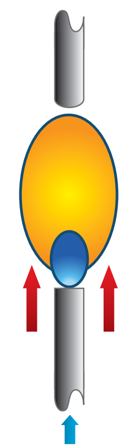
Most flammable vapor analyzers respond differently to different vapors. Whenever the process solvent is changed, the analyzer must be either recalibrated or reprogrammed to ensure that it's measurement of the new solvent vapor is still accurate. This creates a challenge when trying to measure a mixture of solvent vapors. The PrevEx Flammability Analyzer has the unique ability to measure most common process solvent vapors, including mixtures, to within a few percent of their lower flammable limit, without recalibrating, unlike narrow-banded infrared sensors.

Flame Temperature

The flame temperature analyzer measures the amount of heat given off by a pilot flame as it burns in an explosion-proof measuring chamber. The small, well-regulated flame heats the tip of a temperature sensor suspended directly above it. The signal produced by the sensor when no flammable vapors are present drives the LFL indicator up to 0% LFL. This failsafe technique is known as a "live" zero because a weakening or loss of flame caused by lack of fuel will generate a downscale malfunction alarm.

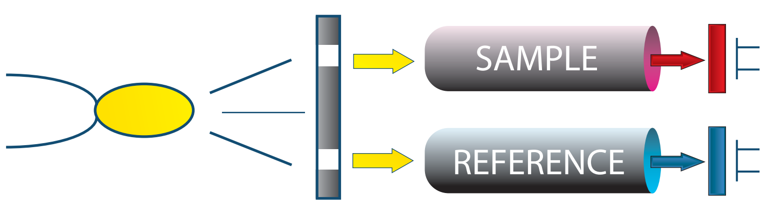


- When a flammable sample is drawn into the measurement chamber it is seen by the pilot flame as an additional source of fuel. This causes the temperature in the area of the pilot flame to increase. Since the meter knows that the increased temperature can only be caused by added fuel (the sample), it rises above zero in direct proportion to the flammability of the sample.

- The dynamics of the flame temperature analyzer give it highly uniform response factors for a wide variety of combustible gases.

Infared Absorption

Combustible gases absorb infrared radiation at certain characteristic wavelengths. A typical non-dispersive infrared (NDIR) detector passes a source of infrared energy through the sample and measures the energy received by one of two detectors. The active detector responds to wavelengths in the same band as the sample gas, while the other detector measures a reference to compensate for changes within the instrument.



When specific combustible gases are present, they absorb some of the infrared energy and produce a signal in the active detector relative to the reference detector. Energy absorbed by the combustible gas for a given wavelength varies exponentially with the particular gas's absorptivity, the concentration, and the path length. This means that infrared detectors must be specifically calibrated for a particular gas, and can have very high variations in response factors and linearity for other gases.

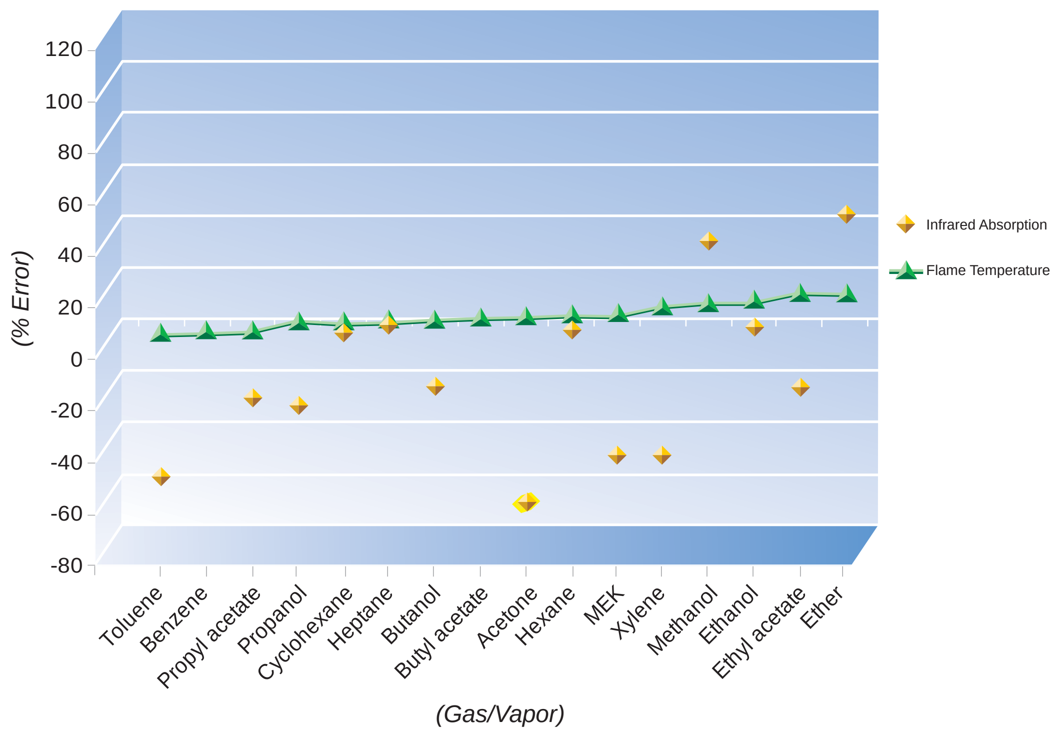
- Infrared detectors are usually limited to detecting a single combustible gas. Like catalytic-bead sensors, they are best suited to area monitoring applications.

Response Accuracy

Few analyzers react the same way to all substances. An infrared sensor is a narrow-band instrument. It can usually discriminate between the substance of interest and background gases but it does not respond to gases outside of it's narrow range of vision.

