



Standard Practice for Determining Limits of Flammability of Chemicals at Elevated Temperature and Pressure¹

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1. Scope

1.1 This practice covers the determination of the lower and upper concentration limits of flammability of combustible vapor-oxidant mixtures at temperatures up to 200°C and initial pressures up to as much as 1.38 MPa (200 psia). This practice is limited to mixtures which would have explosion pressures less than 13.79 MPa (2000 psia).

1.2 *This practice should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.*

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

E681 Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)

2.2 Other Documents:

Bulletin 503 Bureau of Mines, "Limits of Flammability of Gases and Vapors," NTIS AD701575

Bulletin 627 Bureau of Mines, "Flammability Characteristics of Combustible Gases and Vapors," NTIS AD701576

¹ This practice is under the jurisdiction of ASTM Committee E27 on Hazard Potential of Chemicals and is the direct responsibility of Subcommittee E27.04 on Flammability and Ignitability of Chemicals.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3. Terminology

3.1 Definitions:

3.1.1 *lower limit of flammability or lower flammable limit (LFL)*—the minimum concentration of a combustible substance that is capable of propagating a flame through a homogeneous mixture of the combustible and a gaseous oxidizer under the specified conditions of test.

3.1.2 *upper limit of flammability or upper flammable limit (UFL)*—the maximum concentration of a combustible substance that is capable of propagating a flame through a homogeneous mixture of the combustible and a gaseous oxidizer under the specified conditions of test.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *propagation of flames*—as used in this practice, a combustion reaction that produces at least a 7 % rise of the initial absolute pressure,

$$\frac{P_2}{P_1} \geq 1.07.$$

NOTE 1—This 7 % rise in pressure corresponds to 1 psia (0.007 MPa) per atmosphere of initial pressure.

4. Summary of Practice

4.1 A mixture of gaseous or vaporized fuel with a gaseous oxidizer is prepared in a steel or other appropriate metal vessel at a controlled temperature and pressure. Proportions of the components are determined by measurement of partial pressures during filling of the vessel. Ignition of the mixture is attempted with a fuse wire, and flammability is deduced from the pressure rise produced. Fuel concentration is varied between trials until the limits of flammability have been determined. Composition of the mixtures which fix the flammable limits are confirmed by appropriate analysis.

5. Significance and Use

5.1 Knowledge of flammable limits at elevated temperatures and pressures is needed for safe and economical operation of some chemical processes. This information may be needed in order to start up a reactor without passing through a flammable range, to operate the reactor safely and economically, or to store or ship the product safely.

5.2 Limits of flammability data obtained in relatively clean vessels must be carefully interpreted and may not always be