Product Characterisation Note

1series: CO Sensor

Contents

Document Purpose

The purpose of this document is to provide indicative, technical performance data for the 1CO sensor to assist in the integration of the sensor into gas detection instrumentation. The sensor has been subjected to a rigorous testing programme as part of the development process. Within this document, detailed information on the results of this programme are presented.

This document and the information contained within does not constitute a specification. The data is provided for informational purposes only and is not warranted by the manufacturer. It should be used in conjunction with the 1CO Product Datasheet, Operating Principles (OP08) and the Product Safety Datasheet (PSDS 12.1).

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The Gas Response Curve

The data in Figure 1 shows a typical response curve for the 1CO.

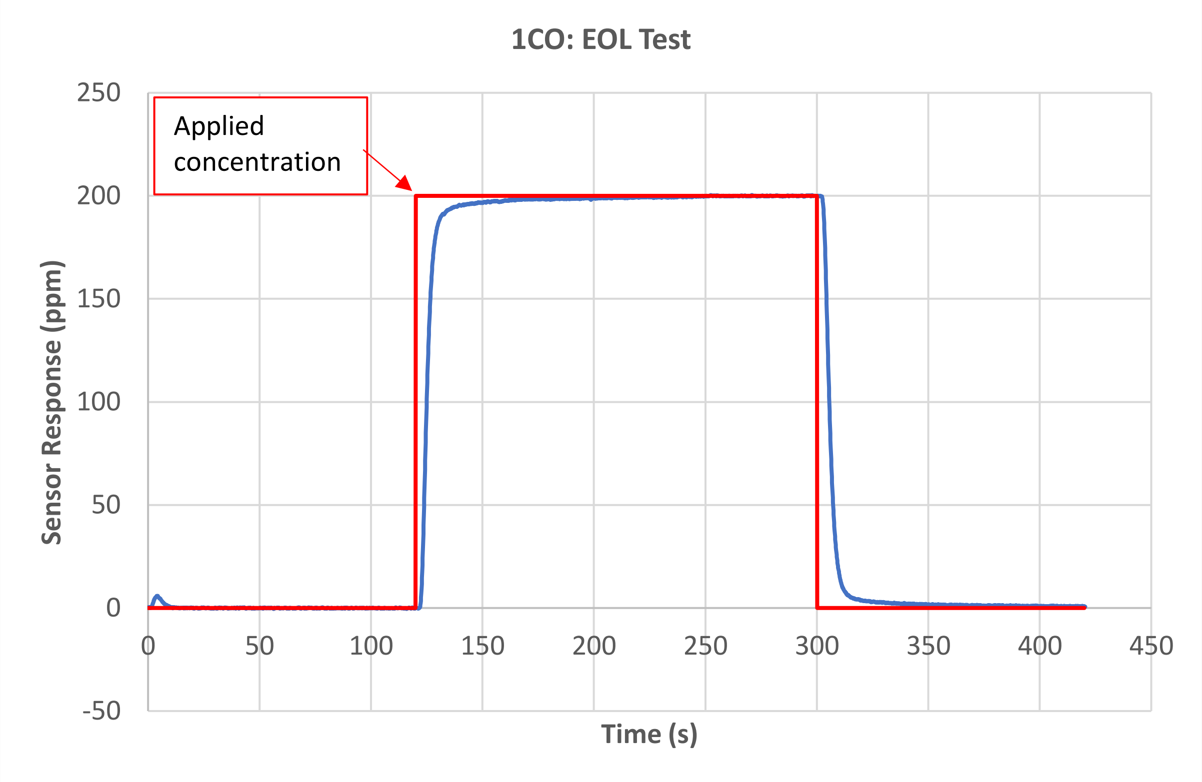
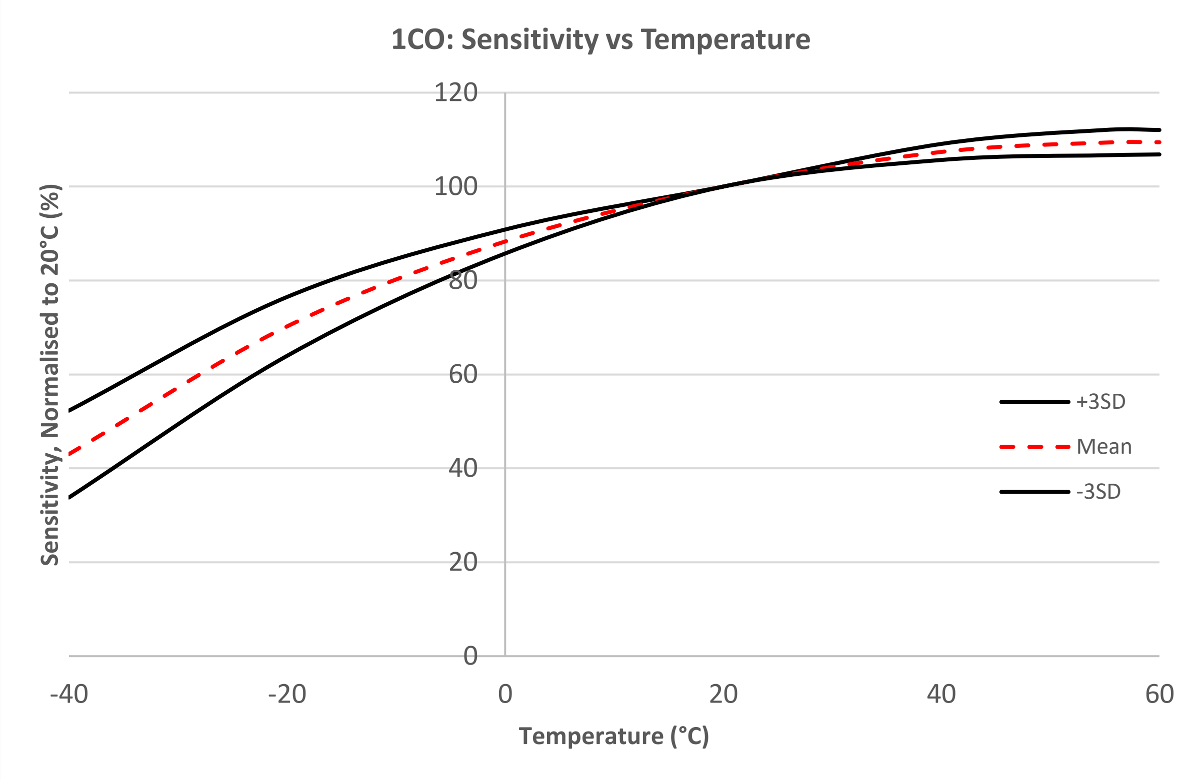


Figure 1. Gas Response Curve

Variation of Sensitivity with Temperature

The output of the 1CO will vary as a function of ambient temperature. The data in Figure 2 shows the typical variation in sensitivity across the operating temperature range and is presented normalized to the 20°C value. For instruments that are expected to function across a wide range of ambient temperatures, City Technology recommends that an electronic compensation algorithm is used to ensure maximum accuracy. The presented results reflect the performance of a typical production batch.

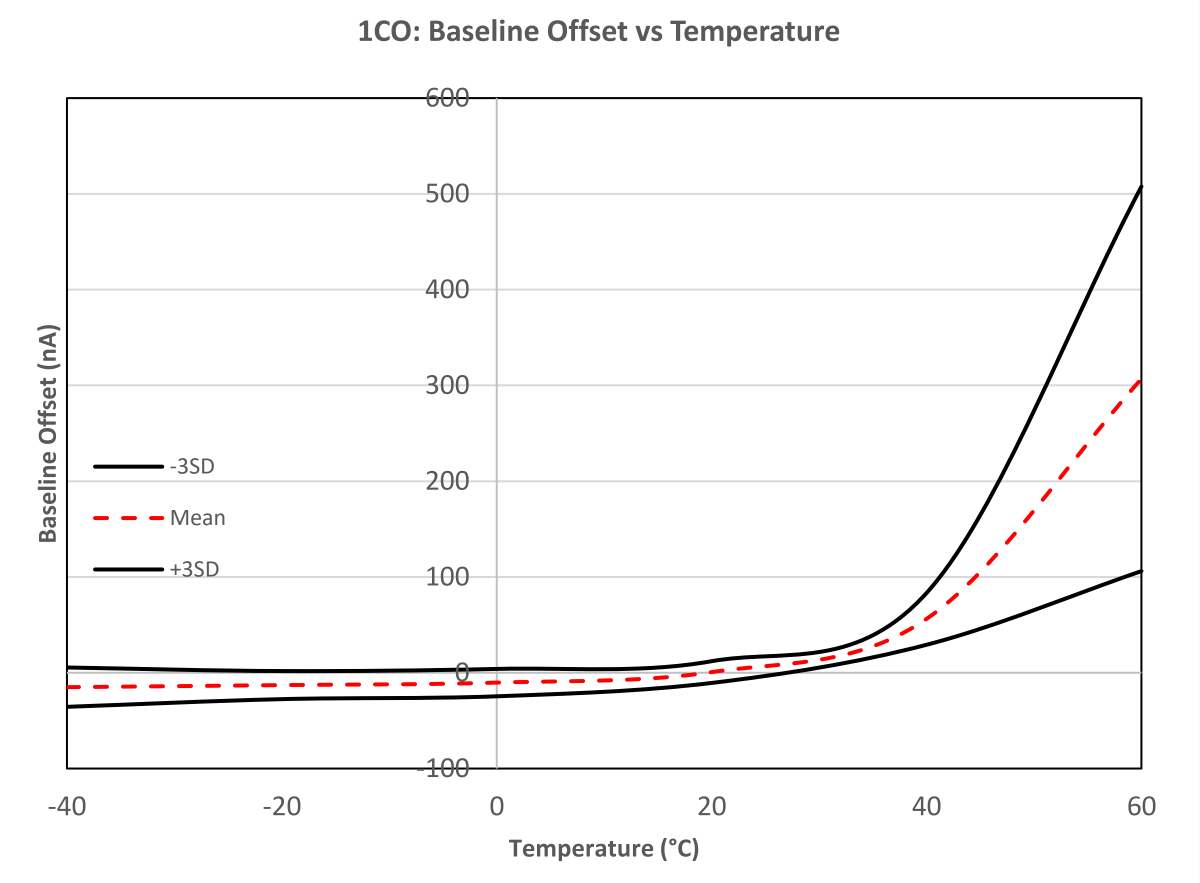


Temperature (°C)	-40	-20	0	20	40	55	60
Average (%)	43.04	70.22	88.29	100	107.37	109.36	109.44
-3SD	33.78	63.95	85.74	100	105.67	106.66	106.84
+3SD	52.29	76.48	90.84	100	109.08	112.06	112.05

Figure 2. Temperature Characteristics Variation of Output with Temperature

Variation of Baseline Offset with Temperature

The electrical output in the absence of target gas (baseline offset) of the 1CO will vary as a function of the ambient temperature. The data below shows typical 1CO performance across the operating temperature range, for sensors calibrated at 20°C. Although the variation is relatively small, City Technology recommends the use of offset correction factors so as to minimize inaccuracies in the baseline measurement. The presented results reflect the performance of a typical production batch.



