

# Lower Explosion Points of selected reference substances under Non-Atmospheric Conditions

Arnas Lucassen

E-mail: *arnas.lucassen@ptb.de*

Physikalisch-Technische Bundesanstalt, Braunschweig, Germany

## Abstract

The lower explosion point (LEP) is an important safety characteristic parameter in explosion protection. It is defined as the temperature of a combustible liquid at which the concentration of the saturated vapour equals the lower explosion limit. This makes it a much more accurate safety measure than the longer used and more widely known Flashpoint. For atmospheric conditions there is an European standard (EN 15794) for the determination of explosion points (lower and upper). Also the Chemsafe database at PTB already holds data for various substances. However, modern industrial processes often use non-atmospheric conditions to enhance the yields. For instance, for partial oxidation of alcohols to aldehydes or carboxylic acids higher pressures or pure oxygen are used. Our work aims to expand the standardised determination method for higher pressures and non-air oxidizers. A theoretical method using the vapor pressure and temperature dependence of the lower explosion limit can be employed to estimate pressure dependence of the LEP, but in many cases, there is a lack of reliable input or LEP validation data. Therefore, an apparatus to measure the LEP at pressures from a 100 mbar up to 6 bars was designed and constructed. The apparatus does include optical access to ensure the connection to the optical detection of the LEP defined in the standard. Traceability to the reference values given in the standard was reached within the measurement uncertainty. Non optical criteria based on pressure and temperature rise after ignition are developed, to shift to automatic detection of the LEP. Very good accordance was also achieved for the pure reference substances which are used to characterise the apparatus in the standard between the values measured at non-atmospheric pressures and the calculation method. As in real industrial processes more complex mixtures containing solvents or process water might occur, further pre-normative research will be performed on mixtures and other oxidizers than air, to ensure safe operation.

**Keywords:** *lower explosion point, LEP, pressure dependence, vapor pressure, explosion limit*