

Laboratory Evaluation

Strop de aer



Background

Three **Strop de aer** sensors were field-tested at the South Coast AQMD Rubidoux fixed ambient monitoring station (06/02/2022 to 08/02/2022) under ambient environmental conditions. Following field-testing, the same three units were evaluated in the South Coast AQMD Sensor Environmental Testing Chamber 2 (SENTEC-2) under controlled artificial aerosol concentration/size range, temperature, and relative humidity.

Strop de aer (3 units tested in the lab):

- Particle sensor: **optical particle counter; (SDS011 by Nova Fitness, non-FEM)**
- Each unit reports: PM_{2.5} and PM₁₀ ($\mu\text{g}/\text{m}^3$), T ($^{\circ}\text{C}$) and RH (%)
- **Unit cost: \$175 (standard version)**
- Time resolution: 1-min
- Unit IDs: Test1, Test2, Test3

Note: the sensor uses proprietary heated inlet that activates when RH is over 60-70%.

Reference instruments:

- PM_{2.5} instrument (**Teledyne T640x, San Diego, CA; hereinafter FEM T640x**); cost: ~\$37,000
- Time resolution: 1-min



Strop de aer

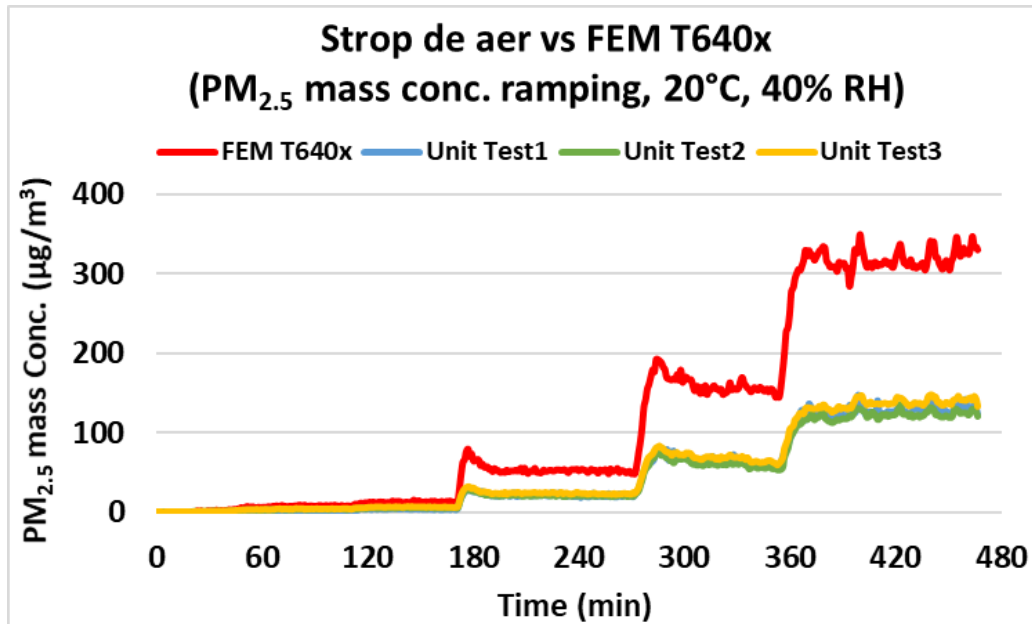


FEM T640x

PM_{2.5}

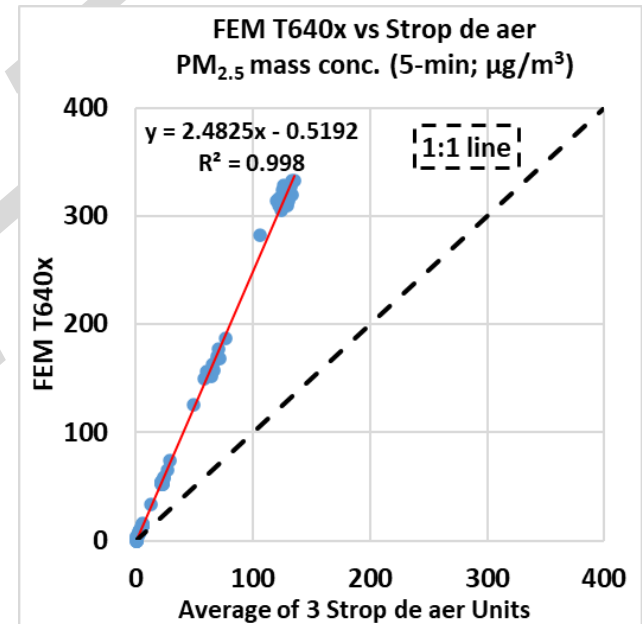
1. **FEM T640x vs Strop de aer**
2. **Accuracy, data recovery and intra-model variability**
3. **Precision**
4. **Climate susceptibility**
5. **Discussion**

Strop de aer vs FEM T640x (PM_{2.5})



- The Strop de aer sensors tracked well with the concentration variation but underestimated PM_{2.5}, compared to the FEM T640x in the concentration range of 0 - 300 µg/m³.

