

Laboratory Evaluation: Elitech Temtop LKC-1000S+



Background

Three **Elitech Temtop LKC-1000S+** (hereinafter **Temtop LKC-1000S+**) sensors (units IDs: Unit 1, Unit 2, Unit 3) were field-tested at the South Coast AQMD Rubidoux fixed ambient monitoring station (01/27/2020 to 03/27/2020) under ambient environmental conditions and have been evaluated in the South Coast AQMD Chemistry Laboratory under controlled artificial aerosol concentration/size range, temperature, and relative humidity. The same three Temtop LKC-1000S+ units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

Temtop LKC-1000S+ (3 units tested):

- Particle sensor: **optical; non-FEM (PM300, Temtop)**
- Each unit reports: PM_{2.5} and PM₁₀ (µg/m³)
- Unit also measures: TVOC and formaldehyde
- Unit also displays: Temperature, Relative Humidity and AQI
- **Unit cost: ~\$140**
- Time resolution: 1 min
- Units IDs: Unit 1, Unit 2, Unit 3

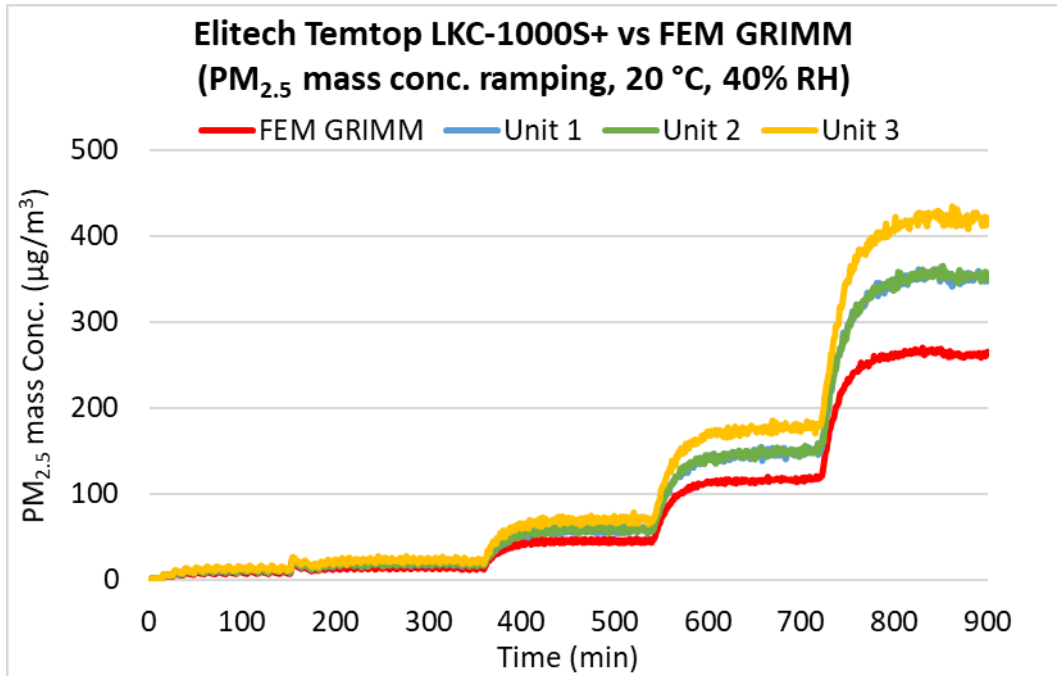


GRIMM (reference method):

- Optical particle counter
- **FEM PM_{2.5}**
- Uses proprietary algorithms to calculate total PM, PM_{2.5}, and PM₁ mass conc. from particle number measurements
- **Cost: ~\$25,000**
- Time resolution: 1-min