Temperature (°C)	-40	-20	0	20	40	60
Average	-15.03	-12.87	-10.28	0.71	56.25	306.89
-3SD	-35.56	-27.52	-24.57	-10.62	29.22	106.14
+3SD	5.49	1.77	4.01	12.05	83.28	507.64

Figure 3. Variation of Baseline Offset with Temperature

Variation of T90 Response Time with Temperature

The response time of the 1CO will vary as a function of ambient temperature, typically getting faster at higher temperatures and responding more slowly at lower temperatures. The data in Figure 4 shows typical T90 response times of the 1CO across the operating temperature range. Data is representative of a typical production batch.

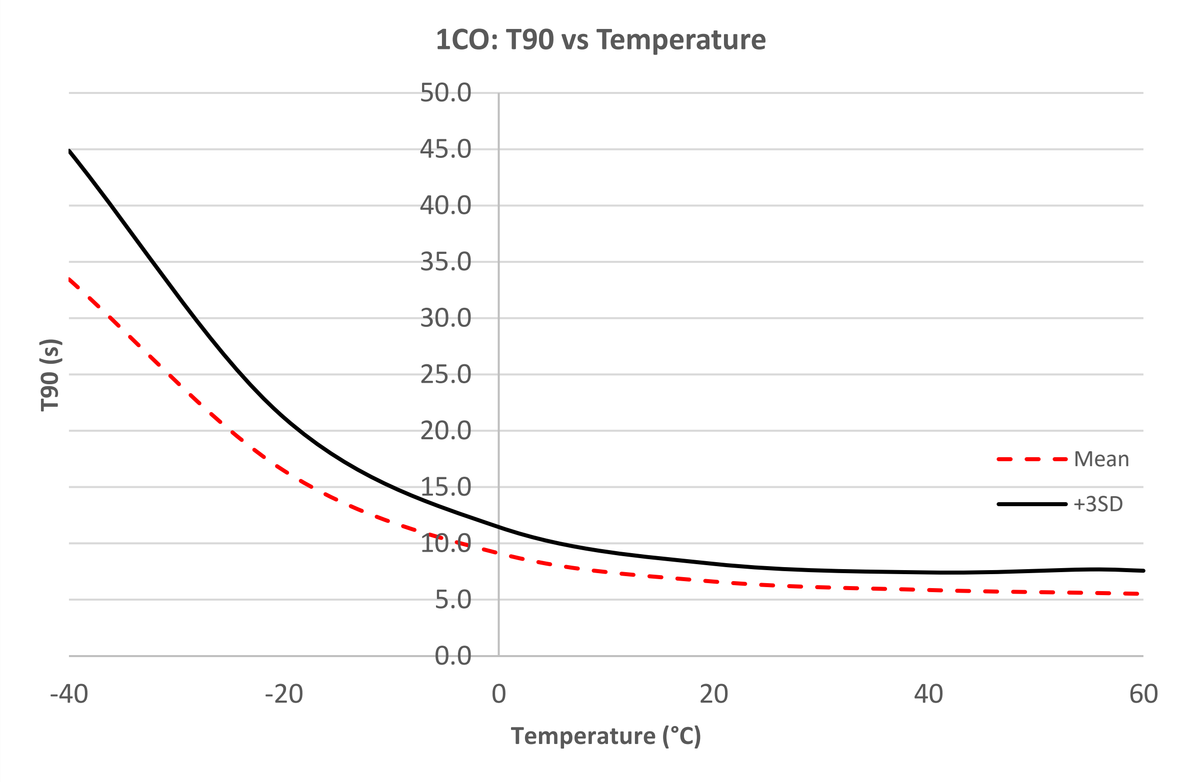


Figure 4. Variation of Response Time with Temperature

Long Term Data:

Long term Sensitivity

The typical long term sensitivity of the 1CO is represented in Figure 5, which reflects the performance of a typical production batch.

The sensor batch under test were stored and tested in ambient conditions.

Complementary results can be referred in the long-term performance note.

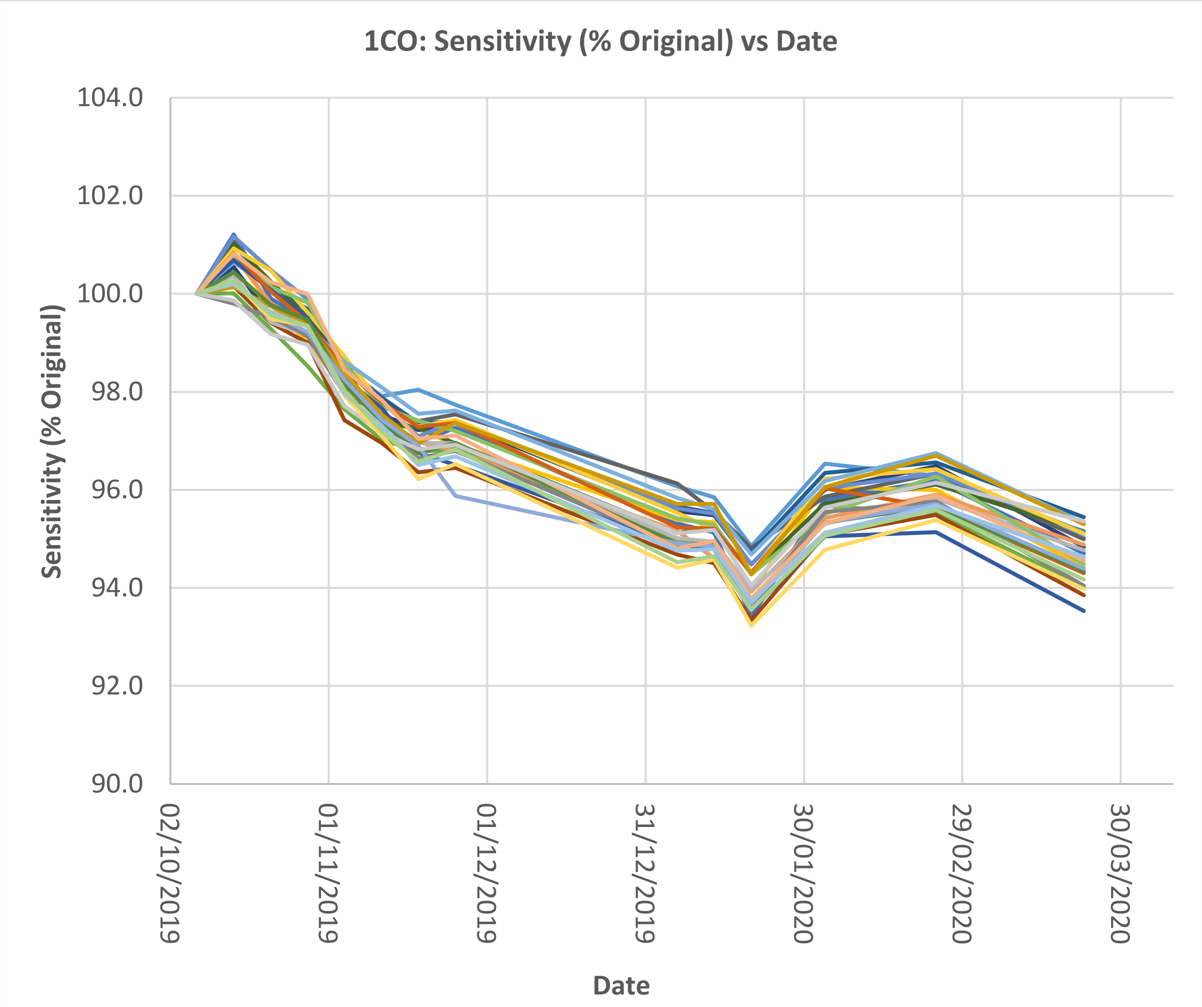


Figure 5. Sensitivity over time.

Long term Baseline Drift

The typical long term output drift of the 1CO is represented in Figure 6, which reflects the performance of a typical production batch.

The sensor batch under test were stored and tested in ambient conditions.

Complementary results can be referred in the long-term performance note.

