

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Explosive atmospheres –
Part 10-1: Classification of areas – Explosive gas atmospheres**

**Atmosphères explosives –
Partie 10-1: Classification des emplacements – Atmosphères explosives
gazeuses**





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Explosive atmospheres –
Part 10-1: Classification of areas – Explosive gas atmospheres**

**Atmosphères explosives –
Partie 10-1: Classification des emplacements – Atmosphères explosives
gazeuses**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.260.20

ISBN 978-2-8322-8890-0

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD	6
INTRODUCTION	10
1 Scope	11
2 Normative references	11
3 Terms and definitions	12
4 General	16
4.1 Safety principles	16
4.2 Hazardous area classification objectives	17
4.3 Interior of equipment containing flammable materials	18
4.4 Explosion risk assessment	18
4.4.1 General	18
4.4.2 Zone of negligible extent	18
4.5 Catastrophic failures	19
4.6 Competence of personnel	19
5 Hazardous area classification methodology	19
5.1 General	19
5.2 Classification by sources of release method	20
5.3 Use of industry codes and national standards	21
5.3.1 General	21
5.3.2 Fuel gas installations	21
5.4 Simplified methods	21
5.5 Combination of methods	21
6 Release of flammable substance	22
6.1 General	22
6.2 Sources of release	22
6.3 Forms of release	23
6.3.1 General	23
6.3.2 Gaseous release	24
6.3.3 Liquefied under pressure release	24
6.3.4 Liquefied by refrigeration release	24
6.3.5 Flammable mists release	25
6.3.6 Vapours release	25
6.3.7 Liquid release	25
7 Ventilation (or air movement) and dilution	26
7.1 General	26
7.2 Main types of ventilation	27
7.2.1 General	27
7.2.2 Natural ventilation	27
7.2.3 Artificial ventilation	27
7.2.4 Degree of dilution	29
8 Type of zone	30
8.1 General	30
8.2 Influence of grade of the source of release	30
8.3 Influence of dilution	30
8.4 Influence of availability of ventilation	30
9 Extent of zone	31

10 Documentation	31
10.1 General	31
10.2 Drawings, data sheets and tables	32
Annex A (informative) Suggested presentation of hazardous areas	33
A.1 Hazardous area – Preferred symbols for zones	33
A.2 Hazardous area suggested shapes	36
Annex B (informative) Estimation of sources of release	38
B.1 Symbols	38
B.2 Examples of grade of release	38
B.2.1 General	38
B.2.2 Sources giving a continuous grade of release	39
B.2.3 Sources giving a primary grade of release	39
B.2.4 Sources giving a secondary grade of release	39
B.3 Assessment of grades of release	39
B.4 Summation of releases	40
B.5 Hole size and source radius	41
B.6 Forms of release	43
B.7 Release rate	44
B.7.1 General	44
B.7.2 Estimation of release rate	45
B.7.3 Release rate of evaporative pools	47
B.8 Release from openings in buildings	49
B.8.1 General	49
B.8.2 Openings as possible sources of release	50
B.8.3 Openings classification	50
Annex C (informative) Ventilation guidance	52
C.1 Symbols	52
C.2 General	53
C.3 Assessment of ventilation and dilution and its influence on hazardous area	53
C.3.1 General	53
C.3.2 Effectiveness of ventilation	54
C.3.3 Criteria for dilution	54
C.3.4 Assessment of ventilation velocity	55
C.3.5 Assessment of the degree of dilution	56
C.3.6 Dilution in a room	58
C.3.7 Criteria for availability of ventilation	59
C.4 Examples of ventilation arrangements and assessments	60
C.4.1 Introduction	60
C.4.2 Jet release in a large building	61
C.4.3 Jet release in a small naturally ventilated building	62
C.4.4 Jet release in a small artificially ventilated building	62
C.4.5 Release with low velocity	63
C.4.6 Fugitive emissions	63
C.4.7 Local ventilation-extraction	64
C.5 Natural Ventilation in buildings	64
C.5.1 General	64
C.5.2 Wind induced ventilation	64
C.5.3 Buoyancy induced ventilation	65

