# TN2019: G460 and Micro IV electrochemical (EC) toxic sensor relative response matrix

January 7, 2014



## TN2019: Partial cross sensitivity matrix for sensors available for use in GfG G460 instruments*

| Sensor | Approximate relative response to target gas** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Acetic acid | Acetylene | Alcohols | Ammonia | Arsine | Bromine | Carbon dioxide | Carbon monoxide | Chlorine | Chlorine dioxide | Diborane | Ethanol | Ethylene | Fluorine | Germane | Hydro-carbons | Hydrogen | Hydrogen chloride | Hydrogen cyanide | Hydrogen fluoride | Hydrogen selenide | Hydrogen sulfide | Iodine | Nitric oxide | Nitrogen dioxide | Ozone | Phosphine | Silane | Sulfur dioxide |
| Ammonia | | | 0.000 | 1.000 | | | | 0.000 | 0.000 | | | | | | | | 0.000 | | | | | + | | | 0.000 | | | | + |
| Carbon monoxide (4CM) | | 0.880 | | 0.000 | | | | 1.000 | | | | 0.000 | 0.970 | | | | <0.280 | | | | | 0.000 | | 0.288 | < 0.025 | | | | 0.000 |
| Carbon monoxide (2CF) | | + | | | | | | 1.000 | | | | | 0.600 | | | | ± 0.050 | | | | | ± 0.034 | | 0.343 | <0.100 | | | | 0.000 |
| 4COSH CO channel | | + | | | | | | 1.000 | 0.000 | | | | | | | | 0.200 | | | | | 0.000*** | | 0.003 | 0.020 | | | | 0.000 |
| 4COSH H2S channel | | | | | | | | 0.000 | 0.000 | | | | | | | | < 0.010 | | | | | 1.000 | | < 0.029 | ≈ -0.200 | | | | < 0.2 |
| Chlorine | | | | 0.000 | | 1.000 | | 0.000 | 1.000 | 0.500 | | | | 0.400 | | | 0.000 | | | | | 0.000 | + | | 0.200 | 0.200 | | | 0.175 |
| Chlorine dioxide | | | 0.000 | | | | | 0.000 | 0.600 | 1.000 | | | | | | | 0.000 | | | | | -0.250 | | | | 2.800 | | | |
| Ethylene oxide | | | | | | | | 0.400 | | | | 0.550 | | | | | | | | | | | | | | | | | |
| Hydrogen | | | | | | | | 0.200 | 0.000 | | | | 0.800 | | | | 1.000 | 0.000 | 0.300 | | | 0.200 | | 0.286 | 0.000 | | | | 0.000 |
| Hydrogen chloride | | | 0.000 | 0.000 | 3.500 | | 0.000 | 0.000 | <±0.02 | | + | | | | | 0.000 | 0.000 | 1.000 | 0.350 | | | 3.000 | | 0.450 | < ±0.05 | | 3.000 | + | 0.400 |
| Hydrogen cyanide | | | 0.000 | | | | 0.000 | 0.000 | | | | | | | | 0.000 | 0.000 | | 1.000 | | | | | -0.050 | -0.700 | | | | 0.000 |
| Hydrogen fluoride | 1.000 | | 0.000 | | | | 0.000 | 0.000 | 0.700 | | | | | | | 0.000 | 0.000 | 0.600 | | 1.000 | | | | | | | | | 0.800 |
| Hydrogen sulfide | | | | | | | | 0.007 | | | | | | | | | 0.001 | | | | | 1.000 | | -0.020 | -0.200 | | | | 0.200 |
| Nitric oxide | | | 0.000 | | | | 0.000 | 0.000 | 0.000 | | | | | | | 0.000 | 0.000 | | 0.250 | | | | | 1.000 | 0.350 | 0.000 | | | 0.300 |
| Nitrogen dioxide | | | 0.000 | | | | 0.000 | | 1.000 | | | | | | | | 0.000 | | | | | | | 0.400 | 1.000 | | | | -0.250 |
| Ozone | | | | | | + | 0.000 | 0.000 | 1.200 | 1.500 | | | | | | | 0.000 | | | | | -0.080 | + | | 0.600 | 1.000 | | | |
| Phosphine | | | | | 0.750 | | | 0.005 | | | 0.350 | | 0.010 | | 0.917 | | 0.001 | | | | | | | | | | | 0.900 | 0.200 |
| Silane | | | 0.000 | | 1.250 | | 0.000 | 0.000 | -0.117 | | 1.350 | | | | + | 0.000 | 0.000 | 0.056 | 0.064 | 0.000 | 0.25 | 0.445 | | | -0.230 | | 1.750 | 1.000 | 0.411 |
| Sulfur dioxide | | 3.000 | | 0.000 | | | | <0.003 | -0.400 | | | | 0.900 | | | | < 0.003 | | <0.500 | | | 0.004 | | <-0.100 | -1.667 | | | | 1.000 |

*Relative response values are subject to modification without prior announcement. Contact factory to verify current accuracy. Response values are approximate, and refer only to the concentrations used to test the sensors in the charts below. Other concentrations of target gas may produce a different relative response ratio. Sensors may include internal filters designed to remove interfering gases. Prolonged exposure to interfering gas may saturate the internal filters, causing a different response to the target gas.

