Crowcon Technical Note

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Sensor Cross Sensitivity Guidance, Advice and Warnings

Introduction:

Toxic sensors are designed and built to demonstrate an optimum response to the target gas. However, interfering gases in the environment can affect the reading given. The information contained in this note has been collated to offer guidance and explain these cross sensitivities.
Crowcon regularly review the sensors available in the market, and focus on using the best possible solutions, many with active filters that assist in both reducing the possibility of inhibiting, poisoning and limiting cross sensitive response.

Flammable sensors are commonly available in two options, pellistor (catalytic) or InfraRed (IR). Whilst the pellistor option is recognised as lower cost and suited to most applications, it is susceptible to poisoning (silicone and hydrogen sulphide), is not failsafe and can be damaged following exposure to greater than 100% LEL levels of gas. Most Crowcon portables offer the 'pellistor saver' mode, which actively turns off the sensor whilst at the same time notifying the user that the sensor is not currently enabled (the monitor should at this point be in alarm as the saver mode is commonly set at 90% LEL).

Infrared sensors are currently available for flammable or carbon dioxide detection. IR options offer failsafe detection, lower battery consumption (meaning that portable monitors will run for longer from one charge) and immunity to potential poisons.

The most popular technology for measuring oxygen concentration in air is the galvanic oxygen sensor. As the lead is oxidised, the lifetime of the sensor is limited to either 2 or 3 years. Oxygen sensors are not commonly inhibited or cross sensitive to other gases.

What is cross sensitivity?

There are a number of forms of cross sensitivity, and more than one can be relevant at one time:

1. Interference readings causing false alarms or no alarm
    i. Positive response to a non target gas, causes a positive reading
    ii. Negative response to a non target gas, causes a negative reading
2. Inhibited response for a timeframe after exposure without causing long term damage
3. Poisoning which renders the sensor inoperable

Cross sensitivities can differ depending on the ambient temperature and level of gas the sensor is being exposed to. The information below is provided as a guide, and a thorough risk assessment to understand the potential gases in the environment is always recommended.

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Proving Response:
The best way to ensure the correct response of any sensor is to perform a regular gas test (bump test). Whilst there are increasingly strong recommendations for testing flammable sensors (EN60079-29 parts 1 and 2) the testing of toxic gases is not yet formalised. Most Crowcon offer this capability; please review the individual manuals for details.

Toxic gas sensors and their cross sensitivity response

The following table provides a guide to sensor cross sensitivities, and should be viewed with the 'Cross Sensitivity Chart' for easy application. Only sensors with cross sensitivity issues are listed.

Sensor	Common 1st Alarm	Common 2nd Alarm	Cross Sensitivity	Description / Recommended action	Status
Ammonia (NH3)	25 ppm		Hydrogen sulphide H_2S	Low positive response, this is a safe situation as the NH_3 sensor will show a positive reading in the presence of H_2S. In extreme cases this could cause a false alarm.	
Ammonia (NH3)	25 ppm		Sulphur Dioxide SO_2	Low to medium negative response	
Arsine AsH_3	0.05 ppm		Hydrogen Chloride HCl	Low positive response, this is a safe situation as the AsH_3 sensor will show a positive reading in the presence of HCL.	
Arsine AsH_3	0.05 ppm		Hydrogen Cyanide HCN	Low positive response, this is a safe situation as the AsH_3 sensor will show a positive reading in the presence of HCN.	
Arsine AsH_3	0.05 ppm		Hydrogen Sulphide H_2S	Medium to high positive response, this is a safe situation as the AsH_3 sensor will show a positive reading in the presence of H_2S.	
Arsine AsH_3	0.05 ppm		Nitrogen dioxide NO_2	Negative reading.	
Arsine AsH_3	0.05 ppm		Phosphine PH_3	High positive response, this is a safe situation as the AsH_3 sensor will show a positive reading in the presence of PH_3.	
Arsine AsH_3	0.05 ppm		Sulphur Dioxide SO_2	Medium positive response, this is a safe situation as the AsH_3 sensor will show a positive reading in the presence of SO_2.	
Carbon Monoxide CO	30 ppm		Acetylene C_2H_2	Unsafe response, CO sensor saturated at <2.5%LEL C_2H_2.	
Carbon Monoxide CO	30 ppm		Ethylene C_2H_4	Unsafe response, CO sensor saturated at <2.5%LEL C_2H_4.	
Carbon Monoxide CO	30 ppm		Ethanol C_2H_6O	Medium positive response, false alarms possible. Tests have shown that CO sensor will recover from short term exposure to low %LEL levels of ethanol.	
Carbon Monoxide CO	30 ppm		Hydrogen H_2	High positive response. The H_2 filtered sensor is therefore recommended for this combination.	
Carbon Monoxide CO	30 ppm		Nitric oxide NO	Low positive response, this is a safe situation as the CO sensor will show a positive reading in the presence of NO. In extreme cases this could cause a false alarm. The H_2 filtered sensor does not exhibit this response and is therefore recommended for this combination where at all possible.	
Chlorine Cl_2	0.3 ppm		Chlorine dioxide ClO_2	Medium positive response, this is a safe situation as the Cl_2 sensor will show a positive reading in the presence of ClO_2. In extreme cases this could cause a false alarm.	

