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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 42368-2023

Determination of explosion limits of combustible vapors and gases at elevated temperature and pressure

高温高压条件下可燃气体（蒸气）爆炸极限测定方法

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Foreword

This document was issued on 17 March 2023 by the State Administration for Market Regulation; Standardization Administration of the PRC and takes effect on 1 October 2023.

It is a GB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies when assessing a submission.

1 Scope

GB/T 42368-2023 covers the measurement of the upper and lower explosion limits of a combustible gas or vapour mixed with air at a stated initial temperature and initial pressure - the principle, in which a known volume fraction is premixed in a reaction vessel, ignited by electric spark or hot wire, and judged by the pressure rise that follows; the test device, its reaction vessel, ignition unit, pressure measurement, gas distribution and temperature control; the test steps, prefaced by the warning that the vessel is never opened while under pressure; the processing of the data, where a pressure increment of at least 5 percent of the given initial pressure counts as flame propagation and therefore as an explosion; the safety measures; the calibration of the device, with pressure and temperature sensors verified at intervals of no more than 3 months; and the test report. Appendix A illustrates a device. Limits quoted at ambient conditions widen once a process runs hot and

pressurised, so a purge calculation or a relief design based on ambient figures can leave a plant inside the explosive range while its paperwork says otherwise. Written for process safety engineers, chemical and petrochemical operators, and laboratories that issue flammability data.

This document describes a method for the determination of explosion limits of the combustible mixture of combustible gases (vapors) and air at a given initial temperature and initial pressure.

This document applies to the determination of explosion limits of combustible gases (vapors) under the conditions of initial temperature below 200 °C, initial pressure below 1.0 MPa (absolute pressure), and maximum explosion pressure not greater than 15.0 MPa (absolute pressure).

This document does not apply to the determination of explosion limits of chemically unstable gases or mixed gases in which components may react with each other.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 12474, Method of test for explosion limits of combustible gases in air

GB/T 16425, Determination for minimum explosive concentration of dust clouds

GB/T 21844, Standard test method for concentration limits of flammability of chemicals (vapors and gases)

4 Test principle

Under the given initial temperature and initial pressure conditions, pre-mix a certain volume fraction of combustible gas (vapor) and air in the explosion reaction vessel; use electric spark or electric heating wire to ignite; judge whether an explosion occurs by the rising value of the explosion pressure (not less than 5% of the given initial pressure); systematically change the concentration of the combustible gas (vapor) until the

minimum or maximum concentration where the explosion occurs is measured.

5 Test device

5.1 General

The test device for explosion limits is mainly composed of an explosion reaction vessel, an ignition device, a pressure measurement unit, a gas distribution unit, a temperature control unit, etc. See Appendix A for a schematic diagram of the test device.

5.2 Explosion reaction vessel

5.2.1 The explosion reaction vessel shall be a spheroidal shape or a cylindrical test vessel with an aspect ratio of 1, which is resistant to high temperature and high pressure. The volume shall not be less than 1 L and should be 20 L, 12 L or 5 L; the shape specifications shall be in accordance with the relevant provisions for test device in GB/T 16425 and GB/T 21844 respectively.

5.2.2 The expected operating temperature of the explosion reaction vessel under initial pressure conditions shall not be less than 200 °C, and the explosion-resistant pressure shall be able to withstand a maximum explosion pressure of not less than 15.0 MPa (absolute pressure) without permanent deformation.

5.2.3 The maximum explosion pressure of combustible gases (vapors) at elevated temperature and pressure shall not be higher than the maximum working pressure of the explosion reaction vessel.

5.2.4 For the determination of explosion limits of low-flammable substances such as ammonia, halogenated substances and certain amines, a 20 L spherical stainless steel explosion tank or an explosion reaction vessel with a larger diameter should be used.

5.2.5 An oil-free stirring device shall be equipped in the explosion reaction vessel.

5.2.6 The connecting pipe fittings between the explosion reaction vessel and the high-pressure gas cylinder shall be made of 316 stainless steel pipes with a pressure not lower than 4.0 MPa (absolute pressure). All pipelines and joints connected to the explosion reaction vessel shall be able to withstand a pressure not lower than 15.0 MPa (absolute pressure).

5.3 Ignition device

5.3.1 The mixture of combustible gas (vapor) and air can be ignited by electric spark, or by electric fuse or high-temperature hot wire.

5.3.2 The ignition energy of the ignition device shall be sufficient to ignite the combustible gas mixture to be tested, and the pressure increase of the ignition source to the mixed gas shall not be greater than 0.5% of the initial pressure.

5.4 Pressure measurement unit

5.4.1 Pressure sensors with low-pressure range and high-pressure range, which are installed in the explosion reaction vessel, shall be able to withstand the continuous high temperature of 200 °C during the test. The response frequency of the pressure sensor with high-pressure range shall not be lower than 10 kHz; it should be installed flush. The distance between the top of the sensor probe and the inner wall of the container for non-flush installation shall not exceed 10 cm.

5.4.2 The pressure sensor with low-pressure range is used to measure the partial pressure of different component gases in the gas distribution process. The lower limit of the range of the pressure sensor with low-pressure range shall reach 0.07 kPa (absolute pressure), and the reading error shall not exceed 1%, and shall be able to meet the gas distribution accuracy requirements. The range of the pressure sensor with high-pressure range shall be able to meet the requirements for measuring the maximum explosion pressure, and shall be able to detect and determine whether an explosion has occurred.

5.5 Gas distribution unit

5.5.1 The gas distribution unit shall adopt an oil-free vacuum pump, and shall realize vacuuming the explosion reaction vessel to below 0.002 MPa (absolute pressure).

5.5.2 The gas distribution accuracy shall not be lower than 0.1% volume fraction.

5.6 Temperature control unit

The ambient temperature in the explosion reaction vessel shall be measured by a k-type thermocouple. The controllable temperature range is from room temperature to 200 °C,