**A "+" sign indicates a positive response is expected, but has not been verified.

***Instruments designed for use with 4COSH sensors calculate the expected breakthrough of H2S on the CO channel, and reduce the CO reading by the amount necessary to correct the reading. Thus, while the CO sensor channel may show a significant response to H2S, (which depending on ambient conditions, can be up to 0.400), the instrumenty reading in most cases is not affected.

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**Sensoric NH3 3E 5000 SE ammonia**

**CROSS SENSITIVITIES AT 20 °C**

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Alcohols | 1000 ppm | 0 |
| Carbon Monoxide | 100 ppm | 0 |
| Chlorine | 5 ppm | 0 |
| Nitrogen Dioxide | 10 ppm | 0 |
| Sulfur Dioxide | 20 ppm | expected / no data |
| Hydrogen | 3000 ppm | 0 |
| Hydrogen Sulfide | 20 ppm | yes / no data |

Notes:
1. Interference factors may differ from sensor to sensor and with life time. It is not adviseable to calibrate with interference gases.
2. This table does not claim to be complete. The sensor might also be sensitive to other gases.

**City 4CM carbon monoxide**

**Cross Sensitivity Table**

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

| Gas | Concentration Used (ppm) | Reading (ppm CO) |
|---|---|---|
| Acetylene ($C_2H_2$) | 100 | 88 |
| Ethylene ($C_2H_4$) | 100 | 97 |
| Hydrogen ($H_2$) | 100 | < 28 |
| Nitric Oxide (NO) | 48.6 | 14 |
| Nitrogen Dioxide ($NO_2$) | 19.5 | <0.5 |
| Chlorine ($Cl_2$) | 13.7 | <0.5 |
| Ethanol ($C_2H_5OH$) | 200 | 0 |
| Hydrogen Sulfide ($H_2S$) | 50 | 0 |
| Sulfur Dioxide ($SO_2$) | 20 | 0 |
| Ammonia ($NH_3$) | 20 | 0 |

The cross-sensitivity values quoted are based on tests conducted on a small number of sensors. They are intended to indicate sensor response to gases other than the target gas. Sensors may behave differently with changes in ambient conditions and any batch may show significant variation from the values quoted.

**Sensoric HF 3E 10 SE hydrogen fluoride**

**Cross Sensitivities at 20 °C**

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Acetic Acid | 100 ppm | 100 |
| Alcohols | 1000 ppm | 0 |
| Carbon Dioxide | 5000 ppm | 0 |
| Carbon Monoxide | 100 ppm | 0 |
| Chlorine | 1 ppm | 0.7 |
| Hydrocarbons | % range | 0 |
| Hydrogen | 3000 ppm | < 1 |
| Hydrogen Chloride | 10 ppm | 6 |
| Sulfur Dioxide | 20 ppm | 16[1] |

1) Short gas exposure in minute range.

**Sensoric 4HYT hydrogen**

**Cross-sensitivity Data**

CiTiceLs may exhibit a response to certain gases in a sample other than the target gas. 4HYT CiTiceLs have been tested with a number of commonly cross-interfering gases and the results are given below. The table shows the typical response to be expected from a sensor when exposed to a given test gas concentration (relevant to safety, e.g. TLV levels).

| Gas | Conc. | 4HYT | Gas | Conc. | 4HYT |
|---|---|---|---|---|---|
| **Carbon monoxide:** | 300ppm | ≤60ppm | **Chlorine:** | 1ppm | 0ppm |
| **Hydrogen sulphide:** | 15ppm | <3ppm | **Hydrogen cyanide:** | 10ppm | ≈3ppm |
| **Sulphur dioxide:** | 5ppm | 0ppm | **Hydrogen chloride:** | 5ppm | 0ppm |
| **Nitric oxide:** | 35ppm | ≈10ppm | **Ethylene:** | 100ppm | ≈80ppm |
| **Nitrogen dioxide:** | 5ppm | 0ppm | | | |

