AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Igienair Zaack AQI

Pollutant: O_3

Measurement Range:
0 - 20 ppm

Type: Electrochemical

Time Resolution: 30-sec

Additional Information

Field evaluation report:
http://www.aqmd.gov/aq-spec/evaluations/field

Lab evaluation report:
http://www.aqmd.gov/aq-spec/evaluations/laboratory

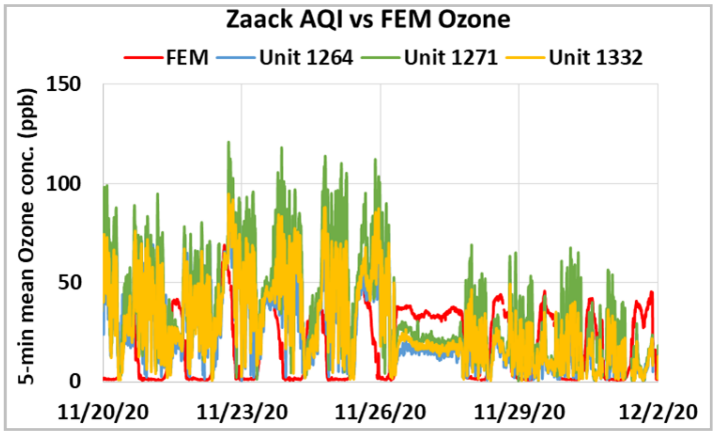
AQ-SPEC website:
http://www.aqmd.gov/aq-spec

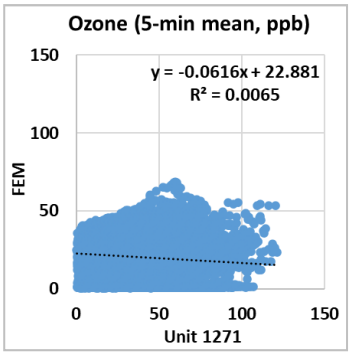
Evaluation Summary

- Moderate to high intra-model variability was observed among the three Zaack AQI units at different O_3 concentrations.
- The three Zaack AQI units showed low to high accuracy compared to the FEM O_3 monitor, for a concentration range between 15 to 300 ppb.
- Units demonstrated high precision in all of the tested environmental conditions (O_3 conc., T and RH), except for colder and drier conditions at low pollutant concentrations. The Zaack AQI units' response was also susceptible to weather conditions (e.g. high temperature & RH).
- O_3 data recovery from the three Zaack AQI units was ~90% in the field.
- Zaack AQI units showed no correlation with the FEM O_3 in the field ($R^2 < 0.01$) and very strong correlations in the lab ($R^2 > 0.97$).

Field Evaluation Highlights

- Deployment period 11/13/2020 - 01/08/2021: the three Zaack AQI units had no correlation with the FEM instrument.
- Data recovery from the Zaack AQI units was ~90%.





Coefficient of Determination (R^2) quantifies how the three sensors followed the O_3 concentration change by FEM.

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

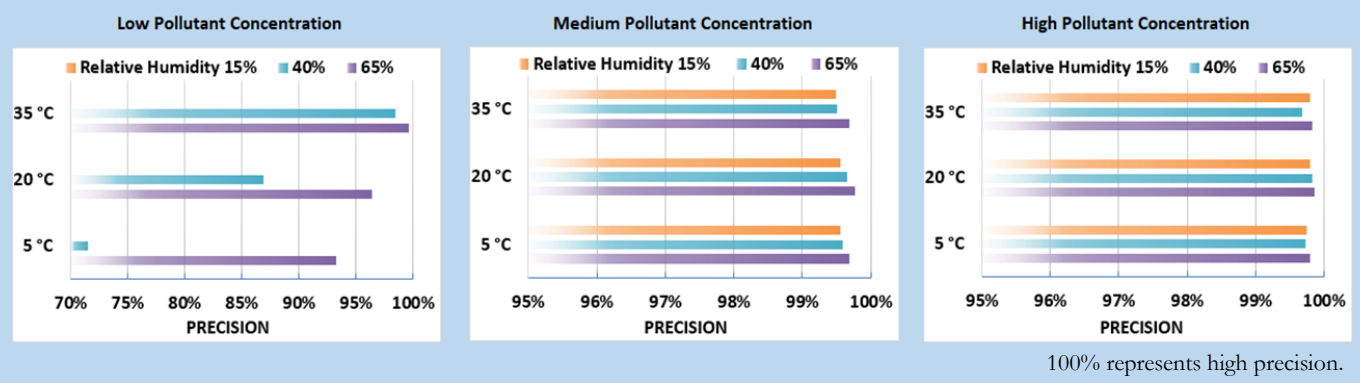
$$A\,(\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

Steady State (#)	Sensor mean (ppb)	FEM T400 (ppb)	Accuracy (%)
1	1.43	14.26	10.0%
2	31.33	48.98	64.0%
3	78.83	99.51	79.2%
4	173.04	198.60	87.1%
5	263.47	296.62	88.8%

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40%. The sensor's readings at each ramping steady state are compared to the reference instrument.

Negative % means sensors' overestimation by more than two fold. The higher the positive value (close to 100%), the higher the sensor's accuracy.

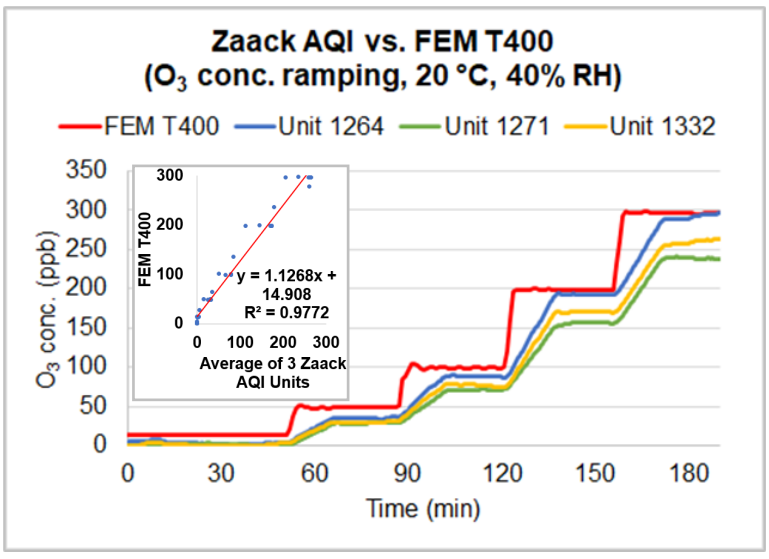
Precision



100% represents high precision.

Sensor's ability of generating precise measurements of O_3 concentration at low, medium, and high pollutant levels were evaluated under 9 combinations of T and RH, including extreme weather conditions like cold and humid (5 °C and 65%), hot and humid (35 °C and 65%), cold and dry (5 °C and 15%), and hot and dry (35 °C and 15%).

Coefficient of Determination



The Zaack AQI units showed very strong correlations with the corresponding FEM data ($R^2 > 0.97$) at 20 °C and 40% RH.

Climate Susceptibility (linear correlation R^2)

R^2	5 °C	20 °C	35 °C
15%	0.96	0.98	0.97
40%	0.99	0.97	0.98
65%	0.98	0.98	0.98

From the laboratory studies, low temperature and low humidity had a slight negative effect on the Zaack AQI's linear correlation with the FEM O_3.

Observed Interferents

Low and high temperature and humidity.