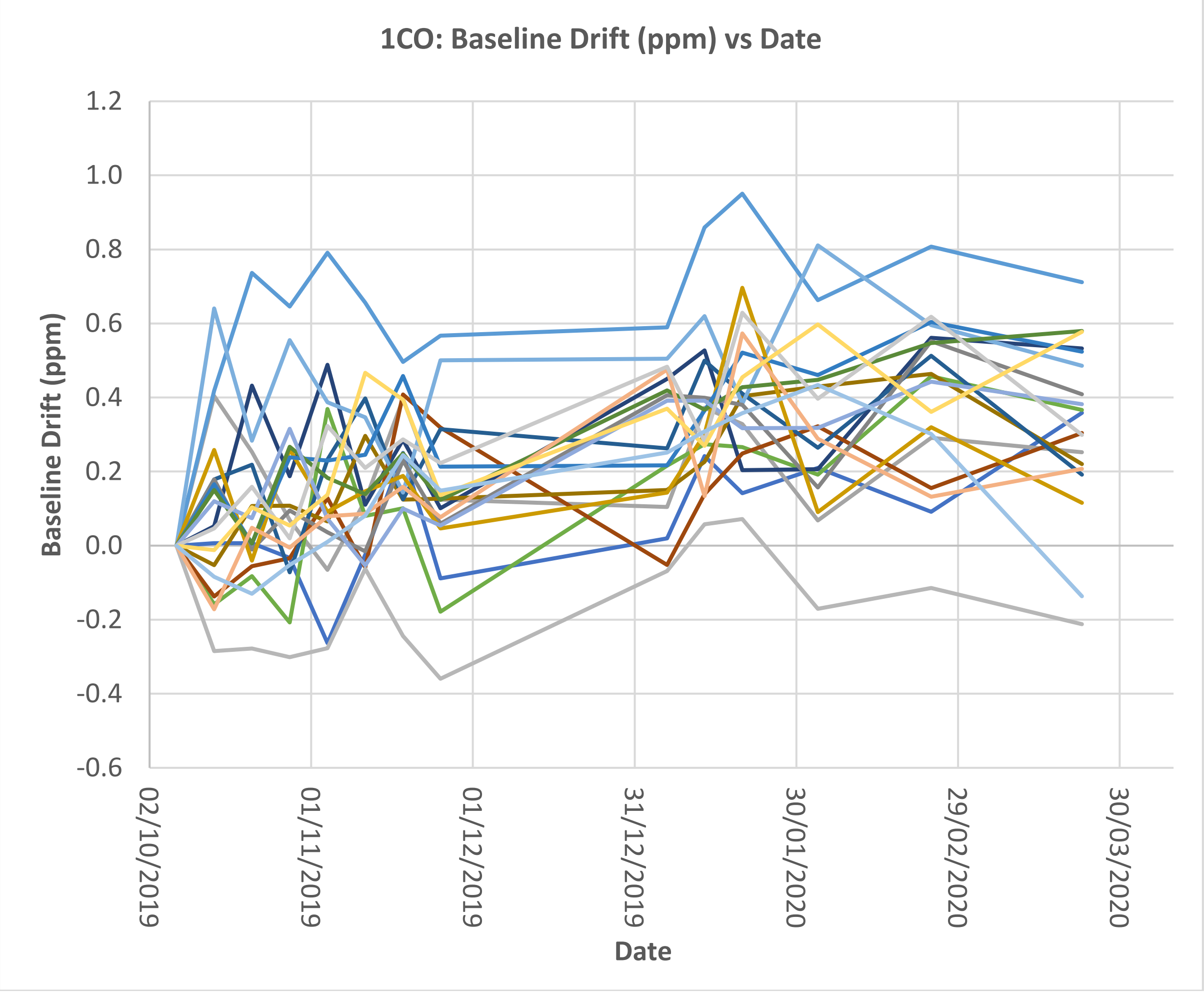


Figure 6. Long Term Baseline Drift

Long term T90 response

The typical long term T90 response of the 1CO is represented in Figure 7, which reflects the performance of a typical production batch.

The sensor batch under test were stored and tested in ambient conditions.

Complementary results can be referred in the long-term performance note.

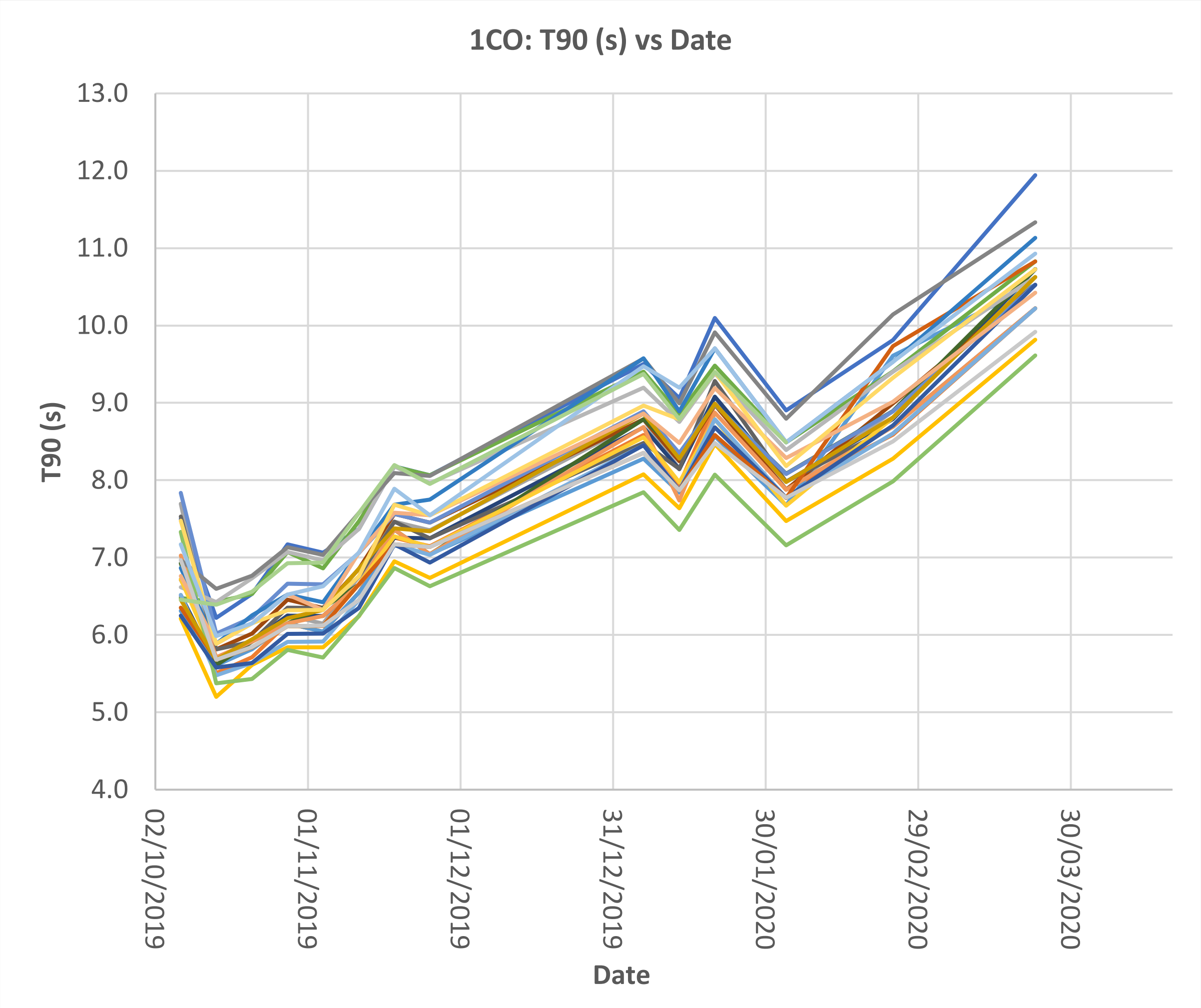


Figure 7. T90 over time

Performance note

Previous results corresponding to the long-term sensitivity, baseline and T90 response can be directly correlated with the weight loss effect of the sensors.

Figures 5, 6 and 7 would suggest that the sensor is slowing down the response and loosing sensitivity at an accelerated rate; however, the degradation of the sensor is attributed to the weight loss of the sensor rather than the elapsed time.

Figure 8 shows the data corresponding to the weight gain over time. During this period the humidity in the storage area dropped, causing sensors to lose water over time. The weight difference demonstrates that the sensors are decreasing weight due to the gradual drying out of water.

The previously long-term performance results can be correlated with the drying out effect.

Figure 8. The humidity in the storage area dropped, causing sensors to lose water over time.

Effect of Prolonged Exposure in Extreme conditions on Performance

If the sensor is subjected to prolonged extremes of relative humidity at high temperatures for extended periods of time, there remains a risk that the performance of the sensor may be compromised, showing a loss in sensitivity, enhanced baseline or slow response times. It is therefore recommended that if the intended use of the 1CO may subject it to prolonged exposures to extreme environments, City Technology's Technical Sales team is consulted for further advice as to the likely implications and how to overcome any issues seen.

60°C & 5 % RH:

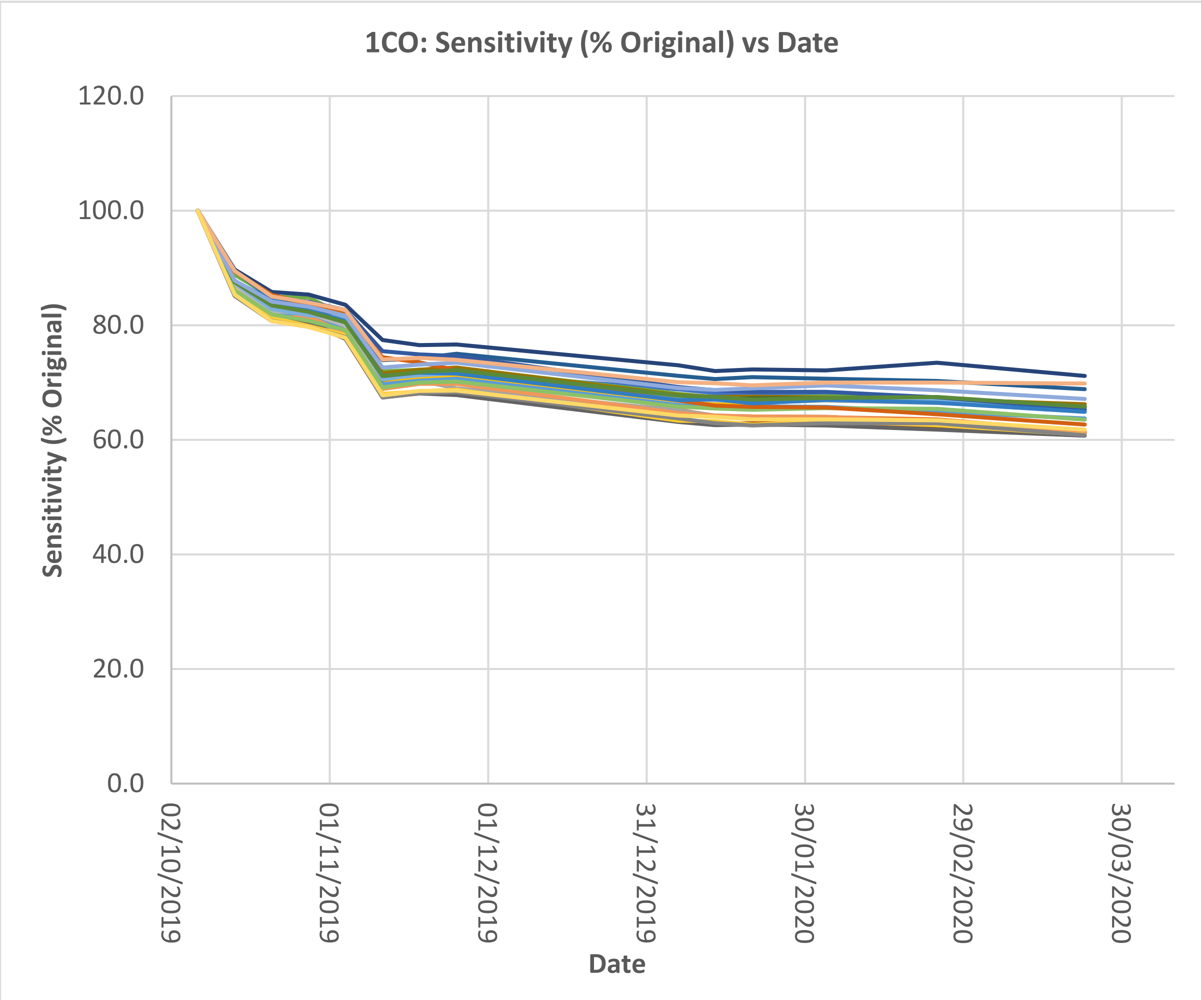


Figure 9. Variation in the Mean Normalised CO Sensitivities of 1CO Sensors with Time Stored Continuously at 60°C & 5%RH and tested in ambient conditions.