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Sensor	Common 1st Alarm	Cross Sensitivity	Description / Recommended action	Status
Chlorine Cl_2	0.3 ppm	Fluorine F_2	Medium positive response, this is a safe situation as the Cl_2 sensor will show a positive reading in the presence of F_2.	
Chlorine Cl2	0.3 ppm	Hydrogen sulphide H2S	Reduce H2S alarm level to 2.5ppm and check response of Cl2 sensor after alarm event. The Cl2 sensor will recover quickly at these low levels, reducing the chance of permanent damage.	
Chlorine Cl_2	0.3 ppm	Nitrogen dioxide NO_2	Medium positive response, this is a safe situation as the Cl2 sensor will show a positive reading in the presence of NO2.	
Chlorine Cl_2	0.3 ppm	Ozone O_3	Medium positive response, this is a safe situation as the Cl_2 sensor will show a positive reading in the presence of O_3.	
Chlorine dioxide ClO_2	0.1 ppm	Hydrogen sulphide H_2S	Negative response at even very low levels, this also inhibits the sensor for a significant amount of time.	
Chlorine dioxide ClO_2	0.1 ppm	Chlorine Cl_2	High positive response, this is a safe situation as the ClO_2 sensor will show a positive reading in the presence of Cl_2.	
Chlorine dioxide ClO_2	0.1 ppm	Ozone O_3	High positive response, this is a safe situation as the ClO_2 sensor will show a positive reading in the presence of O3.	
Ethylene Oxide	5 ppm	Carbon Monoxide CO	Medium positive response, this is a safe situation as the ETO sensor will show a positive reading in the presence of CO.	
Fluorine F_2	1 ppm	Arsine AsH_3	Low to medium negative response	
Fluorine F_2	1 ppm	Chlorine Cl_2	High positive response, this is a safe situation as the F_2 sensor will show a positive reading in the presence of Cl_2.	
Fluorine F_2	1 ppm	Hydrogen Chloride HCl	Medium to high negative response	
Fluorine F_2	1 ppm	Hydrogen Sulphide H_2S	Medium to high negative response	
Fluorine F_2	1 ppm	Nitrogen Dioxide NO_2	High positive response, this is a safe situation as the F_2 sensor will show a positive reading in the presence of NO_2.	
Fluorine F_2	1 ppm	Ozone O_3	High positive response, this is a safe situation as the F_2 sensor will show a positive reading in the presence of O_3.	
Fluorine F_2	1 ppm	Phosphine	Medium negative response	
Fluorine F_2	1 ppm	Sulphur Dioxide SO_2	Low to medium negative response	
Hydrogen H_2 2000ppm range	999ppm	Carbon Monoxide CO	Medium positive response, this is a safe situation as the H_2 sensor will show a positive reading in the presence of CO.	
Hydrogen H_2 2000ppm range	999ppm	Nitrogen Monoxide NO	Medium positive response, this is a safe situation as the H_2 sensor will show a positive reading in the presence of NO.	
Hydrogen H_2 2000ppm range	999ppm	Ethylene C_2H_4	High positive response, sensor saturated at <1%LEL C_2H_4. Not recommended for use in applications with flammable levels of C_2H_4 are expected.	