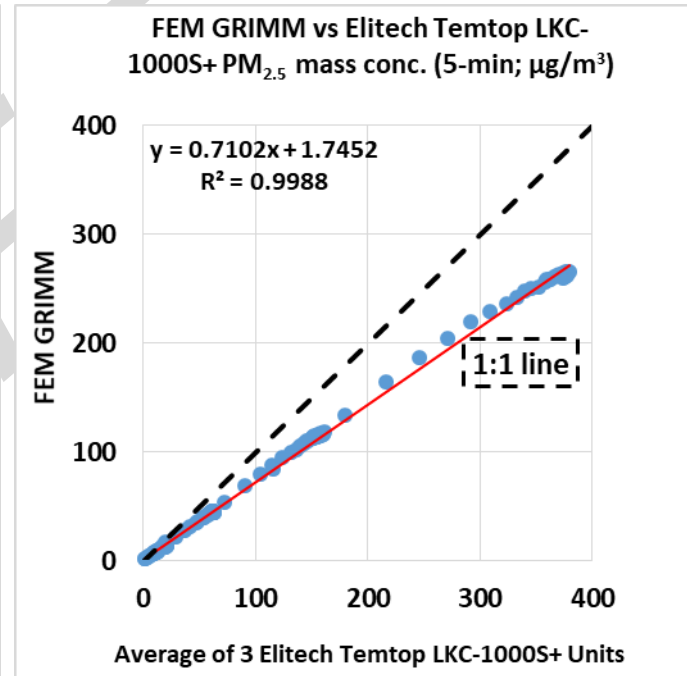


Temtop LKC-1000S+ vs FEM GRIMM (PM_{2.5} mass conc.)



- The Temtop LKC-1000S+ sensors tracked well with the concentration variation as recorded by the FEM GRIMM in the concentration range of 0 - $\sim 250 \mu\text{g}/\text{m}^3$.

Coefficient of Determination



- The Temtop LKC-1000S+ sensors showed very strong correlations with the FEM GRIMM PM_{2.5} mass conc. ($R^2 > 0.99$)

Temtop LKC-1000S+ vs FEM GRIMM PM_{2.5} Accuracy

- Accuracy (20°C and 40% RH)

Steady state #	Sensor Mean (µg/m ³)	FEM GRIMM (µg/m ³)	Accuracy (%)
1	11.0	8.4	68.9
2	19.2	13.7	60.1
3	61.9	45.3	63.3
4	160.1	117.7	64.1
5	375.1	261.5	56.6

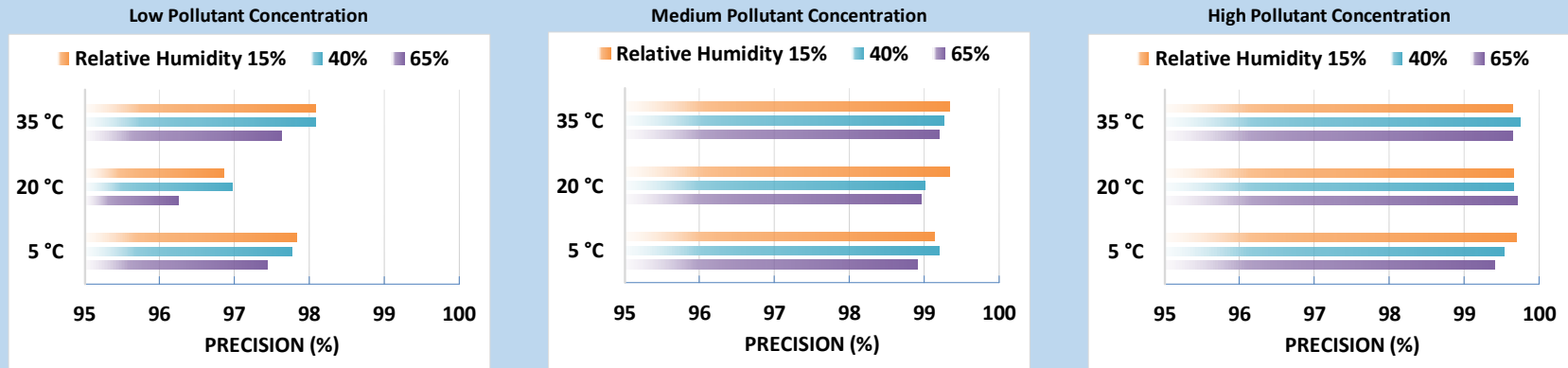
- The Temtop LKC-1000S+ sensors overestimated FEM GRIMM PM_{2.5} mass concentration at 20 °C and 40% RH. The accuracy of the Temtop LKC-1000S+ sensors was relatively constant (57% to 69%) over the PM_{2.5} mass concentration range tested.

Temtop LKC-1000S+: Data Recovery and Intra-model Variability

- Data recovery for PM_{2.5} mass concentration from all units was 100%
- Low PM_{2.5} measurement variations were observed between Temtop LKC-1000S+ sensors