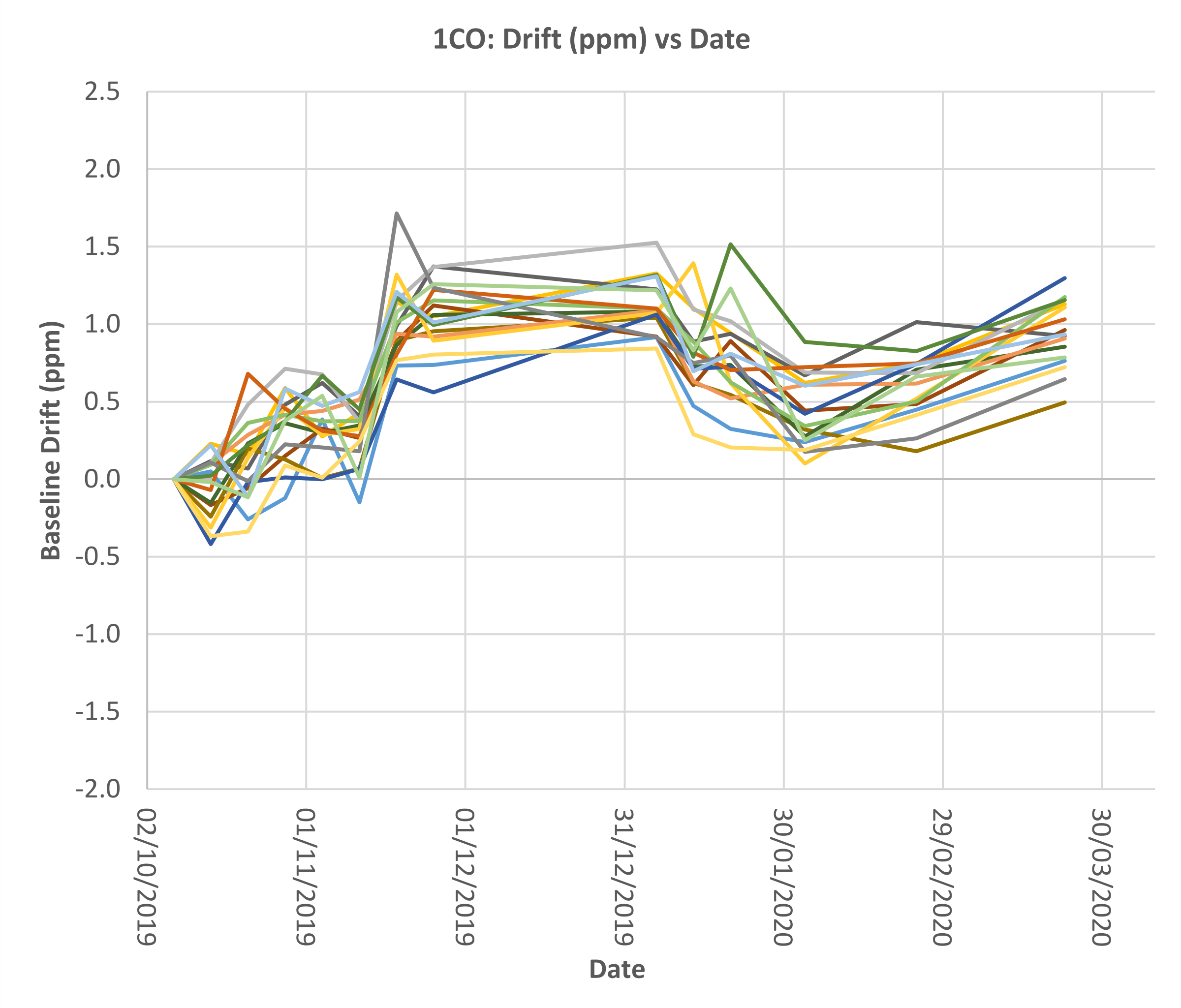


Figure 10. Variation in the baseline of 1CO Sensors with Time Stored Continuously at 60°C & 5%RH and tested in ambient conditions.

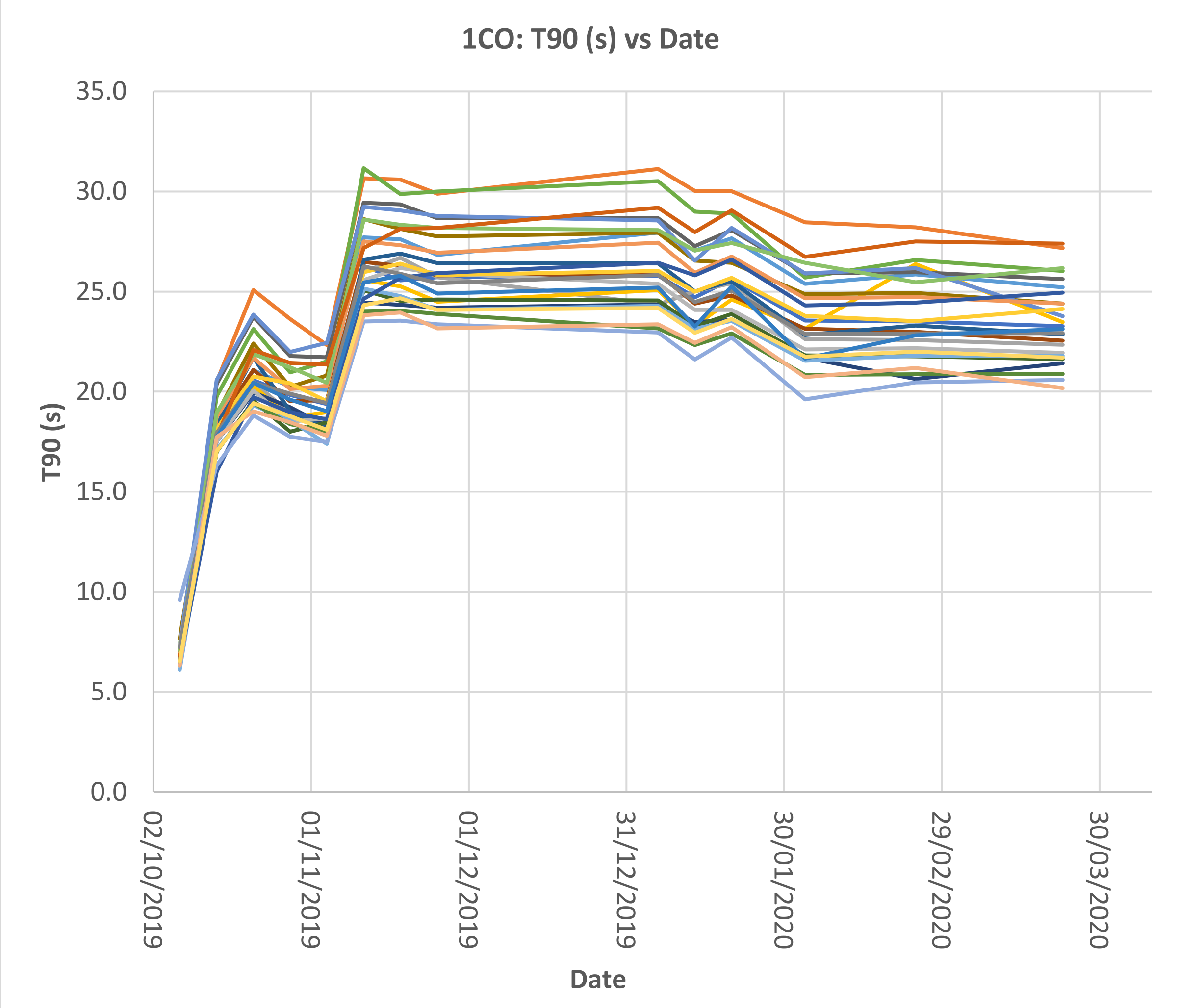


Figure 11. Variation in the T90 response of 1CO Sensors with Time Stored Continuously at 60°C & 5%RH and tested in ambient conditions.

60°C & 90 % RH:

