
Gas cylinders — Gases and gas mixtures — Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets

Bouteilles à gaz — Gaz et mélanges de gaz — Détermination du potentiel d'inflammabilité et d'oxydation pour le choix des raccords de sortie de robinets

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 2, *Cylinder fittings*.

This fourth edition cancels and replaces the third edition (ISO 10156:2010), which has been technically revised. It also incorporates ISO 10156:2010/Cor 1:2010.

The main changes compared to the previous edition are as follows:

- [4.1](#), [4.2.5](#) and [4.4](#) have been technically revised;
- [4.5](#) and [4.6](#) have been added.

Introduction

ISO 5145 specifies the dimensions of different cylinder valve outlets for different compatible gas groups. These compatible gas groups are determined according to practical criteria defined in ISO 14456.

These criteria are based on certain physical, chemical, toxic and corrosive properties of the gases. In particular, the flammability in air and the oxidizing ability are considered in this document.

One of the potential complications that prompted the development of this document is that while there are abundant data in the literature relating to pure gases, differences can be found, depending upon the test methods employed. In the case of gas mixtures, data in the literature are often incomplete or even non-existent.

The initial aim of this document was to eliminate the ambiguities in the case of differences in the literature, and above all, to supplement existing data (mainly in the case of gas mixtures).

Subsequently, this document was used for other purposes than the selection of cylinder valve outlets, such as establishing flammability and oxidizing potential data for the classification and labelling of gases and gas mixtures.

This document is intended to be used under a variety of national regulatory regimes, but has been written so that it is suitable for the application of the UN Model Regulations and the UN-GHS^[9].

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Gas cylinders — Gases and gas mixtures — Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets

1 Scope

This document specifies methods for determining whether or not a gas or gas mixture is flammable in air and whether a gas or gas mixture is more or less oxidizing than air under atmospheric conditions.

This document is intended to be used for the classification of gases and gas mixtures including the selection of gas cylinder valve outlets.

This document does not cover the safe preparation of these mixtures under pressure and at temperatures other than ambient.

2 Normative references

There are no normative references in this document.

3 Terms, definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

gas or gas mixture flammable in air

gas or gas mixture that is ignitable in air at atmospheric pressure and a temperature of 20 °C

3.1.2

lower flammability limit in air

minimum content of a gas or gas mixture in a homogeneous mixture with air at which a flame just starts to propagate

Note 1 to entry: The lower flammability limit is determined at atmospheric conditions.

Note 2 to entry: The term “flammability limit”, as used in this document, is sometimes called “explosion limit”.

3.1.3

upper flammability limit in air

maximum content of a gas or gas mixture in a homogeneous mixture with air at which a flame just starts to propagate

Note 1 to entry: The upper flammability limit is determined at atmospheric conditions.

Note 2 to entry: The term “flammability limit”, as used in this document, is sometimes called “explosion limit”.

3.1.4

flammability range

range of concentration between the lower and upper flammability limits

Note 1 to entry: The term “flammability range”, as used in this document, is sometimes also called “explosion range”.

3.1.5

gas or gas mixture more oxidizing than air

gas or gas mixture that is able, at atmospheric pressure, to support the combustion more than a reference mixture consisting of 23,5 % oxygen in nitrogen

3.1.6

oxidizing power

OP

dimensionless number that compares the oxidizing capability of a gas or gas mixture to that of oxygen

Note 1 to entry: OP is calculated as the sum of the products of the mole fraction(s) of each oxidizing component times its coefficient of oxygen equivalency, C_i .

3.1.7

atmospheric conditions

standard pressure of 101,3 kPa at 20 °C

3.2 Symbols

A_i	molar fraction of the i^{th} flammable gas in a gas mixture, in %
B_k	molar fraction of the k^{th} inert gas in a gas mixture, in %
C_i	coefficient of oxygen equivalency
F_i	i^{th} flammable gas in a gas mixture
I_k	k^{th} inert gas in a gas mixture
n	number of flammable gases in a gas mixture
p	number of inert gases in a gas mixture
K_k	coefficient of equivalency of an inert gas relative to nitrogen (see Table 1)
A'_i	equivalent content of a flammable gas
L_i	lower flammability limit in air of a flammable gas
T_{ci}	maximum content of flammable gas which, when mixed with nitrogen, is not flammable in air, in %
x_i	molar fraction of the oxidizing component, in %
He	helium
Ar	argon
Ne	neon
Kr	krypton
Xe	xenon
N ₂	nitrogen

H ₂	hydrogen
O ₂	oxygen
CO ₂	carbon dioxide
SO ₂	sulfur dioxide
N ₂ O	nitrous oxide
SF ₆	sulfur hexafluoride
CF ₄	carbon tetrafluoride
C ₃ F ₈	octafluoropropane
C ₂ HF ₅	pentafluoroethane
CH ₄	methane

3.3 Units

For the purposes of this document, all gas percentages (%) are given as molar fractions (mol. %) which are equivalent to volume fractions (vol. %) under normal atmospheric conditions.

4 Flammability of gases and gas mixtures in air

4.1 General

[4.2](#) and [4.3](#) give a test method and a calculation method for determining whether a gas or gas mixture is flammable in air. This is used to determine a valve outlet for transportation or GHS classification.

The test method (given in [4.2](#)) may be used in all cases but shall be used when T_{ci} (or L_i) values are not available.

The calculation method (given in [4.3](#)) may only be used if reliable T_{ci} (or L_i) values are available.

[4.5](#) gives a calculation method to determine the lower flammability limit of the flammable mixture determined in [4.3](#) and may be used for the GHS flammable gas categories.

In cases where the test result is different from that obtained by calculation, the test result shall take precedence.

The non-flammable mixtures defined by UN number shall overrule any classification done by calculation.

4.2 Test method

4.2.1 Key points concerning safety

Tests shall be carried out by trained and competent personnel working in accordance with authorized procedures (see also [4.2.4](#)). The reaction tube and flowmeter shall be adequately screened to protect personnel in the event of an explosion. Personnel shall wear personal protective equipment including safety glasses. During the ignition sequence, the reaction tube shall be open to the atmosphere and isolated from the gas supply. Care shall also be taken during the analysis of the test gas or mixture.