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Part 20-1: Material characteristics for gas and vapour classification — Test methods and data

Atmosphères explosives —

Partie 20-1: Caractéristiques des produits pour le classement des gaz et des vapeurs — Méthodes et données d'essai

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This draft is submitted to a parallel vote in ISO and in IEC.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Explosive atmospheres - Part 20-1: Material characteristics for gas and vapour classification - Test methods and data

FOREWORD

1) ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work

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IEC 80079-20-1 has been prepared by subcommittee 31M, Non-electrical equipment and protective systems for explosive atmospheres, of IEC technical committee 31, Equipment for explosive atmospheres. It is an International Standard.

This second edition cancels and replaces the first edition published in 2017. This edition constitutes a technical revision.

The significance of changes between ISO Standard, ISO/IEC 80079-20-1, Edition 2 xxxx and ISO/IEC 80079-20-1, Edition 1 2017 are as listed below:

Table 1 –

		Type		
Changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Scope The addition of the determination of explosion characteristics of flammable gases and vapours with air in an enclosed space *p*max, *K*max, and d*p*/d*t*	1		X	
Classification of mixtures of gases	4.5	X		
Data for flammable gases and vapours, relating to the use of equipment	5	X		
Method of test for the MESG	6	X		
Test method for auto-ignition temperature	7	X		
Determination of explosion characteristics of flammable gases or vapours in air.	8		X	
Ovens of test apparatus for the tests of auto-ignition temperature	Annex A	X		
Tabulated values	Annex B	X		
Determination of cool flames	Annex C	X		
Volume dependence of auto-ignition temperature	Annex D	X		

		Type		
Changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Annex for verification of maximum explosion pressure values and maximum rates of explosion pressure rise	Annex E		X	
Noise Cancelling and Data Smoothing Techniques Filtering or noise cancelling	Annex F		X	

NOTE: The technical changes referred to include the significance of technical changes in the revised IEC Standard, but they do not form an exhaustive list of all modifications from the previous version. More guidance may be found by referring to the Redline Version of the standard.

Explanations:

A) Definitions

Minor and editorial changes clarification decrease of technical requirements minor technical change editorial corrections

These are changes which modify requirements in an editorial or a minor technical way. They include changes of the wording to clarify technical requirements without any technical change, or a reduction in level of existing requirement.

Extension addition of technical options

These are changes which add new or modify existing technical requirements, in a way that new options are given, but without increasing requirements for equipment that was fully compliant with the previous standard. Therefore, these will not have to be considered for products in conformity with the preceding edition.

Major technical changes addition of technical requirements increase of technical requirements

These are changes to technical requirements (addition, increase of the level or removal) made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for products in conformity with the preceding edition.

Note: These changes represent current technological knowledge. However, these changes should not normally have an influence on equipment already placed on the market.

B) Information about the background of Changes

The text of this International Standard is based on the following documents:

Draft	Report on voting

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the ISO/IEC 80079 series, published under the general title *Explosive atmospheres*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

Users of this document are advised that interpretation sheets clarifying the interpretation of this document can be published. Interpretation sheets are available from the IEC web store and can be found in the “history” tab of the page for each document.

1 Scope

This part of ISO/IEC 80079 provides guidance on classification of gases and vapours. It specifies a test method intended for the measurement of the maximum experimental safe gaps (MESG) for gas-air mixtures or vapour-air mixtures under normal conditions of temperature and pressure (20 °C, 101,3 kPa) so as to allow the selection of an appropriate group of equipment. This document also specifies a test method intended for use in the determination of the auto-ignition temperature (AIT) of a vapour-air mixture or gas-air mixture at atmospheric pressure, so as to allow the selection of an appropriate temperature class of equipment.

The materials and the characteristics included in a table (see Annex B) have been selected with particular reference to the use of equipment in hazardous areas. The data in this table have been taken from a number of references which are given in the bibliography. The methods for determining the MESG or the AIT can also be used for gas-air-inert mixtures or vapour-air-inert mixtures. However, data on air-inert mixtures are not tabulated.

Values of chemical properties of materials are provided to assist in the selection of equipment to be used in hazardous areas. Further data might be added as the results of validated tests become available.

This part of the ISO/IEC 80079 specifies a method for the determination of explosion characteristics of flammable gases and vapours with air in an enclosed space p_{max}, K_{max}, and d*p*/d*t*. It gives the criteria by which results obtained using other test procedures can be correlated to yield explosion characteristics as determined by the method specified in this part of ISO/IEC 80079.