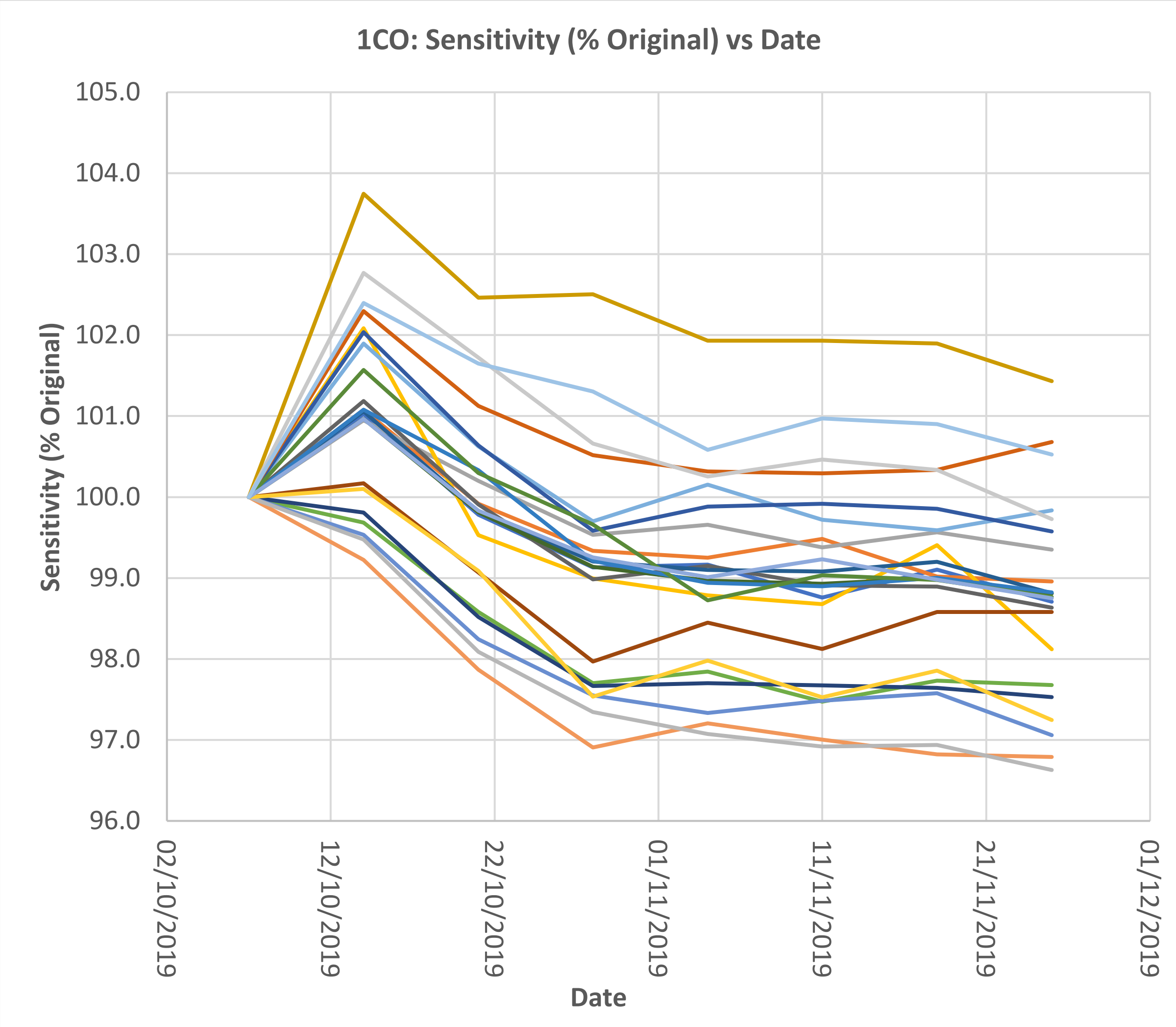


Figure 12. Variation in the Mean Normalised CO Sensitivities of 1CO Sensors with Time Stored Continuously at 60°C & 90%RH and tested in ambient conditions.

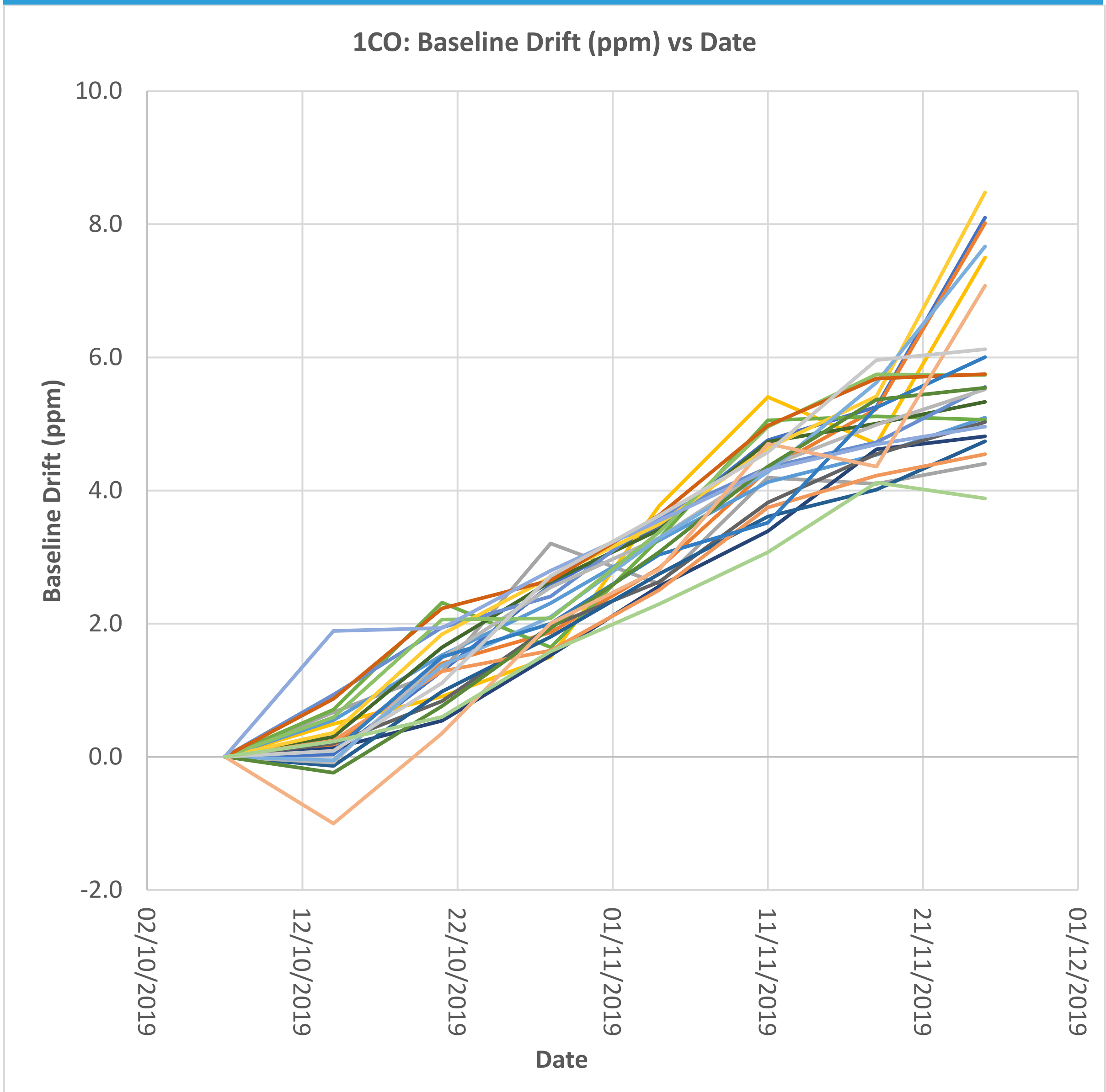


Figure 13. Variation in the baseline of 1CO Sensors with Time Stored Continuously at 60°C & 90%RH and tested in ambient conditions.

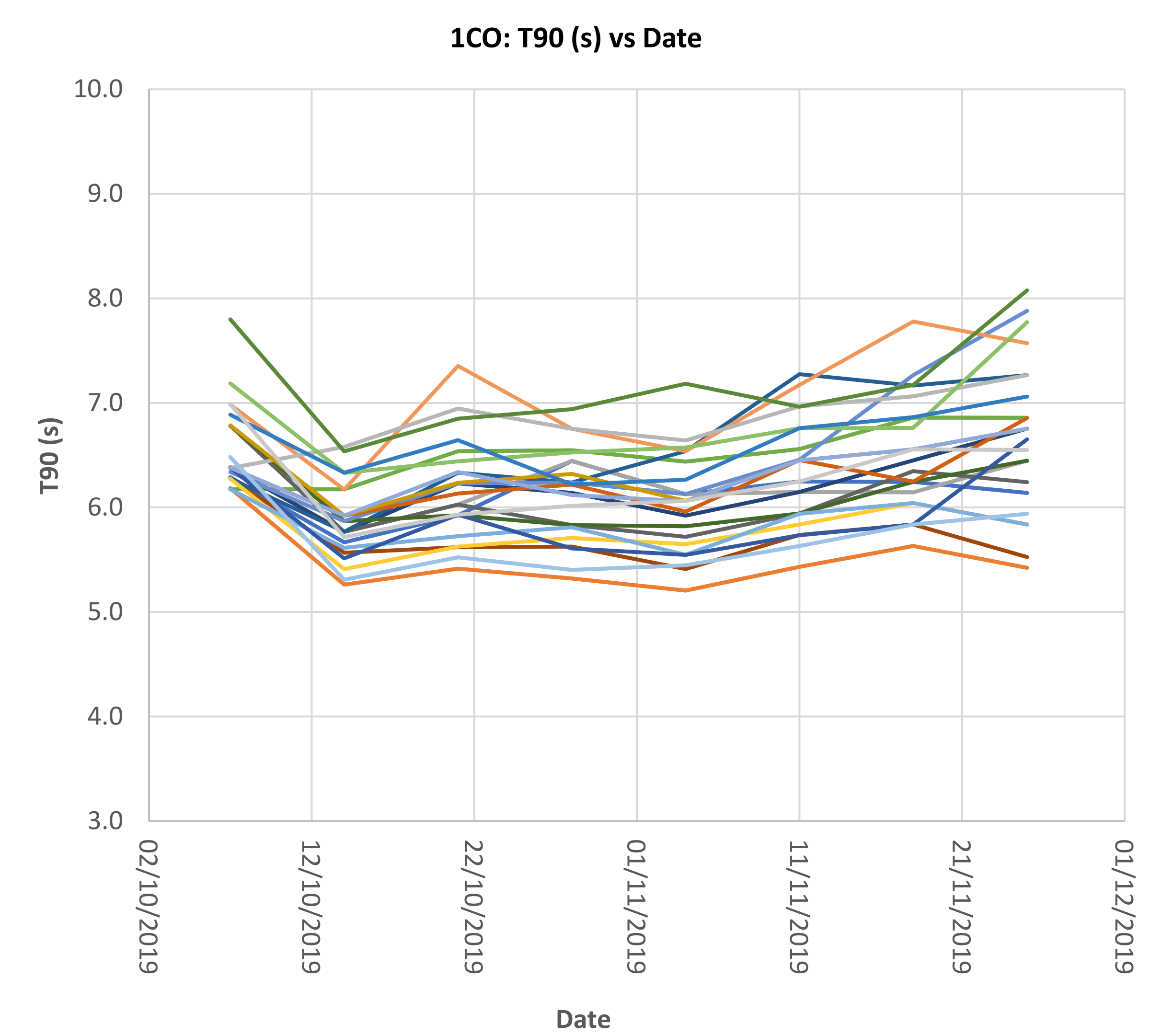


Figure 14. Variation in the T90 response of 1CO Sensors with Time Stored Continuously at 60°C & 90%RH and tested in ambient conditions.