**For details of other possible cross-interfering gases contact City Technology.**

**City 4ETO ethylene oxide**

**Cross-sensitivity**

The following cross-sensitivities have been measured on the 4ETO:

| | | | |
|---|---|---|---|
| Ethanol | ≈55% | Methyl-ethyl-ketone | ≈10% |
| Toluene | ≈20% | Carbon monoxide | ≈40% |

**Sensoric HCl 3E 30 hydrogen chloride**

**CROSS SENSITIVITIES AT 20 °C**

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Alcohols | 1000 ppm | 0 |
| Ammonia | 100 ppm | 0 |
| Arsine | 0.2 ppm | 0.7 |
| Carbon Dioxide | 5000 ppm | 0 |
| Carbon Monoxide | 100 ppm | 0 |
| Chlorine | 5 ppm | <±0.1 |
| Hydrocarbons | % range | 0 |
| Hydrogen | 10000 ppm | 0 |
| Hydrogen Cyanide | 20 ppm | 7 |
| Hydrogen Sulfide | 20 ppm | 60 |
| Nitric Oxide | 100 ppm | 45 |
| Nitrogen | 100 % | 0 |
| Nitrogen Dioxide | 10 ppm | <±0.5 |
| Phosphine | 0.1 ppm | 0.3 |
| Sulfur Dioxide | 20 ppm | 8 |

Notes:
1. Interference factors may differ from sensor to sensor and with life time. It is not adviseable to calibrate with interference gases.
2. This table does not claim to be complete. The sensor might also be sensitive to other gases.

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**Sensoric NO 3E 100 nitric oxide**

## CROSS SENSITIVITIES AT 20 °C

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Alcohols | 1000 ppm | 0 |
| Carbon Dioxide | 5000 ppm | 0 |
| Carbon Monoxide | 100 ppm | 0 |
| Chlorine | 1 ppm | 0 |
| Hydrocarbons | 5 ppm | 0 |
| Hydrogen | 3000 ppm | 0 |
| Hydrogen Cyanide | 20 ppm | 5 |
| Hydrogen Sulfide | 10 ppm | yes; n/d |
| Nitrogen | 100 % | 0 |
| Nitrogen Dioxide | 10 ppm | 3.5 |
| Ozone | 0.25 ppm | 0 |
| Sulfur Dioxide | 20 ppm | 6 |
| unsat. Hydrocarbons | | yes; n/d |

Notes:
1. Interference factors may differ from sensor to sensor and with life time. It is not adviseable to calibrate with interference gases.
2. This table does not claim to be complete. The sensor might also be sensitive to other gases.

**Sensoric NO2 3E 50 nitrogen dioxide**

## CROSS SENSITIVITIES AT 20 °C

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Alcohols | 1000 ppm | 0 |
| Carbon Dioxide | 5000 ppm | 0 |
| Chlorine | 1 ppm | 1 |
| Nitric Oxide | 100 ppm | 0.4 |
| Sulfur Dioxide | 20 ppm | -5 |
| Hydrogen | 3000 ppm | 0 |

Notes:
1. Interference factors may differ from sensor to sensor and with life time. It is not adviseable to calibrate with interference gases.
2. This table does not claim to be complete. The sensor might also be sensitive to other gases.

**City 4PH-fast phosphine**

## Cross-sensitivity Data

CiTiceLs may exhibit a response to certain gases in a sample other than the target gas. 4PH CiTiceLs have been tested with a number of commonly cross-interfering gases and the results are given below. The table shows the typical response to be expected from a sensor when exposed to a given test gas concentration (relevant to safety, e.g. TLV levels).

| Gas | Conc. | 4PH | Gas | Conc. | 4PH |
|---|---|---|---|---|---|
| **Arsine:** | 150ppb | 100ppb | **Sulphur dioxide:** | 5ppm | 1ppm |
| **Silane:** | 1000ppb | 900ppb | **Hydrogen:** | 1000ppm | 1ppm |
| **Diborane:** | 300ppb | 105ppb | **Ethylene:** | 100ppm | 1ppm |
| **Germane:** | 600ppb | 550ppb | **Carbon monoxide:** | 1000ppm | 5ppm |

**For details of other possible cross-interfering gases contact City Technology.**

**City 2CF (low hydrogen cross sensitivity) CO sensor**

## Cross-sensitivity Data

CiTiceLs may exhibit a response to certain gases in a sample other than the target gas. 2CF CiTiceLs have been tested with a number of commonly cross-interfering gases and the results are given below. The table shows the typical response to be expected from a sensor when exposed to a given test gas concentration (relevant to safety, e.g. TLV levels).