C.5.4	Combination of the natural ventilation induced by wind and buoyancy	67
Annex D (informative)	Estimation of hazardous areas	69
D.1	General.....	69
D.2	Estimating types of the zones	69
D.3	Estimating the extent of the hazardous area	70
Annex E (informative)	Examples of hazardous area classification	72
E.1	General.....	72
E.2	Examples	72
E.3	Example case study for hazardous area classification.....	86
Annex F (informative)	Schematic approach to classification of hazardous areas	96
F.1	Schematic approach to classification of hazardous areas.....	96
F.2	Schematic approach to classification of hazardous areas.....	97
F.3	Schematic approach to classification of hazardous areas.....	98
F.4	Schematic approach to classification of hazardous areas.....	99
Annex G (informative)	Flammable mists	100
Annex H (informative)	Hydrogen	103
Annex I (informative)	Hybrid mixtures	105
I.1	General.....	105
I.2	Use of ventilation	105
I.3	Concentration limits	105
I.4	Chemical reactions	105
I.5	Energy/temperature limits	105
I.6	Zoning requirements	105
Annex J (informative)	Useful equations in support to hazardous area classification	106
J.1	General.....	106
J.2	Dilution with air of a flammable substance release	106
J.3	Estimate of the time required to dilute a flammable substance release	106
Annex K (informative)	Industry codes and national standards	108
K.1	General.....	108
Bibliography.....		112
Figure 1 – Dilution Volume.....		29
Figure A.1 – Preferred symbols for zones		33
Figure A.2 – Gas or vapour at low pressure (or at high pressure in case of unpredictable release direction)		36
Figure A.3 – Gas or vapour at high pressure		36
Figure A.4 – Liquefied gas		37
Figure A.5 – Flammable liquid (non boiling evaporative pool).....		37
Figure B.1 – Forms of release.....		43
Figure B.2 – Specific volumetric evaporation rate of liquids		49
Figure C.1 – Chart for assessing the degree of dilution		57
Figure C.2 – Self diffusion of an unimpeded high velocity jet release		61
Figure C.3 – Supply only ventilation.....		62
Figure C.4 – Supply and extraction ventilation		63
Figure C.5 – Local extraction ventilation		64
Figure C.6 – Specific volumetric flow rate of fresh air of equivalent effective opening area ..		67

Figure C.7 – Example of opposing ventilation driving forces.....	68
Figure D.1 – Chart for estimating hazardous area distances	71
Figure E.1 – Degree of dilution (Example No. 1)	73
Figure E.2 – Hazardous distance (Example No. 1)	74
Figure E.3 – Zone classification (Example No. 1).....	74
Figure E.4 – Degree of dilution (Example No. 2)	76
Figure E.5 – Degree of dilution (Example No. 3)	78
Figure E.6 – Hazardous distance (Example No. 3)	79
Figure E.7 – Zones classification (Example No. 3)	79
Figure E.8 – Degree of dilution (Example No. 4)	81
Figure E.9 – Hazardous distance (Example No. 4)	82
Figure E.10 – Zones classification (Example No. 4)	83
Figure E.11 – Degree of dilution (Example No. 5)	85
Figure E.12 – Hazardous distance (Example No. 5)	86
Figure E.13 – Enclosed compressor handling natural gas	88
Figure E.14 – Example of hazardous area classification for a compressor facility handling natural gas (elevation)	94
Figure E.15 – Example of hazardous area classification for a compressor facility handling natural gas (plan)	95
Figure F.1 – Schematic approach to classification.....	96
Figure F.2 – Schematic approach to classification for continuous grade releases.....	97
Figure F.3 – Schematic approach to classification for primary grade releases.....	98
Figure F.4 – Schematic approach to classification for secondary grade releases	99
 Table A.1 – Hazardous area classification data sheet – Part I: Flammable substance list and characteristics	34
Table A.2 – Hazardous area classification data sheet – Part II: List of sources of release	35
Table B.1 – Suggested hole cross sections for secondary grade of releases	42
Table B.2 – Effect of zones on openings as possible sources of release	51
Table C.1 – Indicative outdoor ventilation velocities (u_w)	56
Table D.1 – Zones for grade of release and effectiveness of ventilation	69
Table E.1 – Compressor facility handling natural gas	88
Table E.2 – Hazardous area classification data sheet – Part I: Flammable substance list and characteristics	91
Table E.3 – Hazardous area classification data sheet – Part II: List of sources of release	92
Table K.1 – Examples of codes and standards.....	109

