Control Instruments® Corporation

Technical Note

The Effects of Process Temperature on LFL Measurement

A Gas Monitoring Guide showing flash point, LFL concentration and TWA exposure limits of 172 substances is available from Control Instruments Corporation.

For your free guide, call (973) 575-9114.

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LFL Calculations

Many substances emit vapors that have potential to cause fire or explosion when mixed with air and a source of ignition. The minimum concentration of a substance needed to support combustion is known as it's Lower Flammable Limit (LFL) or Lower Explosive Limit (LEL)[1]. For example, a concentration of 5% methane in air is equal to 100 percent of it's Lower Flammable Limit—enough to propagate a flame.

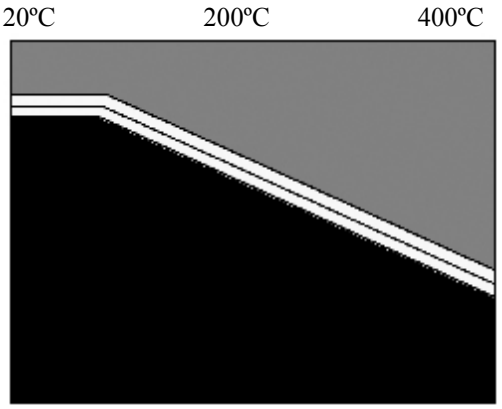
Because the LFL is determined by experiment, values published by different authorities[2] at different times are not always identical. All sources agree that 5% methane in air is equal to 100% of it's LFL. There is only minor disagreement about the LFL of acetone. Three out of five authorities say it's a concentration of 2.5% in air and the other two say it's 2.6%. These small variances might be due to minor differences in testing procedures or number rounding methods.

But some differences can't be explained so easily. Ethylene has published LFL values of 2.3%, 2.7% or 3.1% depending upon the source of information. Methanol can be found as 5.5%, 6.0%, 6.7% or 7.3%; once again, depending upon which source is used.

Temperature Compensation

All of the above examples are temperature-dependent. In general, US authorities calculate the LFL of vapors at 77ºF (25ºC) while most European authorities use 20ºC (68ºF).

As the temperature of a vapor/air mixture increases, the concentration needed to reach the Lower Flammable Limit decreases. 2.5% acetone in air is equal to 100% of it's LFL at 77ºF. At 300ºF, only 2.25% is needed to reach 100% LFL.



Vapor concentration necessary to reach LFL versus sample temperature.

Below 100% LFL
Above 100% LFL
LFL as temperature increases, allowing a margin of uncertainty for published values.

An analyzer has two functions, it measures the flammability of the sample it receives and determines the true flammability existing at the sample point.

An example: Calibrating an analyzer to read 50% LFL by using a cylinder of 50% LFL span gas can lead to disaster. The temperature of the span gas is most likely ambient room temperature, 72ºF. The temperature at the sample point inside a process drying oven might be 300 or 400ºF. Under these conditions, a sample measuring 45% LFL in the analyzer is actually above 53% LFL in the dryer—well above the mandatory shut-down concentration of 50%[3].

Plant personnel responsible for LFL monitoring must be aware that it is necessary to apply a temperature compensation factor[4]. This will cause the analyzer to display accurate information about any potential hazard, based upon the true danger at the sample point.

[1] For the purposes of this application note, the terms LFL and LEL are interchangeable.
[2] US National Fire Protection Association, US Bureau of Mines, Canada CCOHS, Germany Redeker Schon, Germany Nabert Schon.

[3] NFPA 86 Standard for Ovens and Furnaces.
[4] Temperature compensation factors for Control Instruments sensors and analyzers are available from the factory.