Coefficient of Determination



- The Strop de aer sensors showed very strong correlations with the FEM T640x PM_{2.5} mass conc. ($R^2 > 0.99$)

Strop de aer vs FEM T640x PM_{2.5} Accuracy

- Accuracy (20°C and 40% RH)

Steady State #	Sensor Mean (µg/m ³)	FEM T640x (µg/m ³)	Accuracy (%)
1	3.7	9.3	39.6
2	5.7	14.3	39.6
3	21.9	52.6	41.6
4	59.9	154.1	38.9
5	131.6	327.1	40.2

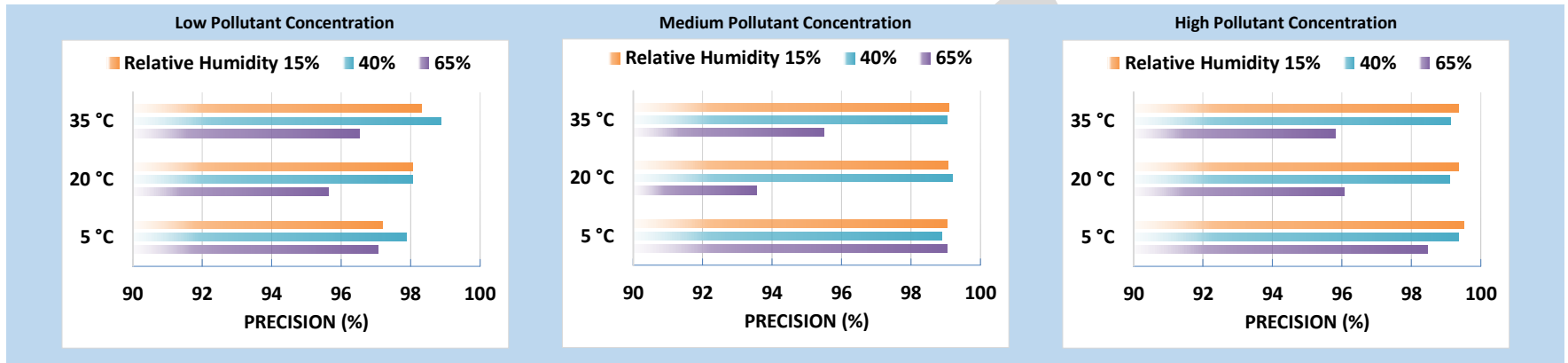
- Overall, the Strop de aer sensors underestimated PM_{2.5} concentration values compared to the FEM T640x PM_{2.5} mass concentration at 20°C and 40% RH. The Strop de aer sensors' accuracy ~40% in the range of 10 to 300 µg/m³ as compared to the reference FEM T640x.

Strop de aer Data Recovery and Intra-model Variability

- Data recovery for PM_{2.5} measurements was 86.4%, 88.5% and 86.6% for Units Test1, Test2 and Test3, respectively.
- Low to moderate PM_{2.5} concentration variations were observed between the units at 20°C and 40% RH, at low, medium, and high PM_{1.0} as measured by the FEM T640x.

Precision: Strop de aer (PM_{2.5})

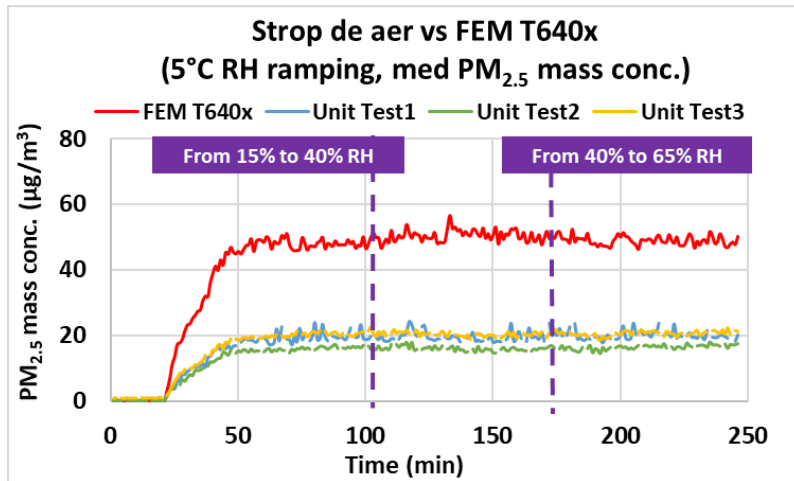
- Precision (effect of PM_{2.5} conc., temperature and relative humidity)