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –**Part 10-1: Classification of areas –
Explosive gas atmospheres****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60079-10-1 has been prepared by subcommittee 31J: Classification of hazardous areas and installation requirements, of IEC technical committee 31: Equipment for explosive atmospheres.

This third edition of IEC 60079-10-1 cancels and replaces the second edition, published in 2015, and constitutes a technical revision. The significant technical changes with respect to the previous edition are as follows:

Changes		Clause	Type		
Changes	Clause		Minor and editorial changes	Extension	Major technical changes
Deleting commercial and industrial applications for fuel gas from the Scope exemptions	1				C1
Updating editorial details and notes to the definitions	3			X	
Deletion of the previous edition clause 3.7.3 definition for catastrophic failure (dealt with in clause 4.5)				X	
Introduction of new Subclause 4.4.2 Zone of negligible extent	4.4.2			X	
Introduction of new clause 5.3.2 Fuel gas installations	5.3.2			X	
Renumbering of headings	7	X			
Introduction of Figure 1 – Dilution volume	7			X	
Upgrading Table A.1 with UFL and its column 15 heading with the 'source of data'	A.1	X			
Updating the flow-chart in Figure B.1	B.6			X	
Updating equations for evaporation rate to align with the recent source modifications	B.7.3			X	
Updating the chart in Figure B.2 according to the updated equations for evaporation rate and the ventilation velocity of 0,25 m/s	B.7.3			X	
Restructuring Table C.1	C.3.4			X	
Removal of safety factor k and deleting it from the horizontal axis of the chart in Figure C.1	C.3.5				C2
Revising equations (C.2) and (C.3)	C.5.2				C3
Revising equations (C.4) and (C.5)	C.5.3				C4
Revising the chart in Figure C.6 by changing the label on the horizontal axis	C.5.3				C5
Revising equation (C.6) and deleting equation (C.7)	C.5.4				C6
Removal of safety factor k and deleting it from the horizontal axis of the charts in Figure D.1	D.3				C7
Imposing limitations to the use of the chart in Figure D.1	D.3			X	
Updating and corrections in Annex E	Annex E			X	
Upgrading Annex G on Flammable mists	Annex G			X	
Introducing new items in Table K.1	Annex K			X	
Introducing new items in the Bibliography	Bibliography			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.

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.

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.

Major technical changes

addition of technical requirements
increase of technical requirements

B) Information about the background of changes

- C1 The previous edition item e) was: “commercial and industrial applications where only low pressure fuel gas is used for appliances e.g. for cooking, water heating and similar uses, where the installation is compliant with relevant gas codes”. Industrial applications of any kind should not be exempted from the scope of this standard. See also new clause 5.3.2.
- C2 The factor k was initially intended to provide for additional safety for uncertainties in determining LFL for flammable substances, particularly gas mixtures. However, this was considered as unnecessary and confusing considering the derivation of the chart.
- C3 The equations are updated to align with BS 5925
- C4 The equations are updated to align with BS 5925
- C5 The chart is revised to match the new equation (C.4)
- C6 The equation is updated to align with BS 5925
- C7 See the explanation under C2

These are changes to technical requirements (addition, increase of the level or removal).

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

The text of this standard is based on the following documents:

FDIS	Report on voting
31J/307/FDIS	31J/310/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60079 series, under the general title *Explosive atmospheres*, can be found on the IEC website.

This is a preview. Click here to purchase the full publication.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.