weak correlations for PM<sub>10</sub> as compared to GRIMM and T640
- Data recovery from the units was ~94% for all PM fractions.

#### 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:

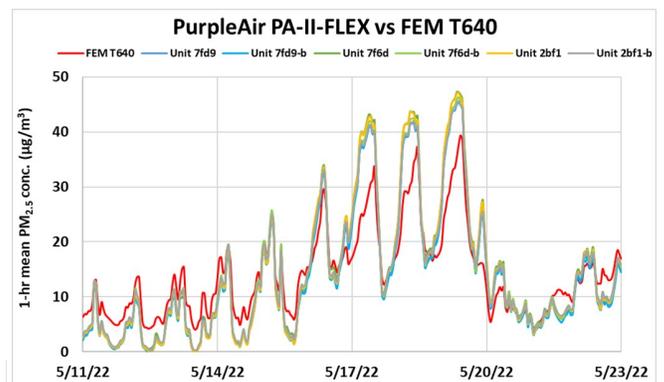
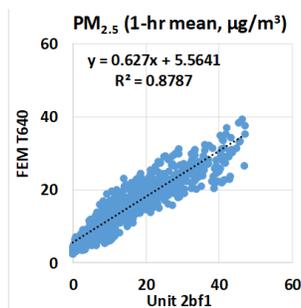
<http://www.aqmd.gov/aq-spec>

1-hr mean, all ref. inst.

PM<sub>1.0</sub>: 0.90 < R<sup>2</sup> < 0.95

PM<sub>2.5</sub>: 0.78 < R<sup>2</sup> < 0.90

PM<sub>10</sub>: 0.22 < R<sup>2</sup> < 0.43



Coefficient of Determination (R<sup>2</sup>) quantifies how the two sensors followed the PM<sub>1.0</sub>, PM<sub>2.5</sub>, or PM<sub>10</sub> concentration change by the reference instruments.

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

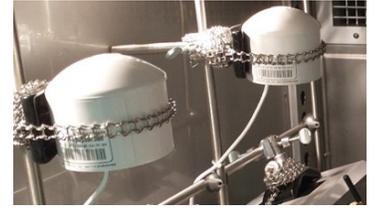
## Accuracy (PM<sub>2.5</sub>)

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

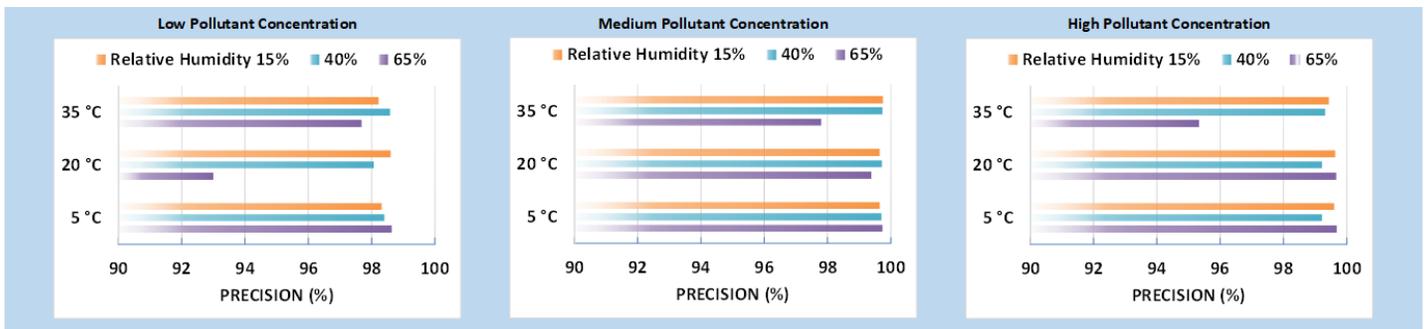
Steady State #	a-Sensor Mean (µg/m <sup>3</sup> )	FEM T640x (µg/m <sup>3</sup> )	Accuracy (%)
1	10.5	9.3	87.2
2	18.4	14.3	71.4
3	51.3	52.6	97.6
4	142.1	154.1	92.2
5	287.3	327.1	87.8

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.



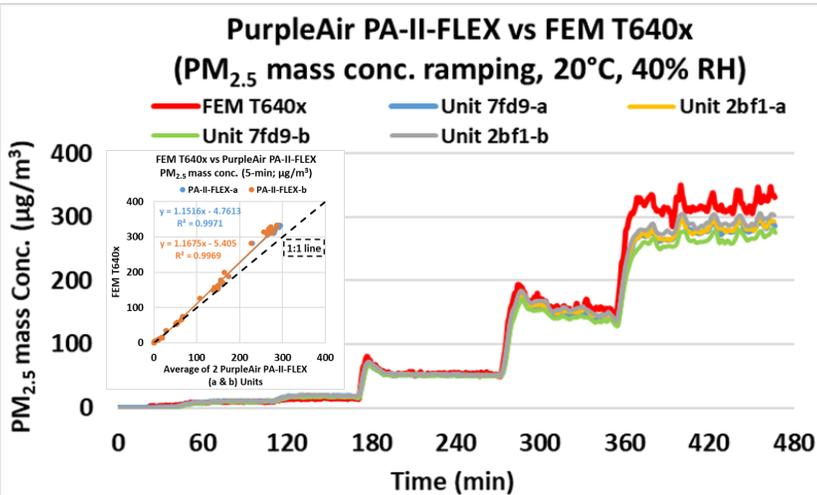
## Precision (PM<sub>2.5</sub> from channel A)



100% represents high precision.

Sensor's ability to generate precise measurements of PM<sub>2.5</sub> 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 PA-II-FLEX sensors 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>, please see the lab report.

## Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the PA-II-FLEX sensors' precision. Spiked concentrations were observed at the 65% RH change point.

## Observed Interferents

N/A

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