-20°C:

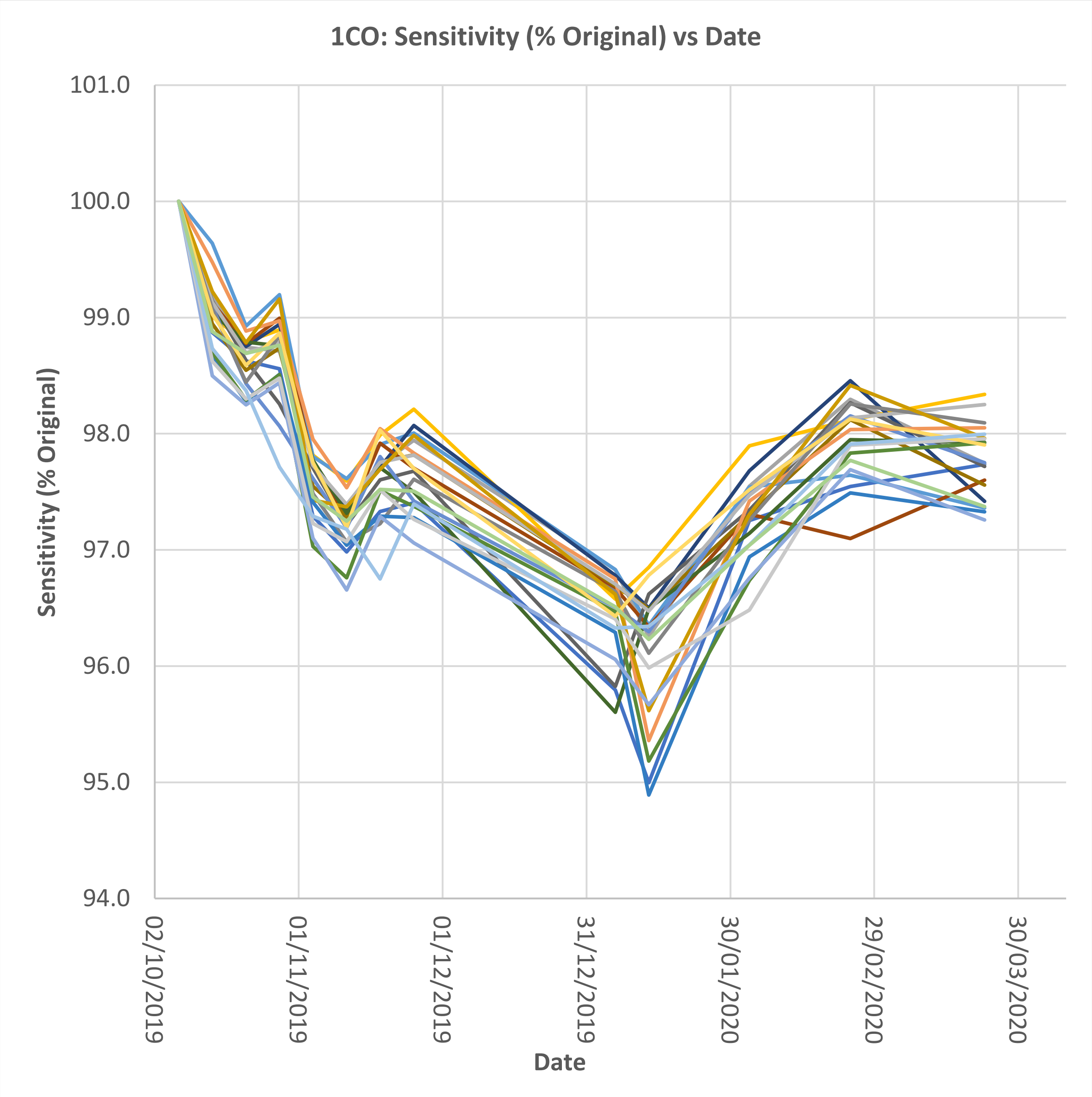


Figure 15. Sensitivity over time when sensors are stored continuously at -20°C. Tested in ambient conditions.

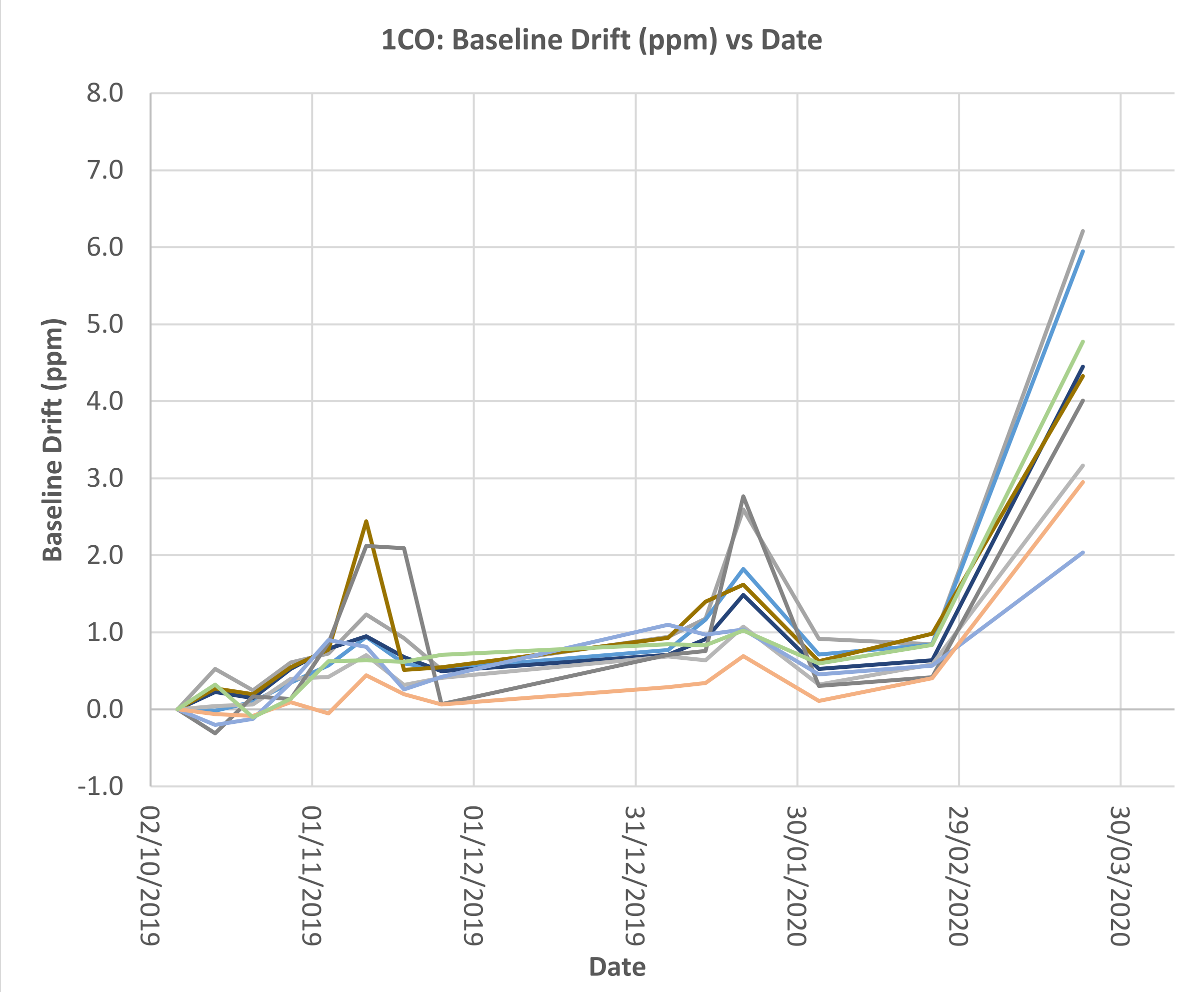


Figure 16. Long Term Baseline Drift when sensors are stored continuously at -20 °C. Tested in ambient conditions.

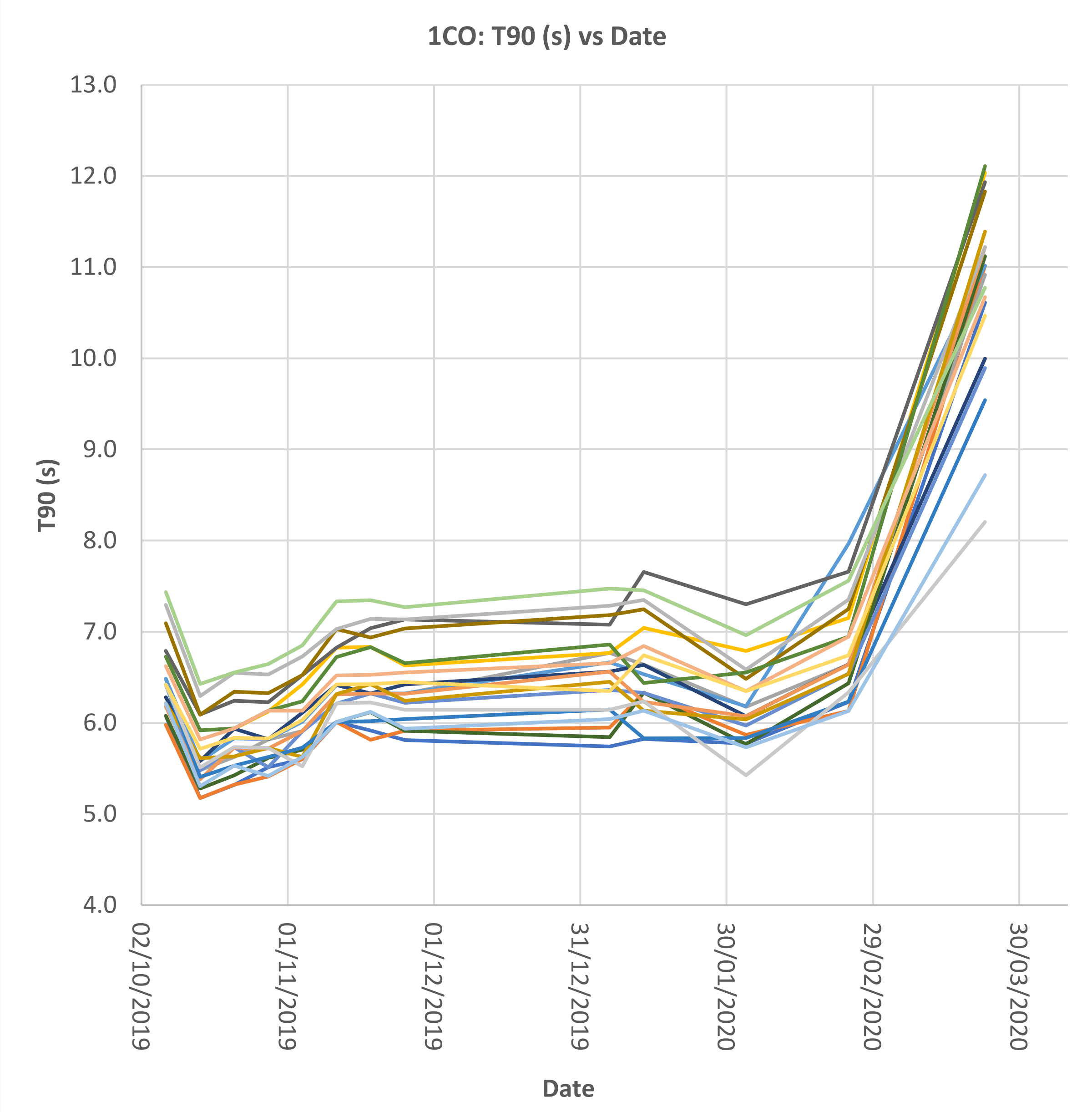


Figure 17. T90 response over time when sensors are stored continuously -20°C. Tested in ambient conditions.