- These variations in infrared sensor response may not pose a significant problem when measuring an atmosphere containing a single substance. But when asked to measure a mixture of different vapors, infrared instruments will usually fail miserably.

Flame temperature analyzers will react accurately to most flammable substances and will usually measure both single substances and mixtures with the same high degree of accuracy. Unlike some sensors, flame temperature analyzers were developed for one specific purpose—to directly measure flammability.



Response Factors

The industry standard accuracy requirement for a flammable gas sensor is +/-10%. Response factors are therefore one of the most significant influences on accuracy, and can easily introduce large errors.

Response factors show how a sensor that is calibrated for one particular gas, usually a "reference" gas, will read when exposed to other gases. If two gases both have the same response factor, they respond equally, unless the sensor is non-linear (infrared), in which case linearization of the signal can introduce more error, or less, depending on the individual characteristics of the sensor for each gas.

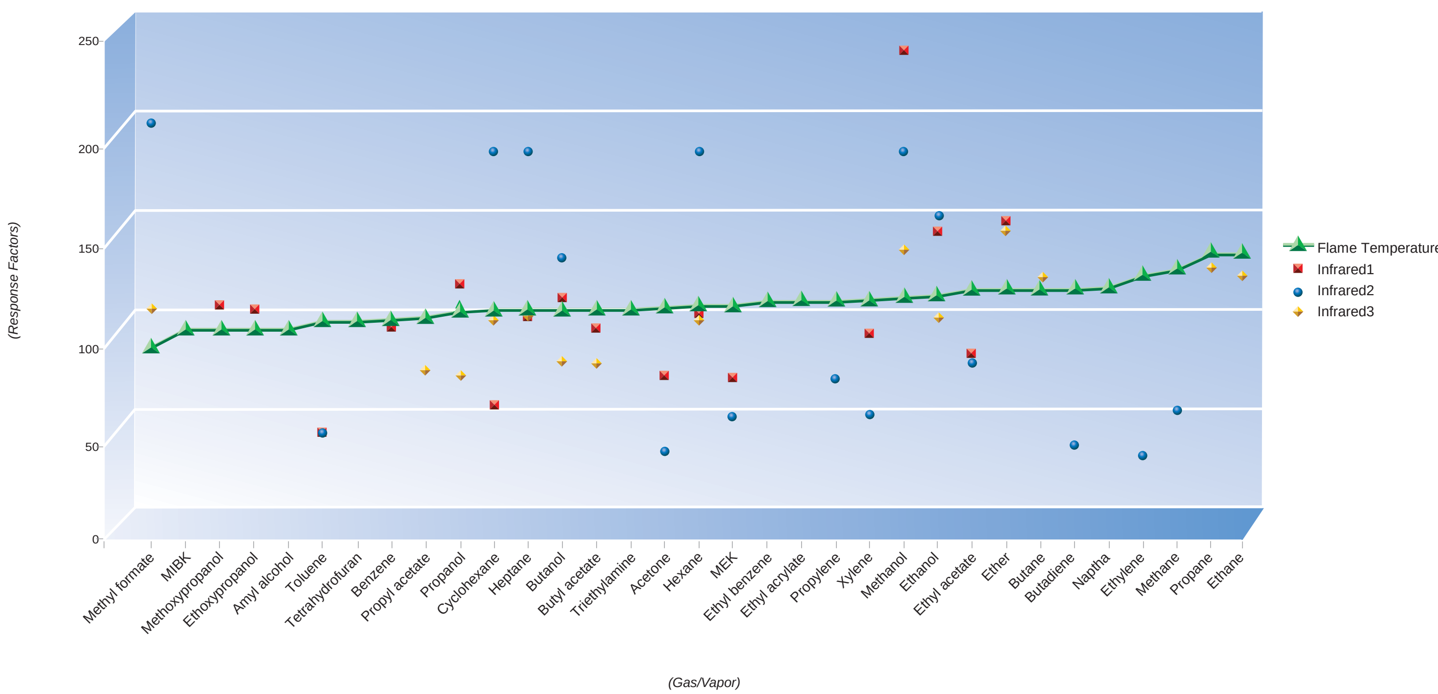
Response factors are obtained by testing. The response factors should be obtained from the manufacturer of the sensor. However, the manufacturer's response factors should have independent verification as part of the third-party approval process (FM, CSA, ATEX, CENELEC).

For many process monitoring applications, the sensor must be calibrated so that all gases to be detected read the actual concentration or higher, but do not under-report the actual concentration. Therefore the sensor is calibrated for the gas with the lowest response factor.

The amount of error that results from attempting to measure two different gases that have different response factors can be understood by taking the ratio of the two factors. Thus an attempt to measure two gases, one with a response factor to 0.5, and another with a response factor of 1.5, could yield a reading one third (0.5/1.5) or three times (1.5/0.5) the actual concentration.

The flame temperature type sensor (PrevEx) is said to have a "universal calibration" for common solvent vapors, because the response factors for common solvent vapors are in the range from 0.9 to 1.1. By contrast, factors for infrared sensors can easily reach 0.25 to 2.0 (an eight-to-one ratio).

The response factors given here are from various sources, including several manufacturers. The factors were all put into the same format (calibration readings in some cases were converted into response factors). This information is for illustrative purposes only. The calibration of actual sensors should be performed only according to the manufacturer's instructions.



The National Fire Protection Association's NFPA-86 2003 Standard for Safe Operation of Class A Ovens and Furnaces, has concluded that, "...Infrared calibration can vary considerably for various solvent types. Its area of application is for single solvent systems..." (Annex E.1). The same document (Annex E.1) describes Flame Temperature systems, "...calibration is relatively constant for various solvents..."