

# AQ-SPEC

## Air Quality Sensor Performance Evaluation Center

### Evaluation Summary

#### Sensor Description

Manufacturer/Model:  
TSI/  
BlueSky

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

Time Resolution:  
1-min

Type: Optical



- Overall, the accuracy of the TSI BlueSky sensors was fairly constant (~ 91% to 99%) over the range of PM<sub>2.5</sub> mass concentration tested. Overall, the TSI BlueSky sensors overestimated PM<sub>2.5</sub> measurements from FEM GRIMM in the laboratory experiments at 20 °C and 40% RH.
- The TSI BlueSky sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The TSI BlueSky sensors (IDs: 8031, 8027 and 8037) showed low to moderate intra-model variability for the field and laboratory evaluations.
- Data recovery was ~80 to 97% and 100% from all units in the field and laboratory evaluations, respectively.
- For PM<sub>2.5</sub>, the TSI BlueSky sensors showed moderate to strong correlations with the corresponding FEM GRIMM and FEM T640 data ( $0.66 < R^2 < 0.78$ ) in the field evaluations and very strong correlations with GRIMM in the laboratory evaluations ( $R^2 > 0.99$  for PM<sub>2.5</sub>). For PM<sub>10</sub>, the sensors showed very weak correlations with the corresponding GRIMM and T640 data ( $0.14 < R^2 < 0.22$ )
- The same three TSI BlueSky 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).

### Field Evaluation Highlights

- Deployment period 04/08/2020 - 06/15/2020: the three TSI BlueSky sensors showed moderate to strong correlations with the corresponding FEM GRIMM and FRM T640 PM<sub>2.5</sub> mass concentrations and showed very weak correlations with the corresponding GRIMM and T640 PM<sub>10</sub> mass concentrations.
- The units showed low intra-model variability and data recovery was ~ 100%.

#### Additional Information

##### Field evaluation report:

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

##### Lab evaluation report:

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

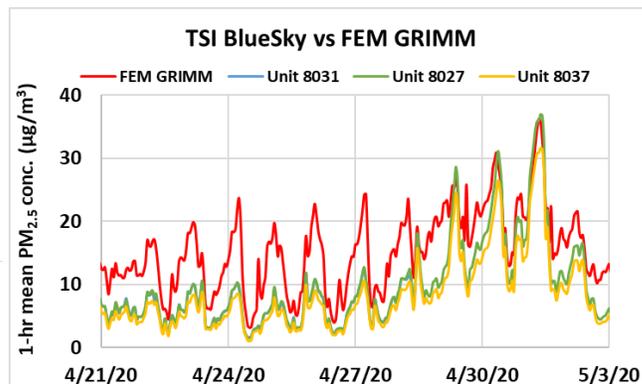
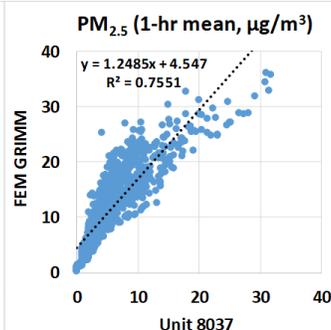
##### AQ-SPEC website:

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

1-hr mean, all ref. inst.

PM<sub>2.5</sub>:  $0.66 < R^2 < 0.78$

PM<sub>10</sub>:  $0.14 < R^2 < 0.22$



Coefficient of Determination ( $R^2$ ) quantifies how the three sensors followed the PM<sub>2.5</sub> 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

# Laboratory Evaluation Highlights

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

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

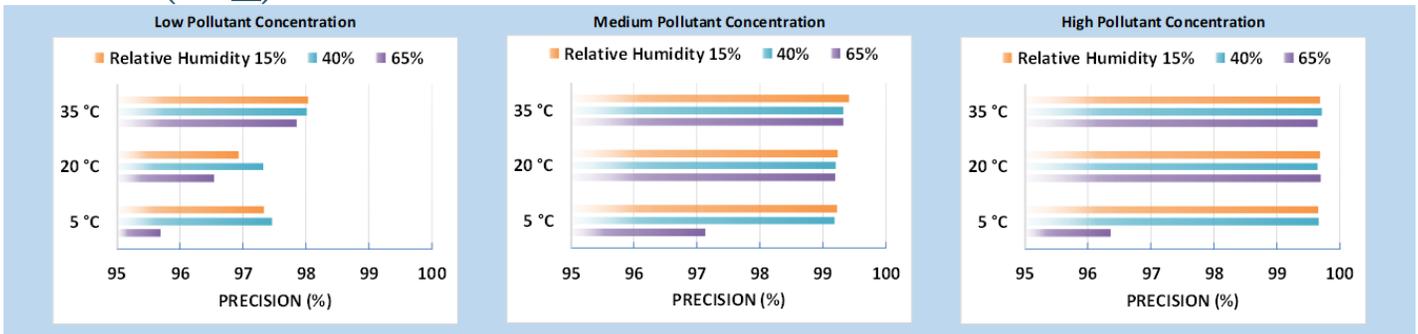
Steady state #	Sensor Mean (µg/m <sup>3</sup> )	FEM GRIMM (µg/m <sup>3</sup> )	Accuracy (%)
1	9.0	8.7	96.4
2	16.1	14.8	91.1
3	48.6	48.1	98.9
4	148.8	149.4	99.6
5	260.2	250.3	96.0

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.



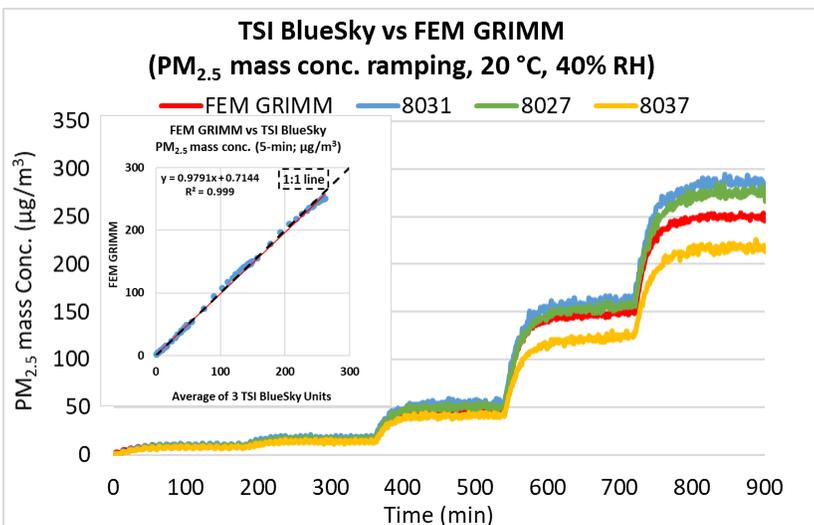
## Precision (PM<sub>2.5</sub>)



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 TSI BlueSky sensors showed very strong correlations with the corresponding FEM PM<sub>2.5</sub> data ( $R^2 > 0.99$ ) at 20 °C/40% RH.

## Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the TSI BlueSky sensors' precision. At the set-points of RH changes, the sensors showed spiked conc. changes for at 5 °C and showed significant concentration variation for at 5 °C/65% RH.

## Observed Interferents

N/A



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