Overload

Toxic gas sensors will be linear up to the maximum overload concentration and can operate for ten minutes without drifting by more than ±2% from the five-minute signal. The data in Figure 18 shows a typical overload response curve for the 1CO.

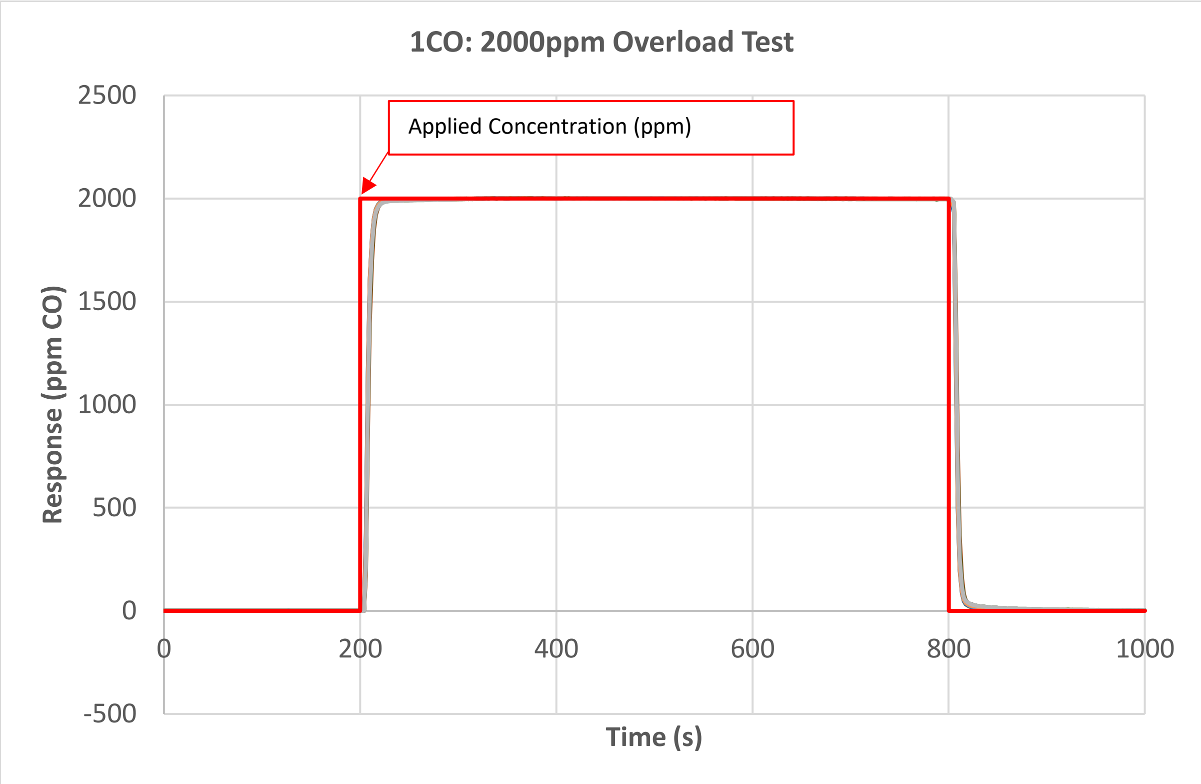
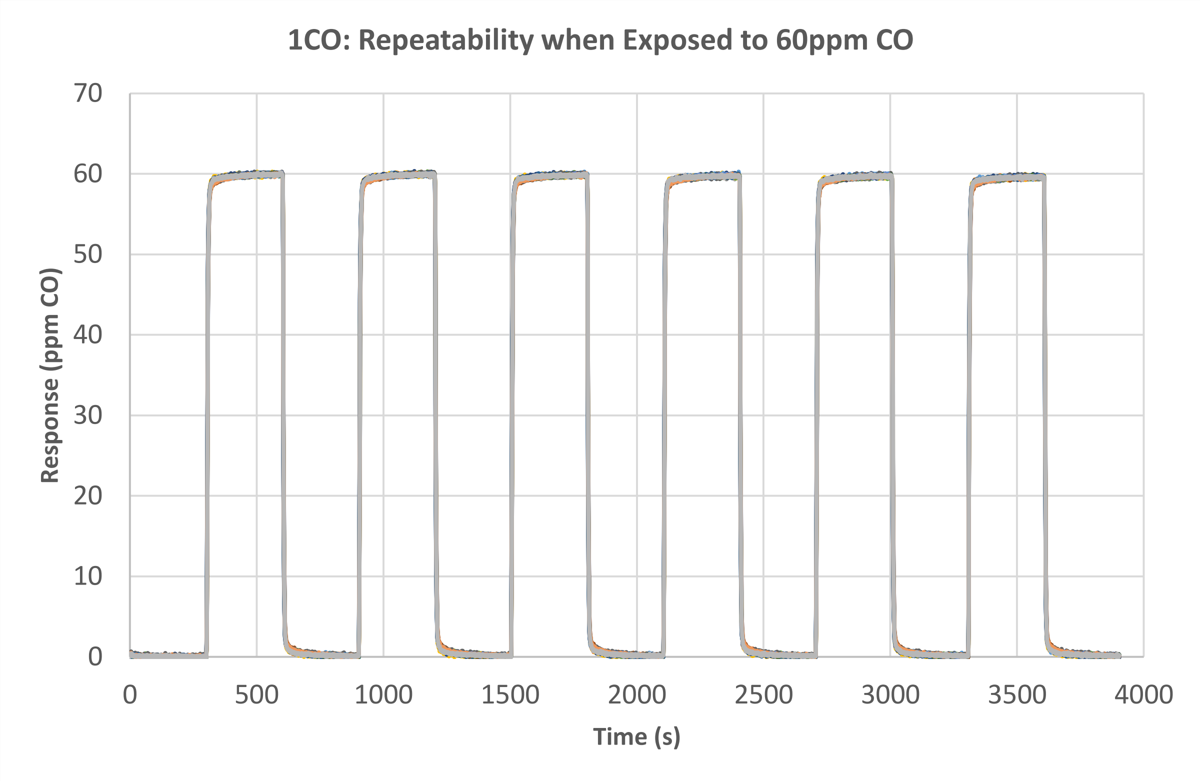


Figure 18: 1CO overload

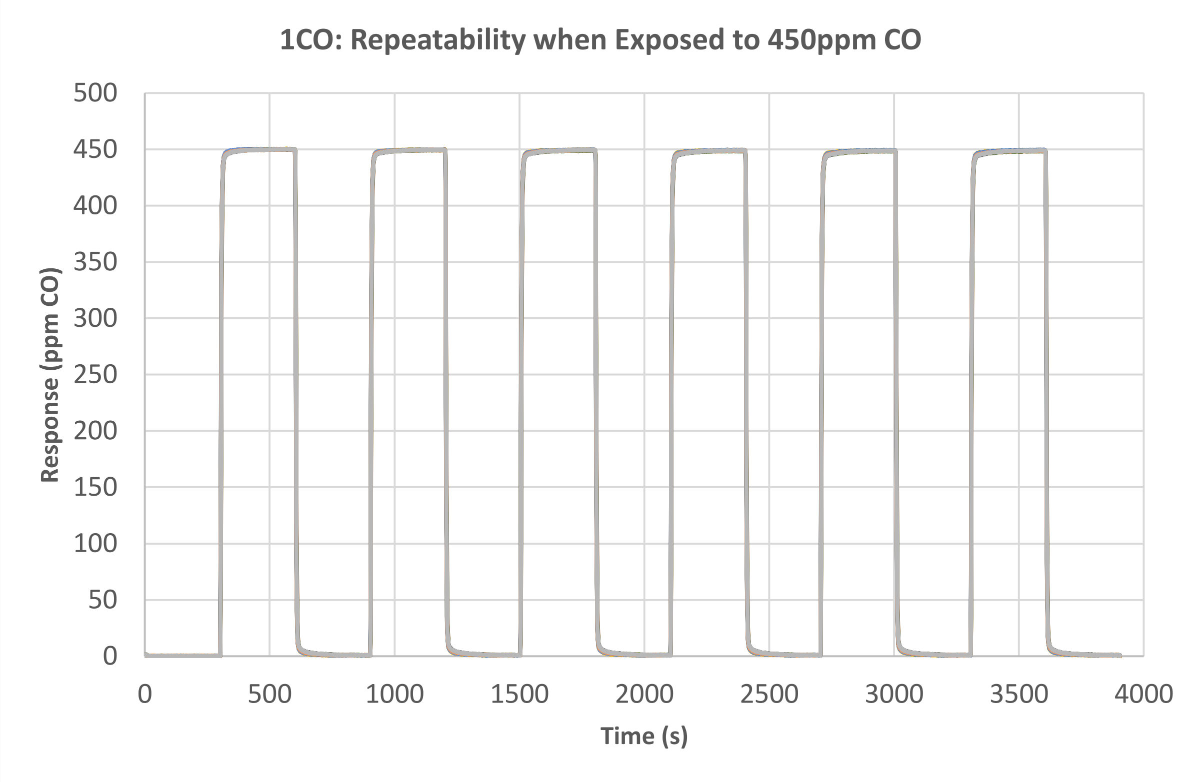
Repeatability

The data in Figure 19, 20 and 21 show the performance of the 1CO sensor when exposed repeatedly to CO. The presented results reflect the performance of a typical production batch.