| Gas | Conc | 2CF |
|---|---|---|
| Hydrogen Sulphide | 15ppm | -0.5ppm < x$ < +0.5ppm |
| Sulphur Dioxide | 5ppm | 0ppm |
| Nitrogen Dioxide | 5ppm | <0.5ppm |
| Hydrogen | 100ppm | -5ppm < x$ < +5ppm |
| Nitric Oxide | 35ppm | 12ppm |
| Ethylene | 100ppm | 60ppm |

**For details of other possible cross-interfering gases contact City Technology.**

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**City 4COSH dual-channel CO and H2S sensor**

## Cross-sensitivity Data

CiTiceLs may exhibit a response to certain gases in a sample other than the target gas. 4COSH CiTiceLs have been tested with a number of commonly cross-interfering gases and the results are given below. The table shows the typical response to be expected from a sensor when exposed to a given test gas concentration (relevant to safety, e.g. TLV levels):

| Test gas | Test gas conc. (ppm) | ppm on $H_2S$ channel | ppm on CO channel |
|---|---|---|---|
| Carbon Monoxide, CO | 300 | <6 | 300 |
| Hydrogen Sulfide, $H_2S$ | 15 | 16 | 0 to 6 |
| Hydrogen | 100 | 0.03 | ~ 20 |
| Nitric Oxide, NO | 35 | <1 | <0.1 |
| Nitrogen Dioxide, $NO_2$ | 5 | ~ -1 | <0.1 |
| Chlorine, $Cl_2$ | 1 | 0 | 0 |
| Sulfur Dioxide, $SO_2$ | 5 | <1 | 0 |

**Sensoric HCN 3E 30 F hydrogen cyanide**

### CROSS SENSITIVITIES AT 20 °C

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Alcohols | 1000 ppm | 0 |
| Carbon Dioxide | 5000 ppm | 0 |
| Carbon Monoxide | 100 ppm | 0 |
| Hydrocarbons | % range | 0 |
| Hydrogen | 10000 ppm | 0 |
| Nitric Oxide | 100 ppm | -5 |
| Nitrogen Dioxide | 10 ppm | -7 |
| Hydrogen Sulfide | 20 ppm | 0[1] |

1) Short gas exposure in minute range; after filter saturation: approx. 40 ppm reading.

Notes:
1. Interference factors may differ from sensor to sensor and with life time. It is not adviseable to calibrate with interference gases.
2. This table does not claim to be complete. The sensor might also be sensitive to other gases.

**Sensoric 4Cl2 3E 50 chlorine**

### CROSS SENSITIVITIES AT 20 °C

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Ammonia | 100 ppm | 0 |
| Bromine | 1 ppm | 1.0 |
| Carbon Dioxide | 1 % | 0 |
| Carbon Monoxide | 100 ppm | 0 |
| Chlorine Dioxide | 1 ppm | 0.5 |
| Fluorine | 1.0 ppm | 0.4 |
| Hydrogen | 3000 ppm | 0 |
| Hydrogen Sulfide | 20 ppm | 0[1] |
| Nitrogen Dioxide | 10 ppm | 2 |
| Ozone | 0.25 ppm | 0.05 |
| Sulfur Dioxide | 20 ppm | 3.5 |

1) Exposure to $H_2S$ will poison the cell; further exposure to chlorine will re-activate the sensor.

Notes:
1. Interference factors may differ from sensor to sensor and with life time. It is not advisable to calibrate with interference gases.
2. This table does not claim to be complete. The sensor might also be sensitive to other gases.

**Sensoric ClO2 3E 1 O chlorine dioxide**

### CROSS SENSITIVITIES AT 20 °C

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Alcohols | 1000 ppm | 0 |
| Carbon Monoxide | 100 ppm | 0 |
| Chlorine | 1 ppm | 0.6 |
| Ozone | 0.25 ppm | 0.7 |
| Hydrogen | 3000 ppm | 0 |
| Hydrogen Sulfide | 20 ppm | -5 |

Notes:
1. Interference factors may differ from sensor to sensor and with life time.
2. This table does not claim to be complete. The sensor might also be sensitive to other gases.
3. It is recommended to use 1 – 5 ppm $Cl_2$ for cross calibration.

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**Sensoric O3 3E 1 ozone**

**CROSS SENSITIVITIES AT 20 °C**

| Gas | Concentration | Reading [ppm] |
|---|---|---|
| Bromine, Iodine | | yes; n/d |
| Carbon Dioxide | 5000 ppm | 0 |
| Carbon Monoxide | 100 ppm | 0 |
| Chlorine | 1 ppm | 1.2 |
| Chlorine Dioxide | 1 ppm | 1.5 |
| Hydrazine | 3 ppm | -3 |
| Hydrogen | 3000 ppm | 0 |
| Hydrogen Sulfide | 20 ppm | -1.6 [1)] |
| Nitrogen | 100 % | 0 |
| Nitrogen Dioxide | 10 ppm | 6 |

1) Continuous exposure at ppm level over more than 30 min. might blind the sensor.

