



Auto calibration of gas sensors of E4000 probe

Ver	Date	Modification / Update
V1	Initial	Version Initial/Initial version

Auto calibration of gas sensors

Solid State CO2 sensor

This type of sensor drift slowly but an ABC algorithm type (Automatic Background Calibration) is used to compensate this drift as follows:

24h after the last auto zero, 50 ppm is artificially removed from the measured value. After some hours of unoccupancy, the sensor is exposed to a concentration corresponding to the outside air due to the 10% of the nominal value ventilation (minimum required for the health of the building). Once the measurement is less than 390ppm, the "zero" is automatically updated (zero term means this is actually 390ppm CO₂ because it is the lowest level in the atmosphere). Thus, if the sensor drift is negligible, 50 ppm being artificially subtracted, the first auto zero will start from 390 +50 = 440ppm. This usually occurs during a dilution so a CO₂ decrease; it will happen multiple times until CO₂ concentration stop to decrease. That shows that this type of sensor is not suitable to certain situations when human presence is continuous like for hospital bed rooms.

NDIR CO2 sensor

The sensor used has two IR light sources, one for the measurement that takes place every 25 seconds and the other one as a reference during the self-calibration. This calibration takes place every about 20 hours.

Light source is compared daily to the reference source and CO₂ concentration from the 2 sources compared.

The aging of the reference source is considered as zero over 10 years; the measuring light source will have been activated 20 million times compared with only 4400 times for the reference source.

Self-calibration is based on actual measurement at any CO₂ concentration.

This sensor is suitable for hospital and for particular case where human presence is continuous (police, uninterrupted process control room....).

VOC sensor

The VOC sensor is initially heated for 3 days prior factory calibration.

It is then calibrated with an « air zero » (cleaned air) and several injections of VOCs to determine the response curve of each sensor to formaldehyde.

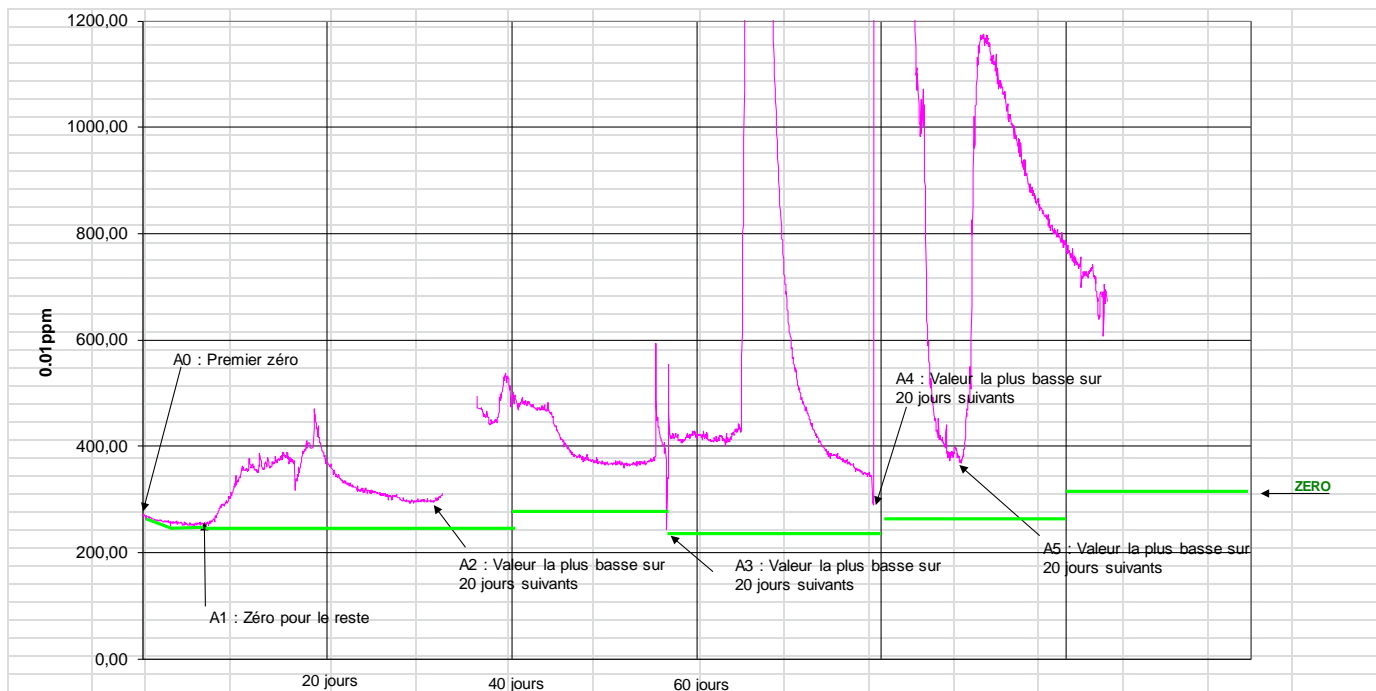
Sensor drift is extremely low and auto zero process does not manage this drift. Auto zero is based on environmental conditions of the building. Auto zero also uses zero ABC algorithm (Automatic Background Calibration)

Indeed, the "air zero" is extremely difficult to obtain outside laboratories as outdoor air is rarely pure. It is therefore unrealistic to ventilate to get such a low value. The only solution is to consider the lowest value measured as the target value (beyond it would be useless over ventilation).

The lowest value is treated as zero. If an even lower value is observed it becomes immediately the new zero.

On the 20 days period, the new zero is the average between the lowest value seen in this period of time and the current value. This value is therefore progressively averaged by period of 20 days unless a lower measured value instantly and automatically resets the zero. This method takes into account the evolution of the incoming outside air quality.

The graph below shows the algorithm of auto-zero over a long period of time (with a break of a few days around the 37th day).



To be noted that after waiting 20 minutes after start up to condition the VOC sensor, the first measure is forced to zero and it is helpful to activate the ventilation with the minimum 10% or count on the CO₂ to lower VOC concentration to automatically adjust the zero. (See the beginning of the curve). It may be necessary to wait few days to take advantage of the maximum sensitivity of VOC sensor.

If the facility has a system for incoming air treatment by photo catalysis and / or activated charcoal, the probe will have a better sensitivity and indoor air quality will be significantly improved. This principle is recommended in urban areas and near roads with heavy traffic.