

Calibration of flue gas analysers

Like many measuring instruments, a flue gas analyser relies on a comparison between two values, one stored in some way and one to be measured. The method of storing the value varies from measuring instrument to measuring instrument. A ruler has a value “stored” in that it is manufactured to a certain tolerance and the scale is marked on it. It can be considered accurate at a particular temperature and will not change with time. An analogue voltmeter has a specific reaction to a certain level of current flow. Since this depends on a reaction to a magnetic field, which can change with time, this may need checking and recalibration if particularly accurate results are required.

The situation is more complicated with a flue gas analyser. Here, the results are genuinely stored in a memory.

Specifically this is the reaction of an electrochemical sensor to a known gas concentration. An electrochemical sensor is basically a battery. A concentration of gas will fuel a chemical reaction with the electrolyte in the sensor. This reaction then produces a measurable voltage, proportional to the concentration of the gas. As with all batteries, the electrolyte will eventually be consumed, reducing the signal with time. This will not happen suddenly, but will rather be seen as a slow process,

depending on the exposure time and concentration of the gas. Again, analogue to the battery, much research has been carried out to keep the signal constant for as long as possible, so the user will not see a constant linear decline from full signal to zero, but will rather see a long, slow linear decline to about two thirds of the original signal and then a more rapid decrease. This effect will help to keep the calibration values constant and will minimise drift.



Nevertheless, this is a precision instrument used to make readings with legal and financial significance, so regular calibration must be part of the procedure. Calibration intervals will vary from case to case, but should have a reason for their existence. Once or twice a year can be seen as the bare minimum for an instrument that is not being used too often.

Two points are required to define a straight line, so calibration of the sensor in a flue gas analyser will require two separate readings to complete the calibration. The zero point on a sensor for toxic gases is an easy one to take. When the instrument is switched on it will automatically take a reading of the response in fresh air and store this as the latest zero point. The second point can only be achieved using a calibration gas of known concentration and accuracy. Since it is not economical or practical to carry the necessary bottles around at all times, this result will be stored and used for all future measurements until the next calibration. The curve will merely be shifted slightly each time the instrument is activated to agree with the new zero. Since electrochemical sensors do react to gases other than the specific target gas, it is essential to carry out the procedure using single gases in a neutral carrier. Some gases will decompose with time, so they generally have a use-by date. A certain time should be left between exposures to gas to allow the system to flush completely.

Despite everything we learned in High School about the behaviour of gases, these lessons do not apply to gases at the pressures encountered in the average storage cylinder. With time they will separate into the constituent parts according to molecular weight and the cylinders will require at the very least a regular change of position to ensure a homogenous mixture inside. Failure to observe this precaution will lead to gas being extracted at an unknown concentration and the complete upsetting of the value of the cylinder. If one component is disproportionately removed, then the overall concentration must change permanently and the cylinder becomes useless.