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 edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-426, *International Electrotechnical Vocabulary − Part 426: Electrical apparatus for explosive atmospheres (available at http://www.electropedia.org/)*

IEC 60079-11, *Explosive atmospheres − Part 11: Equipment protection by intrinsic safety "i"*

IEC 60079-14, *Explosive atmospheres − Part 14: Electrical installations design, selection and erection*

IEC 60584-1, *Thermocouples - Part 1: EMF specifications and tolerances*

EN 15967:2022, *Determination of maximum explosion pressure and the maximum rate of pressure rise of gases and vapours*

ISO 1773, *Laboratory glassware - Narrow-necked boiling flasks*

JIS C 1602, *Thermocouples*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-426 and the following 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
auto-ignition
reaction which is evidenced by a clearly perceptible flame or explosion, and for which the ignition delay time does not exceed 5 min

Note 1 to entry: See Clause 7 for a test method for auto-ignition temperature (AIT).

3.2
ignition delay time
time between the completed injection of the flammable material and the ignition

3.3
auto-ignition temperature
AIT
lowest temperature (of a surface) at which under specified test conditions an ignition of a flammable gas or vapour in mixture with air or air-inert gas occurs

Note 1 to entry: See Clause 7 for a test method.

3.4
maximum experimental safe gap
MESG
maximum gap of a joint of 25 mm in length which prevents any transmission of an explosion during tests made under the specified conditions

Note 1 to entry: See Clause 6 for a test method.

3.5
minimum igniting current
MIC
minimum current in a specified test circuit that causes the ignition of the explosive test mixture in the spark test apparatus according to IEC 60079-11 [1]

Note 1 to entry: See 5.1.6 for the test circuit.

3.6
flammable limits
lower flammable limit (LFL) (3.6.1) and upper flammable limit (UFL) (3.6.2) of gas in a gas-air mixture, between which a flammable mixture is formed

Note 1 to entry: The term “explosive limits” is used especially in European standardization and regulations interchangeably to describe these limits.

Note 2 to entry: The concentration can be expressed as either a volume fraction or a mass per unit volume.

3.6.1
lower flammable limit
LFL
concentration of flammable gas or vapour in air, below which an explosive gas atmosphere does not form

Note 1 to entry: For the purposes of Ex Equipment, this was previously referred to as the lower explosive limit (LEL).

Note 2 to entry: The concentration can be expressed as either a volume fraction or a mass per unit volume.

3.6.2
upper flammable limit
UFL
concentration of flammable gas or vapour in air, above which an explosive gas atmosphere does not form

Note 1 to entry: For the purposes of Ex Equipment, this was previously referred to as the upper explosive limit (UEL).

Note 2 to entry: The concentration can be expressed as either a volume fraction or a mass per unit volume.

3.7
equipment grouping
classification system of equipment related to the explosive atmosphere for which they are intended to be used

Note 1 to entry: IEC 60079-0 identifies three equipment groups:

a) Group I − equipment for mines susceptible to fire damp;

b) Group II, which is sub-divided into groups IIA, IIB, and IIC − equipment for all places with an explosive gas atmosphere other than mines susceptible to fire damp;

c) Group III, which is sub-divided into groups IIIA, IIIB, and IIIC − equipment for all places with an explosive dust atmosphere other than mines susceptible to fire damp.

Note 2 to entry: Examples of transportable equipment include laptops, fans, temporary luminaires on a stand, equipment on casters

[SOURCE: IEC 60079-0:2026 [2] , 3.34]

3.8
flash point
FP
lowest liquid temperature at which, under specified test conditions, a liquid gives off vapours in quantity such as to be capable of forming an ignitable vapour-air mixture

3.9
gas
gaseous phase of a substance that cannot reach equilibrium with its liquid or solid state in the temperature and pressure range of interest

Note 1 to entry: This is a simplification of the scientific definition, and merely requires that the substance is above its boiling point or sublimation point at the ambient temperature and pressure.