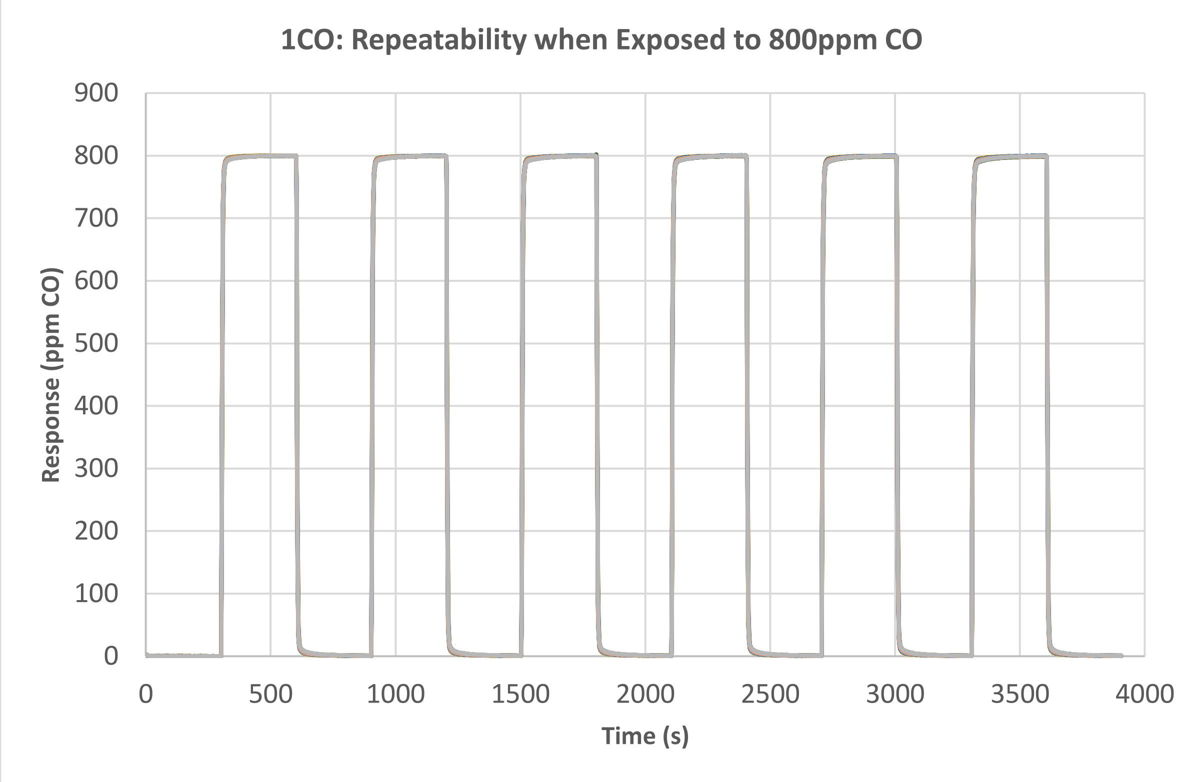
	1st application	2nd	3rd	4th	5th	6th
Mean response (ppm)	59.86	59.99	59.82	59.71	59.66	59.47
St Dev (ppm)	0.06	0.15	0.10	0.13	0.15	0.12

Figure 19. Repeatability of 1CO Sensor response to 60 ppm CO.



	1st application	2nd	3rd	4th	5th	6th
Mean response (ppm)	450.02	449.72	449.32	449.00	449.00	449.11
St Dev (ppm)	0.08	0.26	0.21	0.24	0.29	0.31

Figure 20. Repeatability of 1CO Sensor response to 450 ppm CO.



	1st application	2nd	3rd	4th	5th	6th
Mean response (ppm)	800.14	799.49	799.82	799.73	799.57	799.26
St Dev (ppm)	0.09	0.15	0.26	0.21	0.31	0.39

Figure 21. Repeatability of 1CO Sensor response to 800 ppm CO.

Linearity

The data in Figure 22 shows the typical linearity performance of the 1CO when subjected to differing carbon monoxide concentrations across the detection range. The presented results reflect the performance of a typical production batch. Across typical measurement ranges for industrial safety, the sensor can be considered linear.

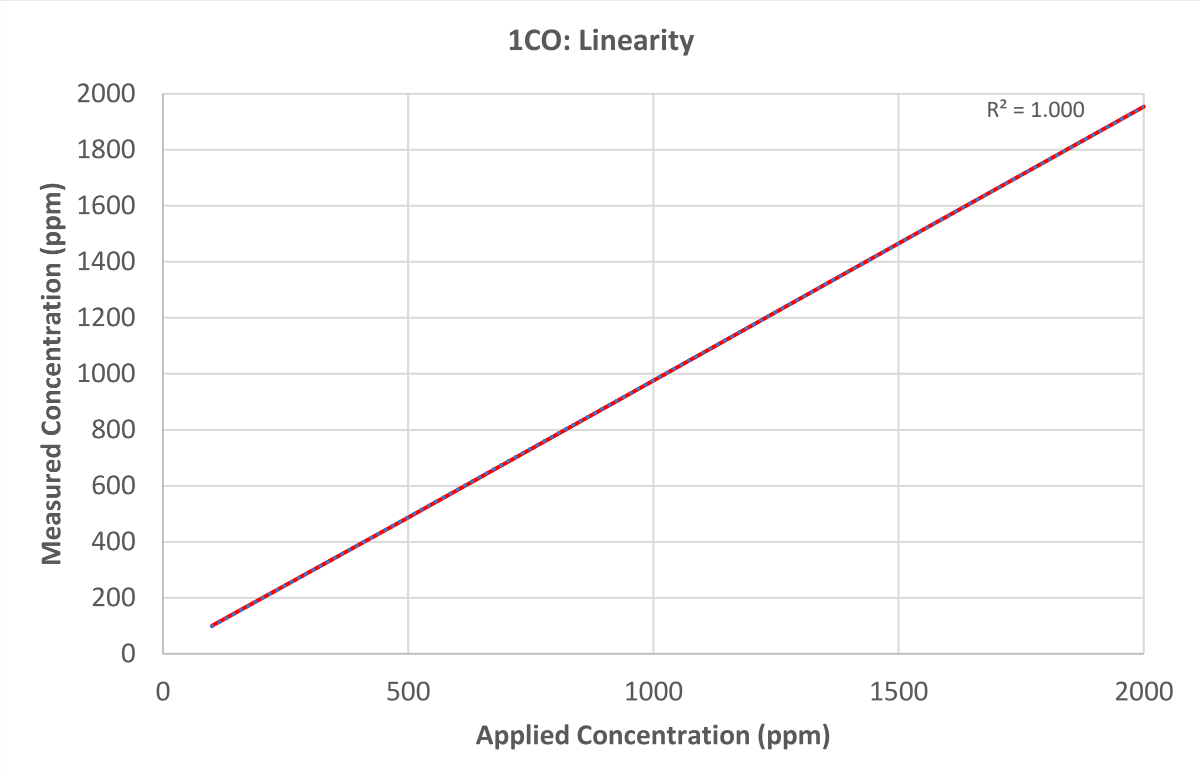


Figure 22: Linearity.

Cross Sensitivity Data

IMPORTANT NOTE The cross-sensitivity data shown below does not form part of the product specification and is supplied for guidance only. Values quoted are based on tests conducted on a small number of sensors and any batch may show significant variation. For the most accurate measurements, an instrument should be calibrated using the gas under investigation.

Whilst 1Series are designed to be specific to the gas they are intended to measure, they will still respond to some degree to various other gases. The table below is not exclusive and other gases not included in the table may still cause a sensor to react.

Gas	Applied	Response (ppm)	Cross-sensitivity (%)
Carbon Dioxide	5% V/V	0.6	0
Hydrogen	100ppm	20	20
Hydrogen Sulphide	10ppm	0.8	8
Methane	5%V/V	0	0
Nitrogen Dioxide	10ppm	0.4	4
Nitric Oxide	25ppm	7	28

Counter polarisation

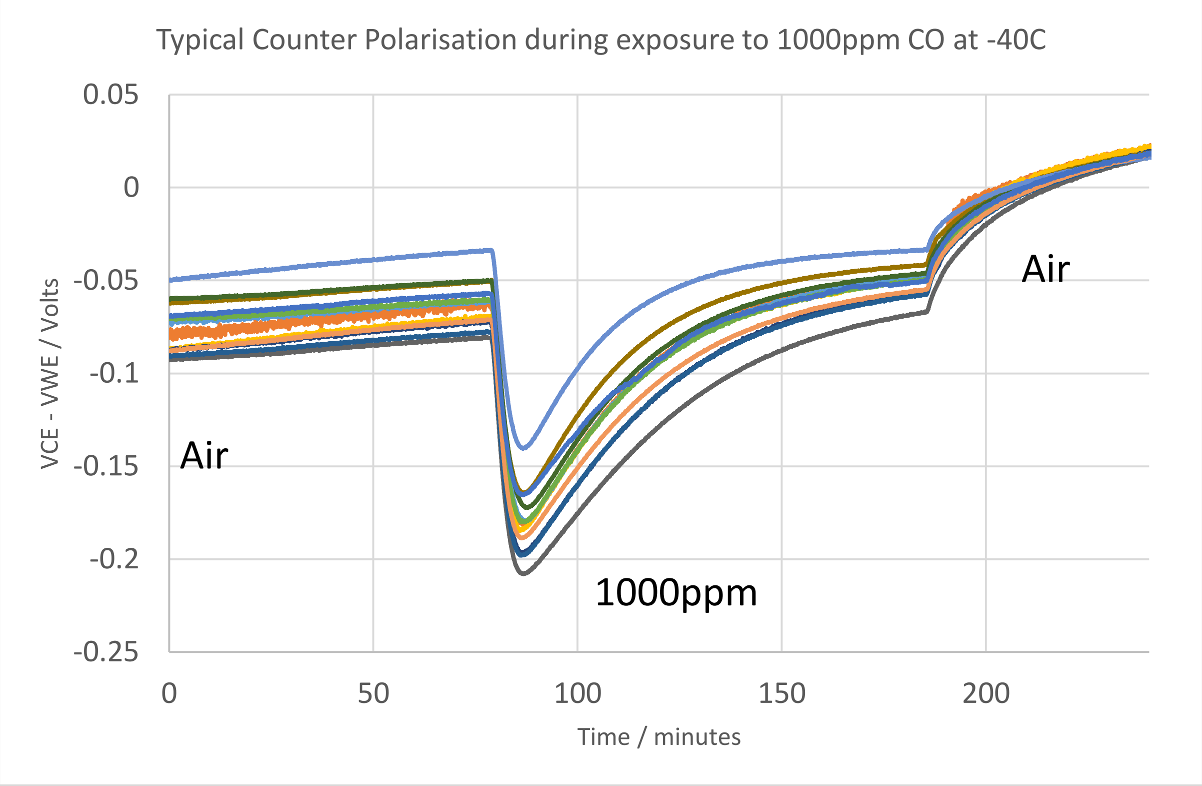


Figure 23: Counter polarization

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