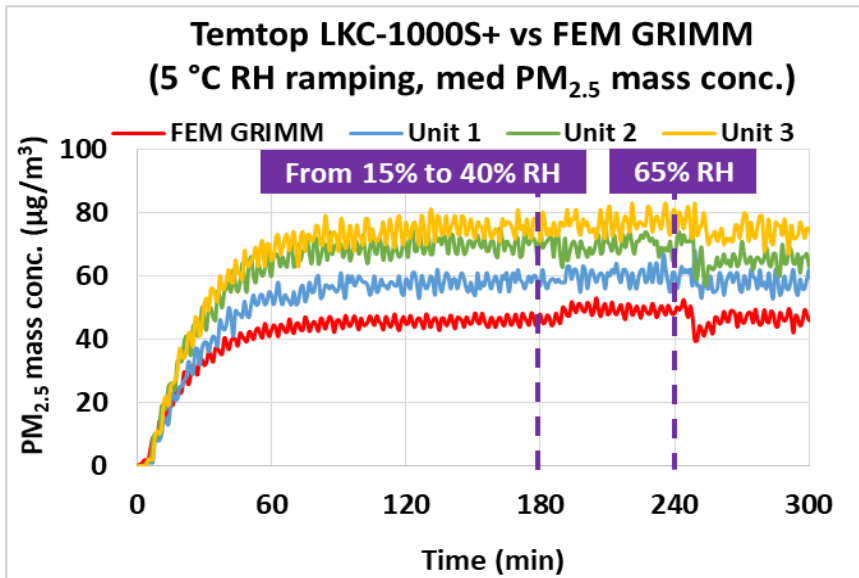
Temtop LKC-1000S+ PM_{2.5}: Precision

- Precision (Effect of PM_{2.5} conc., Temperature and Relative Humidity)



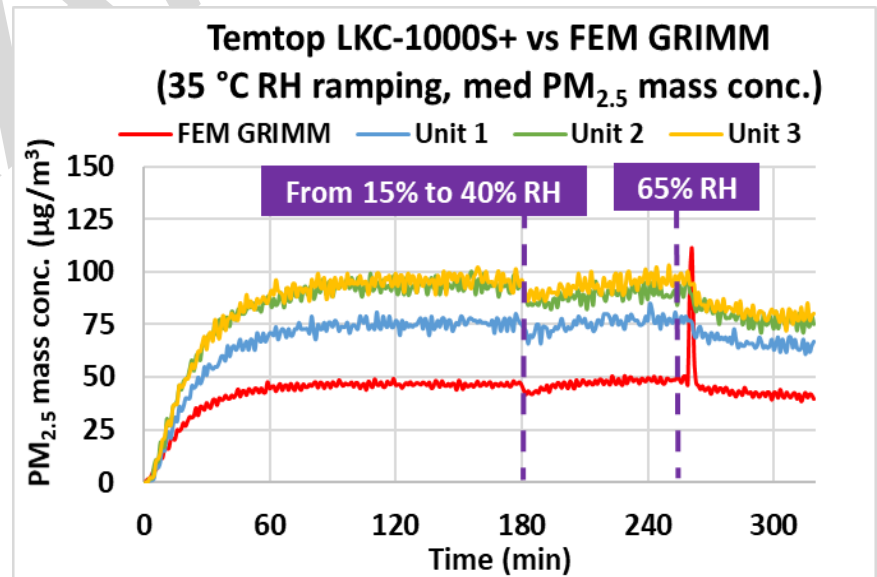
- Overall, the Temtop LKC-1000S+ sensors showed high precision for all combinations of low, medium and high PM_{2.5} conc., T, and RH.
- Precision was relatively higher at higher PM_{2.5} mass concentrations.

Temtop LKC-1000S+ PM_{2.5}: Climate Susceptibility



**Low Temp – RH ramping
(medium conc.)**

**High Temp – RH ramping
(medium conc.)**



Discussion

- **Accuracy:** Overall, the accuracy of the Temtop LKC-1000S+ sensors was relatively constant (57% to 69%) over the PM_{2.5} mass concentration range tested. The Temtop LKC-1000S+ sensors overestimated PM_{2.5} measurements from FEM GRIMM in the laboratory experiments at 20 °C and 40% RH.
- **Precision:** The Temtop LKC-1000S+ sensors showed high precision for all test combinations (PM concentrations, T and RH) for PM_{2.5} mass concentrations
- **Intra-model variability:** Low intra-model variability was observed among the Temtop LKC-1000S+ sensors.
- **Data Recovery:** Data recovery for PM_{2.5} mass concentration from all units was 100%.
- **Coefficient of Determination:** The Temtop LKC-1000S+ sensors showed very strong correlation/linear response with the corresponding FEM GRIMM PM_{2.5} measurement data ($R^2 > 0.99$).
- **Climate susceptibility:** For most of the temperature and relative humidity combination, the climate condition had minimal effect on the Temtop LKC-1000S+ sensors' precision; the sensors showed small spiked conc. change at the 65% RH change points at 5 °C for high PM level.