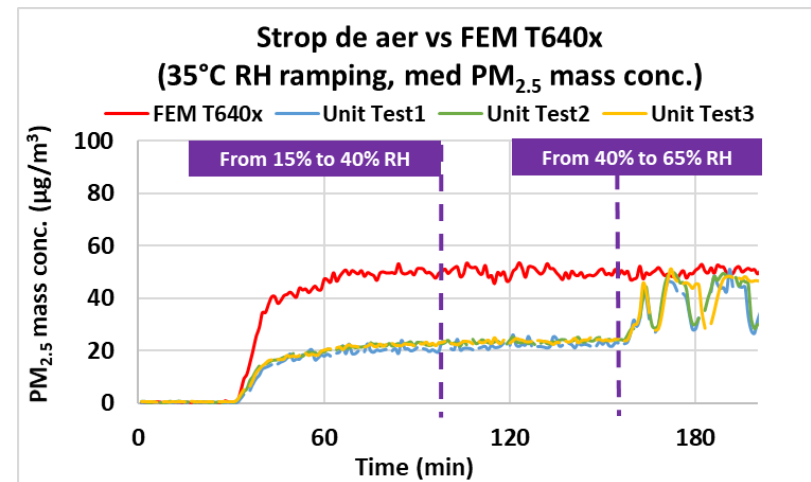
- Overall, Strop de aer sensors showed high precision for all the combinations of low, medium, and high PM_{2.5} conc., T, and RH.

Climate Susceptibility: Strop de aer (PM_{2.5})

Low Temp - RH ramping
(medium conc.)



High Temp – RH ramping
(medium conc.)



Discussion: PM_{2.5}

- **Accuracy:** Overall, the Strop de aer sensors underestimated PM_{2.5} concentration values compared to the FEM T640x PM_{2.5} mass concentration at 20 °C and 40% RH. The Strop de aer sensors' accuracy ~40% in the range of 10 to 300 µg/m³ as compared to the reference FEM T640x.
- **Precision:** The three Strop de aer sensors exhibited high precision during all tested PM_{2.5} conc., T, and RH conditions.
- **Intra-model variability:** Low to moderate PM_{2.5} measurement variations were observed among the three Strop de aer sensors at 20°C and 40% RH.
- **Data Recovery:** Data recovery for PM_{2.5} measurements was 86.4%, 88.5% and 86.6% for Units Test1, Test2 and Test3, respectively.
- **Bias:** N/A
- **Detection limit:** The detection limit cannot be estimated due to limitations in the chamber system design.
- **Response time:** Response time could not be studied due to the design of the chamber system. With a 1.6 m³ chamber volume, it was not possible to reach a high pollutant concentration within a short time.
- **Linear Correlation:** The three Strop de aer sensors showed very strong correlation/linear response with the corresponding FEM T640x PM_{2.5} measurement data ($R^2 > 0.99$).
- **Selectivity:** N/A for PM sensors test
- **Interferences:** N/A for PM sensors test

Discussion: PM_{2.5}

- **Measurement duration:** Strop de aer sensors report 1-min averaged values.
- **Measurement frequency:** Strop de aer sensors report 1-min averaged values. The obtained data was used for calculation of statistics (e.g. data recovery, intra-model variability, mean, accuracy, precision), and condensed to 5-minute averages for linear correlation studies against the FEM T640x.
- **Sensor contamination and expiration:** Prior to the laboratory evaluation, the Strop de aer sensors were tested in the field for two months. The PM_{2.5} laboratory studies lasted for about three weeks with intermittent non-operating periods and a storage period of ~9 months.
- **Concentration range:** Up to 1000 µg/m³ as suggested by the manufacturer. During the laboratory evaluation, the Strop de aer sensors were challenged with PM_{2.5} concentrations up to 300 µg/m³.
- **Drift:** N/A
- **Climate susceptibility:** During the lab studies, climate did not significantly impact sensors' precision. Spiked concentrations were observed at the RH change points, especially at the 65% RH change point. Increasing RH led to less underestimation compared to the FEM T640x.
- **Response to loss of power:** Strop de aer sensors were powered through the entirety of the lab tests.