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Sensor	Common 1st Alarm	Cross Sensitivity	Description / Recommended action	Status
Hydrogen cyanide HCN	0.9 ppm	Nitrogen Monoxide NO	Low negative response	
Hydrogen cyanide HCN	0.9 ppm	Nitrogen Dioxide NO_2	High negative response	
Hydrogen cyanide HCN	0.9 ppm	Hydrogen Sulphide	After filter saturation there will be a high positive response. This is a safe situation as the HCN sensor will show a positive reading in the presence of H_2S.	
Hydrogen chloride HCl	1 ppm	Arsine AsH_3	High positive response, this is a safe situation as the HCl sensor will show a positive reading in the presence of AsH_3.	
Hydrogen chloride HCl	1 ppm	Chlorine Cl_2	Low level response which can be positive or negative.	
Hydrogen chloride HCl	1 ppm	Hydrogen Cyanide HCN	Medium to high positive response, this is a safe situation as the HCl sensor will show a positive reading in the presence of HCN	
Hydrogen chloride HCl	1 ppm	Hydrogen Sulphide H_2S	High positive response, this is a safe situation as the HCl sensor will show a positive reading in the presence of H_2S.	
Hydrogen chloride HCl	1 ppm	Nitrogen Monoxide NO	Medium to High positive response, this is a safe situation as the HCl sensor will show a positive reading in the presence of NO.	
Hydrogen chloride HCl	1 ppm	Nitrogen Dioxide NO_2	Low level response which can be positive or negative.	
Hydrogen chloride HCl	1 ppm	Phosphine PH_3	High positive response, this is a safe situation as the HCl sensor will show a positive reading in the presence of PH_3.	
Hydrogen chloride HCl	1 ppm	Sulphur Dioxide SO_2	High positive response, this is a safe situation as the HCl sensor will show a positive reading in the presence of SO_2.	
Hydrogen sulphide H_2S	5 ppm	Chlorine	Low negative response, 1ppm of Cl_2 (please note the common alarm level is 0.3ppm) will be indicated by a -0.25ppm reading on the H_2S sensor. Reduce H_2S alarm level to 2.5ppm.	
Hydrogen Fluoride HF	1.8 ppm	Acetic Acid $C_2H_4O_2$	High positive response, 100ppm Acetic Acid will be indicated by approx. 80ppm.	
Hydrogen Fluoride HF	1.8 ppm	Chlorine Cl_2	High positive response, 5ppm Cl_2 will be indicated by a >5ppm reading. (*Short gas exposure in minute range*).	
Hydrogen Fluoride HF	1.8 ppm	Hydrogen Chloride HCl	High positive response, 10ppm HCl will be indicated by an 8ppm reading. (*Use HCl for HF calibration*)	
Hydrogen Fluoride HF	1.8 ppm	Sulphur Dioxide SO_2	High positive response, 20ppm SO_2 will be indicated by a >10ppm reading. (*Short gas exposure in minute range – reading will rise initially and then drop*).	
Hydrogen sulphide H_2S	5 ppm	Sulphur dioxide SO_2	Low positive response, this is a safe situation as the H_2S sensor will show a positive reading in the presence of SO_2. In extreme cases this could cause a false alarm.	
Hydrogen sulphide H_2S	5 ppm	Nitrogen Monoxide NO	Low positive response, this is a safe situation as the H_2S sensor will show a positive reading in the presence of NO. In extreme cases this could cause a false alarm.	

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Hydrogen sulphide H_2S	5 ppm	Nitrogen dioxide NO_2	Low negative response. Reduce H_2S alarm level to 2.5ppm.	
Nitrogen Monoxide NO	2 ppm	Hydrogen sulphide H_2S	Medium positive response, this is a safe situation as the NO sensor will show a positive reading in the presence of H_2S. In extreme cases this could cause a false alarm.	
Nitrogen Monoxide NO	2 ppm	Chlorine Cl_2	Low positive response, this is a safe situation as the NO sensor will show a positive reading in the presence of Cl_2. In extreme cases this could cause a false alarm.	
Nitrogen Monoxide NO	2 ppm	Sulphur dioxide SO_2	Low positive response, this is a safe situation as the NO sensor will show a positive reading in the presence of SO_2. In extreme cases this could cause a false alarm.	
Nitrogen Monoxide NO	2 ppm	Nitrogen dioxide NO_2	Low positive response, this is a safe situation as the NO sensor will show a positive reading in the presence of NO2. In extreme cases this could cause a false alarm.	
Nitrogen dioxide NO_2	0.5 ppm	Chlorine Cl_2	High positive response, this is a safe situation as the NO2 sensor will show a positive reading in the presence of Cl2. In extreme cases this could cause a false alarm.	
Nitrogen dioxide NO_2	0.5 ppm	Hydrogen sulphide H_2S	Low negative response. Reduce H_2S alarm level to 2.5ppm.	
Nitrogen dioxide NO_2	0.5 ppm	Sulphur dioxide SO_2	Low negative response, this situation should be highlighted to the user as SO2 on the NO2 sensor could lead to a low reading. However with EH40 alarm levels in place this is a safe situation as alarms will have sounded prior to incorrect readings.	
Ozone O_3	0.1 ppm	Chlorine Cl_2	High positive response, this is a safe situation as the O3 sensor will show a positive reading in the presence of Cl2. In extreme cases this could cause a false alarm.	
Ozone O_3	0.1 ppm	Chlorine dioxide ClO_2	High positive response, this is a safe situation as the O3 sensor will show a positive reading in the presence of ClO2. In extreme cases this could cause a false alarm.	
Ozone O_3	0.1 ppm	Hydrogen sulphide H_2S	Negative response at even very low levels, this also inhibits the sensor for a significant amount of time.	
Ozone O_3	0.1 ppm	Nitrogen dioxide NO_2	High positive response, this is a safe situation as the O3 sensor will show a positive reading in the presence of NO2. In extreme cases this could cause a false alarm.	
Phosphine PH_3	0.1 ppm	Arsine AsH_3	High positive response, this is a safe situation as the PH_3 sensor will show a positive reading in the presence of AsH_3.	
Phosphine PH_3	0.1 ppm	Chlorine CL_2	Low to medium negative response.	
Phosphine PH_3	0.1 ppm	Nitrogen Dioxide NO_2	Low to medium negative response.	
Phosphine PH_3	0.1 ppm	Sulphur Dioxide SO_2	Low to medium positive response on some sensors, this is a safe situation as the PH_3 sensor would show a positive reading in the presence of SO_2.	
Phosgene $COCl_2$	0.02ppm	Chlorine Cl_2	Medium to high positive response. This is a safe situation as the $COCl_2$ sensor will show a positive reading in the presence of Cl_2.	
Phosgene $COCl_2$	0.02ppm	Hydrogen Chloride HCl	High positive response. This is a safe situation as the $COCl_2$ sensor will show a positive reading in the presence of HCl.	

