

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Redspira

Pollutants:
PM_{2.5} and PM₁₀
mass concentration

Time Resolution:
1 min

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

- Overall, the Redspira sensors overestimated the FEM T640x PM_{2.5} mass concentration at 20 °C and 40% RH. The accuracy of the Redspira sensors increased (~ 71% to 99%) with increasing PM_{2.5} mass concentrations.
- The Redspira sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The Redspira sensors (IDs: 0083, 0084, 0085) showed low intra-model variability in both the field and laboratory evaluations.
- Data recovery was ~ 96% and 100% from all units in field and laboratory evaluations, respectively.
- For PM_{2.5}, the Redspira sensors showed strong correlations with the corresponding FEM T640 and FEM BAM data ($0.73 < R^2 < 0.89$, 1-hr mean) during the field evaluations and very strong correlations ($R^2 > 0.99$) with the corresponding FEM T640x in the laboratory evaluations. For PM₁₀, the sensors showed very weak to weak correlations ($0.20 < R^2 < 0.41$) with the corresponding FEM BAM and T640 data during the field evaluations.
- The same Redspira units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing, except for Unit 0084)

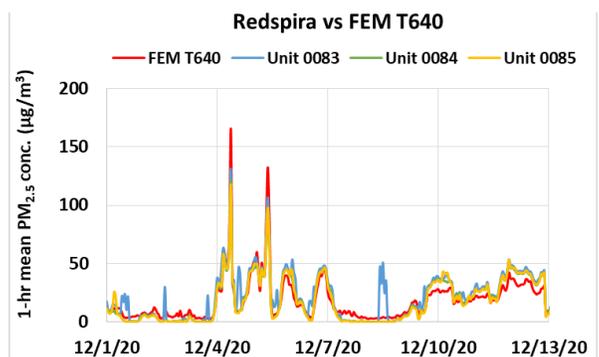
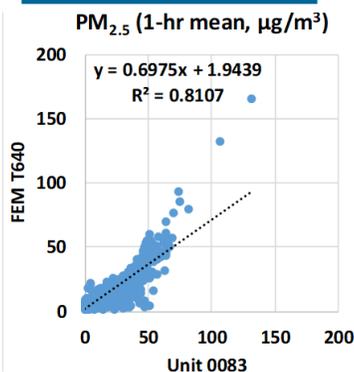
Field Evaluation Highlights

- Deployment period 10/29/2020 to 12/25/2020: the three Redspira sensors showed strong, and very weak to weak correlations with the corresponding reference instruments for PM_{2.5} and PM₁₀ mass concentrations, respectively
- The units exhibited low intra-model variability and data recovery for all PM measurements was ~96% from all units.

1-hr mean, all ref. instr.

PM_{2.5}: $0.73 < R^2 < 0.89$

PM₁₀: $0.20 < R^2 < 0.41$



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})

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

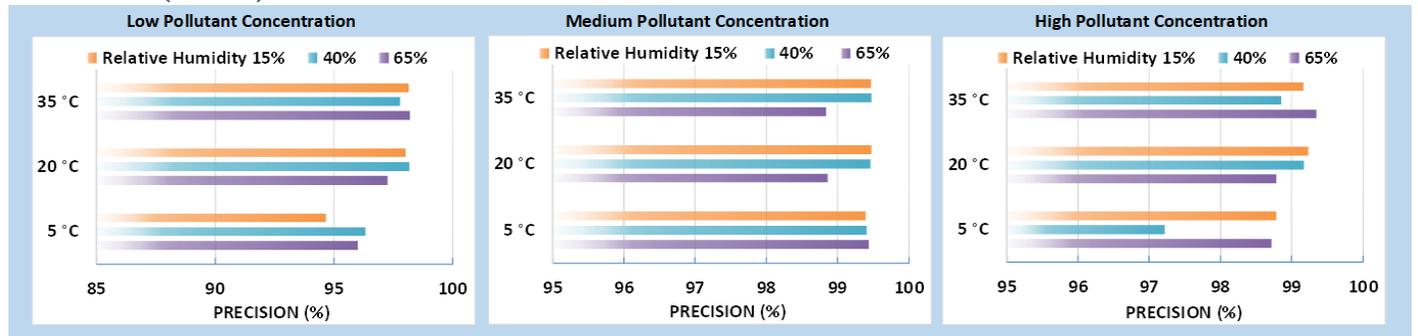
Steady state #	Sensor Mean (PM _{2.5} , µg/m ³)	FEM T640x (PM _{2.5} , µg/m ³)	Accuracy (%)
1	14.7	11.4	71.0
2	66.9	52.3	72.1
3	108.4	104.0	95.7
4	145.5	144.4	99.3
5	275.1	282.6	97.4

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.



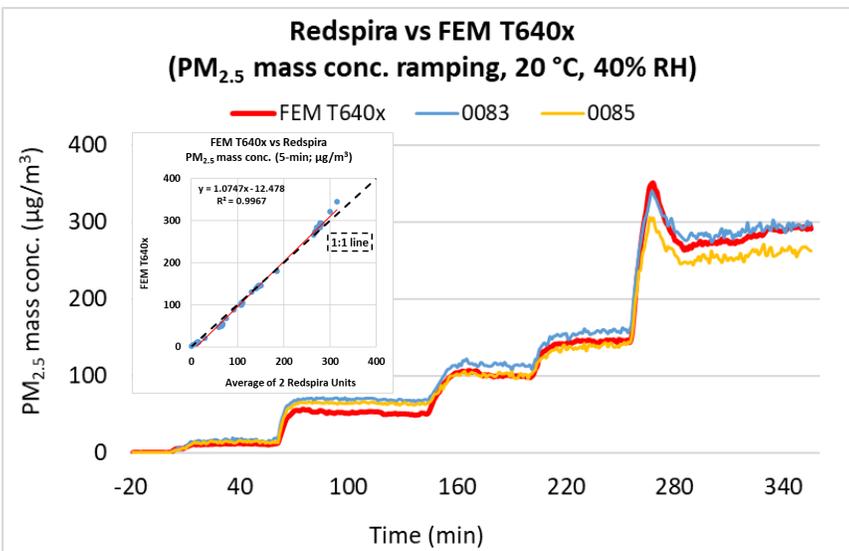
Precision (PM_{2.5})



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 Redspira 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 Redspira sensors; at the set-points of RH change, the sensors showed some small spiked conc. changes.

Observed Interferents

N/A



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