

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Evaluation Summary

Sensor Description

Manufacturer/Model:
Piera Systems/Canãree R1
Pollutants:
PM_{1.0}, PM_{2.5}, and PM₁₀
mass concentration

Time Resolution:
1-min

Type: Optical



- The accuracy of the Canãree R1 sensors was 70.4% to 99.9% and 24.5% to 94.7% for PM_{1.0} and PM_{2.5}, respectively, in the laboratory evaluation. Overall, the Canãree R1 sensors underestimated PM_{1.0} (except at 15 and 50 µg/m³) and overestimated PM_{2.5} measurements compared to the T640x in the lab.
- The Canãree R1 sensors exhibited high precision for all conc., T/RH combinations for PM_{1.0} and PM_{2.5}.
- The Canãree R1 sensors showed low to moderate and low intra-model variability for PM_{1.0} and PM_{2.5} in the lab, respectively.
- Data recovery was 98% to 100% and 100% from all units tested in the field and laboratory evaluations, respectively.
- Canãree R1 sensors showed strong to very strong correlations for PM_{1.0} and PM_{2.5} and very weak to weak correlations for PM₁₀ with GRIMM and T640 from the field; and very strong correlations with the T640x in the laboratory studies ($R^2 > 0.99$ for PM_{1.0} and PM_{2.5}).
- The same Canãree R1 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 02/22/2022 - 04/23/2022: the Canãree R1 sensors showed strong to very strong correlations for PM_{1.0} and PM_{2.5} and very weak to weak correlations for PM₁₀ as compared to GRIMM and T640
- Data recovery from the units was ~98% to 100% 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:

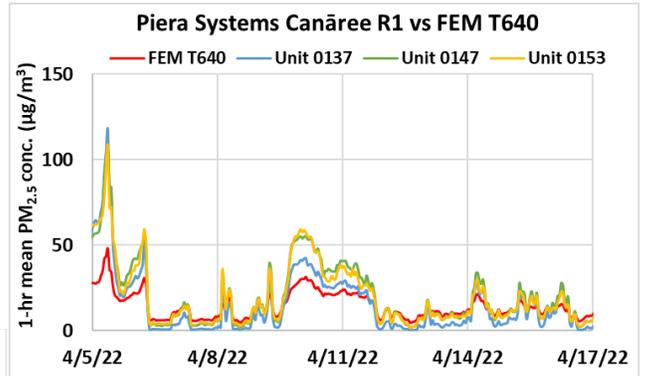
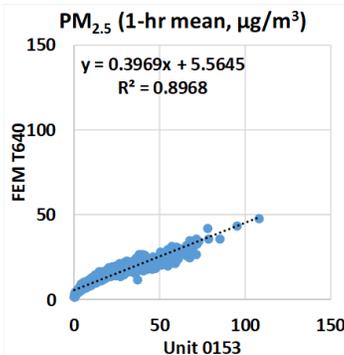
<http://www.aqmd.gov/aq-spec>

1-hr mean, all ref. inst.

PM_{1.0}: $0.83 < R^2 < 0.93$

PM_{2.5}: $0.71 < R^2 < 0.92$

PM₁₀: $0.20 < R^2 < 0.38$



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

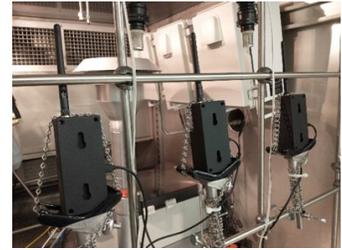
Accuracy (PM_{2.5})

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

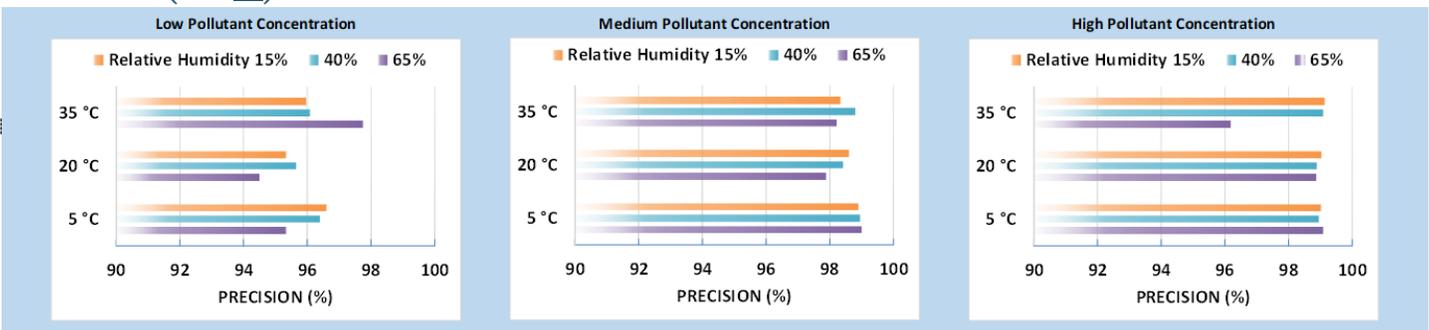
Steady State #	Sensor Mean (µg/m ³)	FEM T640x (µg/m ³)	Accuracy (%)
1	9.8	9.3	94.7
2	23.3	14.3	37.7
3	92.3	52.6	24.5
4	252.2	154.1	36.4
5	508.7	327.1	44.5

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.



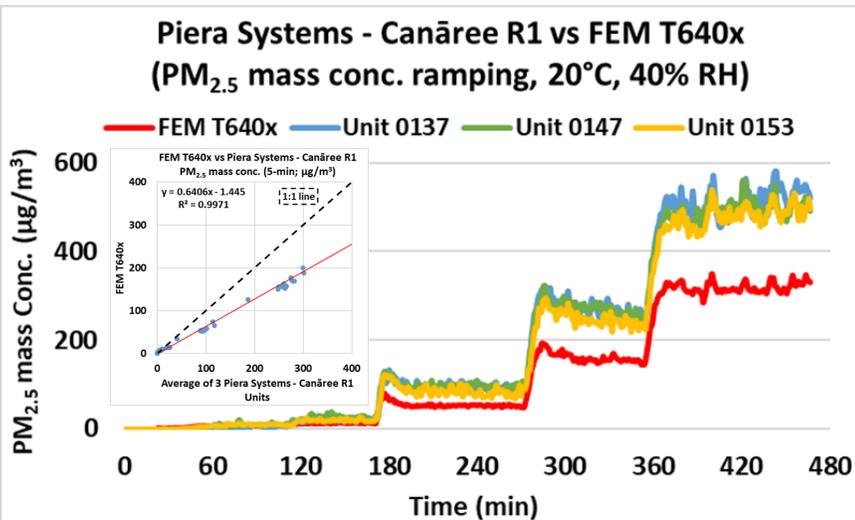
Precision (PM_{2.5})



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 Canãree R1 sensors showed very strong correlations with the corresponding FEM PM_{2.5} data ($R^2 > 0.99$) at 20°C and 40% RH.

For conc. ramping experiments of PM_{1.0}, please see the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Canãree R1 sensors' precision. Spiked concentrations were observed at the RH change points, especially at the 65% RH change point.

Observed Interferents

N/A



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