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Phosgene $COCl_2$	0.02ppm	Nitrogen Dioxide NO_2	Low to medium negative response.	
Sulphur dioxide SO_2	2 ppm	Chlorine Cl_2	Negative reading,	
Sulphur dioxide SO_2	2 ppm	Nitrogen Dioxide NO_2	Negative reading,	
Sulphur dioxide	2 ppm	Ethylene	Low positive response, this is a safe situation as the SO2 sensor will show a positive reading in the presence of C2H4. In extreme cases this could cause a false alarm.	

Status Key:

	Disruptive
	Under caution
	Lower Alarm Level

Note: Where CO or H2S are listed the detail is relevant to both single and dual sensors.

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Cross-Sensitivity Reference Table

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Cross Sensitivity Chart, reference - GEN089

Issue 1

Gas Applied	Sensor in Crowcon Portable: Oxygen	Ammonia	Arsine	Carbon monoxide	Carbon monoxide (H2 compensated)	Carbon dioxide	Chlorine	Chlorine dioxide	Ethylene Oxide	Fluorine	Hydrogen (2000ppm)	Hydrogen Cyanide	Hydrogen Chloride	Hydrogen Fluoride	Hydrogen sulphide	Nitrogen Monoxide	Nitrogen dioxide	Ozone	Phosphine	Phosgene	Sulphur dioxide
Pumped	Yes	Yes	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes	No	No	Yes	No	No	No	No	No	Yes
	O_2	NH_3	AsH_3	CO	CO	CO_2	Cl_2	ClO_2	EtO	F_2	H_2	HCN	HCl	HF	H_2S	NO	NO_2	O_3	PH_3	$COCl_2$	SO_2
Oxygen O_2																					
Ammonia NH_3																					
Arsine AsH3													+ High						+ High		
Carbon Monoxide CO									+ Med		+ Med										
Carbon Dioxide CO_2																					
Chlorine Cl_2		+ Med						+ High		+ High			+/- Low	+ High	H_2S	+ Low	+ High	+ High		+ Med	
Chlorine Dioxide ClO_2							+ Med											+ High			
Ethylene Oxide EtO				+ Med	+ Med						+ Med										
Fluorine F_2							+ High														
Hydrogen H_2				+ Med										+ Low							
Hydrogen Cyanide HCN			+ Low										+ Med								
Hydrogen Chloride HCl			+ Low											+ High						+ High	
Hydrogen Fluoride HF																					
Hydrogen Sulphide H_2S		+ Low	+ Med				H_2S					+ High	+ High			+ Med	H_2S				+ Low
Nitrogen Monoxide NO				+ Low							+ Med		+ High		+ Low						+/- Low
Nitrogen Dioxide NO_2		+ High					+ Med			+ High					H_2S	+ Low		+ High			
Ozone O_3							+ Med	+ High		+ High											
Phosphine PH_3			+ High										+ High								
Phosgene $COCl_2$																					
Sulphur Dioxide SO_2			+ Med										+ High	+ High	+ Low	+ Low	+ Low		+ Med		
Ethanol																					
Acetylene C_2H_2									+ High		+ High						+ High				+ High
Ethylene C_2H_4									+ Med		+ High						+ High				+ Med

	Disruptive	Should not be configured in the same detector. If the gas on the left is present in the application caution should be exercised.
	Under caution	Cross sensitivity indication, should the gas on the left be applied to the sensor. (Low= <15%, Med =15 to 60%, High equals >60%)
	Lower Alarm Level	The alarm level of the disruptive gas (shown in the cell) should be lowered to increase safety
	OK	No issues

Disclaimer: Please note, sensor cross sensitivity is dependant on sensors used and gases in the working environment. Sensitivity may be dependant on exposure level and time. The best way to ensure sensor performance is to regularly bump test and calibrate according to the manufacturers recomendations of use.

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