AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Davis Instruments - AirLink

Pollutants:
$PM_{1.0}$ (field evaluation only), $PM_{2.5}$, and PM_{10} (field evaluation only) mass concentration

Time Resolution:
1-min

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

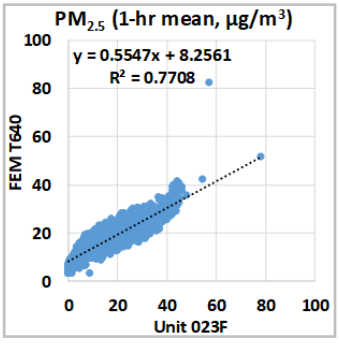
Evaluation Summary

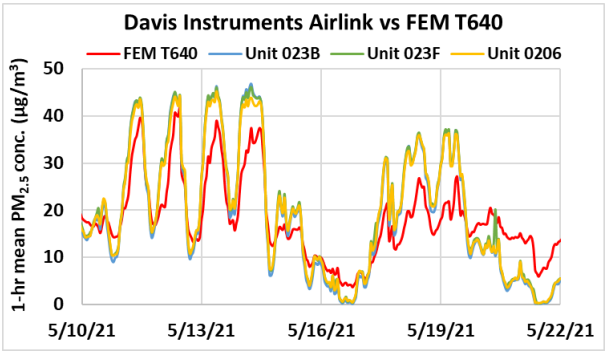
- The accuracy of the AirLink sensors for $PM_{2.5}$ was 92.3% to 97.8% in the lab. The AirLink sensors overestimated $PM_{2.5}$ at lower concentrations and underestimated $PM_{2.5}$ at higher concentrations compared to the Teledyne T640x in the lab.
- The AirLink sensors exhibited high precision for all conc., T/RH combinations for $PM_{2.5}$.
- The AirLink sensors showed low to moderate intra-model variability for $PM_{2.5}$ in the lab.
- Data recovery in the field and lab was ~ 100% from the three units tested.
- AirLink sensors showed strong correlations with GRIMM and T640 in the field for both $PM_{1.0}$ (R^2: 0.88-0.89) and $PM_{2.5}$ (0.76-0.82), very weak to weak correlations with reference instruments in the field for PM_{10} (R^2: 0.26-0.33), and very strong correlations with the reference instruments in the laboratory studies ($R^2 > 0.99$ for $PM_{2.5}$).
- All of the same AirLink 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 04/02/2021 - 06/01/2021: the three AirLink sensors showed strong correlations with the $PM_{1.0}$ and $PM_{2.5}$ mass concentration as recorded by GRIMM and T640, and very weak to weak correlations with the corresponding GRIMM and T640 data for PM_{10}.
- The units showed data recovery was ~100%.

1-hr mean, all ref. inst.
$PM_{1.0}$: $0.88 < R^2 < 0.89$
$PM_{2.5}$: $0.76 < R^2 < 0.82$
PM_{10}: $0.26 < R^2 < 0.33$





Coefficient of Determination (R^2) quantifies how the three sensors followed the $PM_{1.0}$, $PM_{2.5}$, or PM_{10} 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 ($PM_{2.5}$)

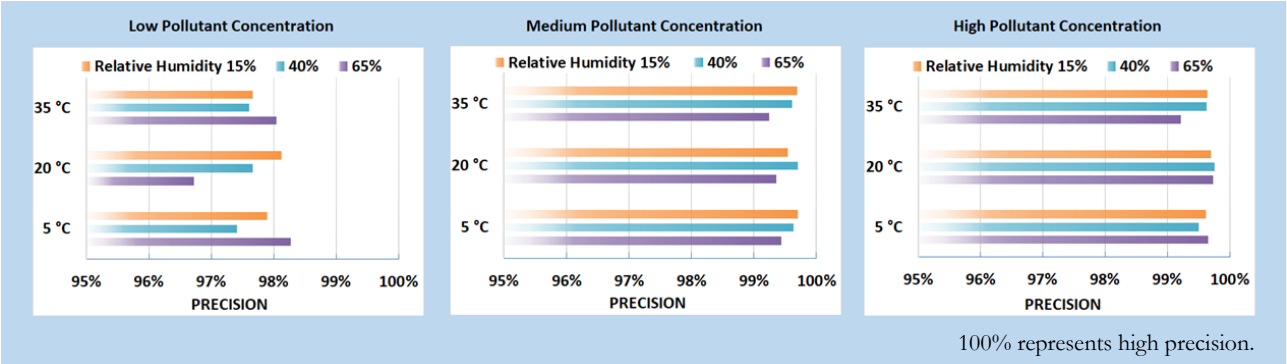
$$A\,(\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

Steady State #	Sensor Mean (µg/m³)	FEM T640x (µg/m³)	Accuracy (%)
1	8.74	9.05	96.5%
2	51.14	47.50	92.3%
3	103.57	97.71	94.0%
4	192.09	196.31	97.8%
5	273.76	296.41	92.4%

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40% RH. The sensors' 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.

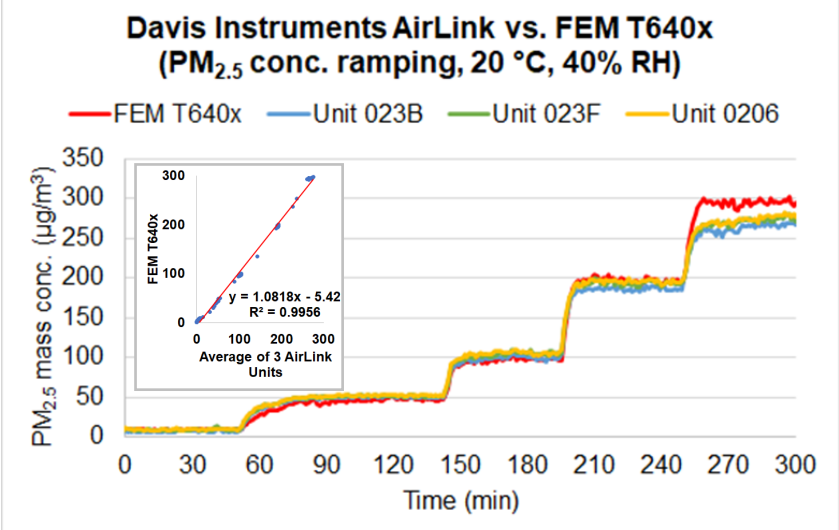
Precision ($PM_{2.5}$)



100% represents high precision.

Sensors' 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 AirLink sensors showed very strong correlations with the corresponding FEM $PM_{2.5}$ data ($R^2 > 0.99$) at 20 °C and 40% RH.
At the time of lab testing, the reference monitor did not report $PM_{1.0}$. The AirLink sensors' field performance did not qualify it for PM_{10} testing in the lab.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the AirLink sensors' precision.

Observed Interferents

N/A