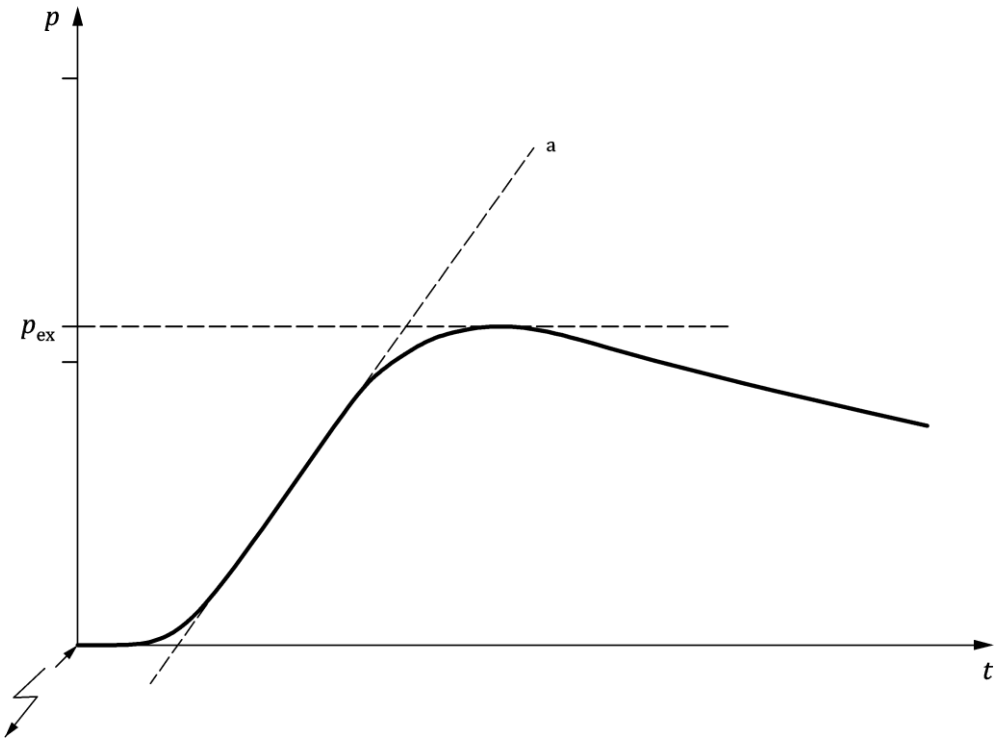
3.10
vapour
gaseous phase of a substance that can reach equilibrium with its liquid or solid state in the temperature and pressure range of interest

Note 1 to entry: This is a simplification of the scientific definition, and merely requires that the substance is below its boiling point or sublimation point at the ambient temperature and pressure.

3.11
explosion
sudden increase of pressure and temperature, due to oxidation or other exothermic reaction

3.12
explosion characteristic
numerical term, determined in accordance with the test methods specified in this part of ISO/IEC 80079 which characterises the contained explosion of a specified concentration of reactants in a vessel having a volume of $1m^3$

Note 1 to entry: Figure 1 shows the pressure-time curve, expressed in MPa and seconds respectively, of a typical explosion.



Key

p	pressure
p_{ex}	explosion pressure
t	time
a	maximum rate of pressure rise

Figure 1 – pressure-time curve

3.13
explosion pressure
p_{ex}

highest pressure occurring in a closed vessel during the explosion of a specific mixture of flammable substances with air or air and inert gases determined under specified test condition

Note 1 to entry: Figure 1 shows the pressure-time curve for an explosion with p_{ex} marked

Note 2 to entry: p_{ex} is expressed as absolute pressure with gases and vapour and as overpressure with dusts.

[SOURCE: EN 15967:2022 [3], 3.1, modified - Note 1 to entry has been modified and Note 2 to entry has been added]

3.14
maximum explosion pressure
p_{max}

maximum value of the explosion pressure (p_{ex}) determined by tests over a wide range of reactant concentrations

3.15
rate of explosion pressure rise
dp/dt
slope of the pressure-time curve in the straight portion of the pressure rise

Note 1 to entry: shows the pressure-time curve for an explosion with the rate of explosion pressure rise marked

[SOURCE: ISO 6772:2012 [4], 3.1 modified - Note deleted and term changed to "rate of explosion pressure rise"]

3.16
maximum rate of explosion pressure rise
$(dp/dt)_{max}$
maximum value of the rate of explosion pressure rise determined by tests over a wide range of reactant concentrations

3.17
K_{max}
normalised characteristic defining the maximum rate of pressure rise with time $(d\text{p}/d\text{t})_{max}$ of an explosion in a volume *V*, according to the Formula (1). The violence of an explosion is evaluated from the value of K_{max}

$$K_{max} = \left(\frac{dp}{dt}\right)_{max} \times V^{1/3} \quad (1)$$

Note 1 to entry: Under certain circumstances, Formula (1) is not valid for vessels with a length to diameter ratio greater than 2:1 or with a volume of less than 1m^3.

Note 2 to entry: This standard restricts itself to quiescent conditions. For further information on turbulent conditions the reader is referred to the explosion protection guidelines (for example EN 14797 [5] or NFPA 69 [6]).

4 Classification of gases and vapours

4.1 General

Equipment Group I addresses mines susceptible to firedamp.

NOTE Firedamp consists mainly of methane, but always contains small quantities of other gases, such as nitrogen, carbon dioxide, and hydrogen, and sometimes ethane and carbon monoxide. The terms firedamp and methane are used frequently in mining practice as synonyms.

Equipment Group II addresses flammable gases and vapours other than in mines susceptible to firedamp. Equipment Group II gases and vapours are classified according to their MESG or MIC ratio into Equipment Groups IIA, IIB, and IIC.

All flammable materials are classified according to their AIT into temperature classes.