Notes:
1. Interference factors may differ from sensor to sensor and with life time. It is not adviseable to calibrate with interference gases.
2. This table does not claim to be complete. The sensor might also be sensitive to other gases.

**Sensoric SiH4 3E 50 LT silane**

**Cross Sensitivity Table**

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

| Gas | Concentration Used (ppm) | Reading (ppm $SiH_4$) |
|---|---|---|
| Arsine, $AsH_3$ | 0.16 | 0.2 |
| Carbon Dioxide, $CO_2$ | 5000 | 0 |
| Carbon Monoxide, CO | 85 | 0 |
| Chlorine, $Cl_2$ | 0.85 | -0.1 |
| Diborane, $B_2H_6$ | 0.2 | 0.27 |
| Hydrocarbons, $CH_4$ | 18000 | 0 |
| Hydrogen, $H_2$ | 3100 | 0 |
| Hydrogen Chloride, HCl | 8 | 0.45 |
| Hydrogen Cyanide, HCN | 12 | 0.77 |
| Hydrogen Fluoride, HF | 7.2 | 0 |
| Hydrogen Selenide, $H_2Se$ | 0.8 | 0.2 |
| Hydrogen Sulfide, $H_2S$ | 18 | 8 |
| Nitrogen Dioxide, $NO_2$ | 10 | -2.3 |
| Phosphine, $PH_3$ | 0.2 | 0.35 |
| Propan-2-ol, $C_3H_5OH$ | 25000 | 0 |
| Sulfur Dioxide, $SO_2$ | 18 | 7.4 |

The cross-sensitivity values quoted are based on tests conducted on a small number of sensors. They are intended to indicate sensor response to gases other than the target gas. Sensors may behave differently with changes in ambient conditions and any batch may show significant variation from the values quoted.

**City 4HS-LM hydrogen sulfide**

**Cross-sensitivity Data**

CiTiceLs may exhibit a response to certain gases in a sample other than the target gas. 4HS/LM CiTiceLs have been tested with a number of commonly cross-interfering gases and the results are given below. The table shows the typical response to be expected from a sensor when exposed to a given test gas concentration (relevant to safety, e.g. TLV levels).

| Gas | Conc. | 4HS/LM | Gas | Conc. | 4HS/LM |
|---|---|---|---|---|---|
| **Carbon monoxide:** | 300ppm | ≤2ppm | **Hydrogen:** | 10000ppm | ≤10ppm |
| **Sulphur dioxide:** | 5ppm | ≈1ppm | **Nitrogen dioxide:** | 5ppm | ≈-1ppm |
| **Nitric oxide:** | 35ppm | <0.7ppm | | | |

**For details of other possible cross-interfering gases contact City Technology.**

**Methanol Sensitivity**

The 4HS/LM CiTiceL is designed for use in applications where methanol might be present. Whilst cross sensitivity reactions on CiTiceLs are normally readily defined, the behavior of the 4HS/LM when exposed to methanol is significantly more complex, and can not be specified as above for carbon monoxide. The 4HS/LM CiTiceL is the result of an extensive development project, which has achieved, for this application, a significant performance advantage over standard 4HS CiTiceLs.

For more detailed information about the response to methanol please contact Technical Support at City Technology.

**City 4S-Rev. 2 sulfur dioxide**

**Cross Sensitivity Table**

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

| Gas | Formula | Concentration Used (ppm) | Reading (ppm SO2) |
|---|---|---|---|
| Carbon Monoxide | CO | 300 | <1 |
| Nitric Oxide | NO | 50 | 0 - 5 |
| Nitrogen Dioxide | $NO_2$ | 6 | <-10 |
| Hydrogen Sulfide | $H_2S$ | 25 | <0.1 |
| Chlorine | $Cl_2$ | 5 | <-2 |
| Ammonia | $NH_3$ | 20 | 0 |
| Hydrogen | $H_2$ | 400 | <1 |
| Hydrogen Cyanide | HCN | 10 | <5 |
| Acetylene | $C_2H_2$ | 10 | <30 |
| Ethene | $C_2H_4$ | 50 | <45 |

**Note:** The figures in this table are typical values and should not be used as a basis for cross calibration. Cross sensitivities may not be linear and should not be scaled. All data based on a 5 minute gassing. For some cross interferents break through will occur if gas is applied for a longer time period.