

INTERNATIONAL STANDARD



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



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2015 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.

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 It also gives information on projects, replaced and withdrawn publications.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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 60 000 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.

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: csc@iec.ch.

INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.260.20

ISBN 978-2-8322-2867-8

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms and definitions	11
4 General	15
4.1 Safety principles	15
4.2 Area classification objectives	16
4.3 Explosion risk assessment	16
4.4 Competence of Personnel	17
5 Area classification methodology	17
5.1 General.....	17
5.2 Classification by sources of release method.....	18
5.3 Use of industry codes and national standards	18
5.4 Simplified methods	18
5.5 Combination of methods	19
6 Release of flammable substance	19
6.1 General.....	19
6.2 Sources of release.....	19
6.3 Forms of release.....	20
6.3.1 General	20
6.3.2 Gaseous release	21
6.3.3 Liquefied under pressure	21
6.3.4 Liquefied by refrigeration	22
6.3.5 Aerosols	22
6.3.6 Vapours.....	22
6.3.7 Liquid releases	22
6.4 Ventilation (or air movement) and dilution	23
6.5 Main types of ventilation	23
6.5.1 General	23
6.5.2 Natural ventilation.....	23
6.5.3 Artificial ventilation	24
6.5.4 Degree of dilution	25
7 Type of zone	26
7.1 General.....	26
7.2 Influence of grade of the source of release	26
7.3 Influence of dilution.....	27
7.4 Influence of availability of ventilation.....	27
8 Extent of zone	27
9 Documentation	28
9.1 General.....	28
9.2 Drawings, data sheets and tables	28
Annex A (informative) Suggested presentation of hazardous areas	30
A.1 Hazardous area zones – Preferred symbols	30
A.2 Hazardous area suggested shapes	33

Annex B (informative) Estimation of sources of release.....	35
B.1 Symbols.....	35
B.2 Examples of grade of release.....	35
B.2.1 General	35
B.2.2 Sources giving a continuous grade of release	35
B.2.3 Sources giving a primary grade of release	36
B.2.4 Sources giving a secondary grade of release.....	36
B.3 Assessment of grades of release	36
B.4 Summation of releases	37
B.5 Hole size and source radius	38
B.6 Forms of release.....	40
B.7 Release rate	41
B.7.1 General	41
B.7.2 Estimation of Release Rate	41
B.7.3 Release rate of evaporative pools.....	44
B.8 Release from openings in buildings.....	46
B.8.1 General	46
B.8.2 Openings as possible sources of release	46
B.8.3 Openings classification	46
Annex C (informative) Ventilation guidance.....	48
C.1 Symbols.....	48
C.2 General.....	49
C.3 Assessment of ventilation and dilution and its influence on hazardous area	49
C.3.1 General	49
C.3.2 Effectiveness of ventilation	50
C.3.3 Criteria for dilution	50
C.3.4 Assessment of ventilation velocity	51
C.3.5 Assessment of the degree of dilution	52
C.3.6 Dilution in a room	53
C.3.7 Criteria for availability of ventilation	55
C.4 Examples of ventilation arrangements and assessments.....	56
C.4.1 Introduction	56
C.4.2 Jet release in a large building	56
C.4.3 Jet release in a small naturally ventilated building	57
C.4.4 Jet release in a small artificially ventilated building.....	57
C.4.5 Release with low velocity.....	58
C.4.6 Fugitive emissions	59
C.4.7 Local ventilation-extraction	59
C.5 Natural Ventilation in buildings.....	60
C.5.1 General	60
C.5.2 Wind induced ventilation.....	60
C.5.3 Buoyancy induced ventilation.....	61
C.5.4 Combination of the natural ventilation induced by wind and buoyancy	63
Annex D (informative) Estimation of hazardous zones.....	65
D.1 General.....	65
D.2 Estimating types of the zones	65
D.3 Estimating the extent of the hazardous zone	65
Annex E (informative) Examples of hazardous area classification	68

E.1	General.....	68
E.2	Examples.....	68
E.3	Example case study for area classification.....	83
Annex F (informative)	Schematic approach to classification of hazardous areas	93
F.1	Schematic approach to classification of hazardous areas.....	93
F.2	Schematic approach to classification of hazardous areas.....	94
F.3	Schematic approach to classification of hazardous areas.....	95
F.4	Schematic approach to classification of hazardous areas.....	96
Annex G (informative)	Flammable mists.....	97
Annex H (informative)	Hydrogen	99
Annex I (informative)	Hybrid mixtures	101
I.1	General.....	101
I.2	Use of ventilation	101
I.3	Concentration limits	101
I.4	Chemical reactions	101
I.5	Energy/Temperature limits	101
I.6	Zoning requirements.....	101
Annex J (informative)	Useful equations in support to hazardous area classification	102
J.1	General.....	102
J.2	Dilution with air of a flammable substance release	102
J.3	Estimate of the time required to dilute a flammable substance release.....	102
Annex K (informative)	Industry codes and national standards	104
K.1	General.....	104
Bibliography.....		106
Figure A.1 – Preferred symbols for hazardous area zones		30
Figure A.2 – Gas/vapour at low pressure (or at high pressure in case of unpredictable release direction).....		33
Figure A.3 – Gas/vapour at high pressure		33
Figure A.4 – Liquefied gas		34
Figure A.5 – Flammable liquid (non boiling evaporative pool).....		34
Figure B.1 – Forms of release.....		40
Figure B.2 – Volumetric evaporation rate of liquids		45
Figure C.1 – Chart for assessing the degree of dilution		52
Figure C.2 – Self diffusion of an unimpeded high velocity jet release		57
Figure C.3 – Supply only ventilation		58
Figure C.4 – Supply and extraction ventilation		58
Figure C.5 – Local extraction ventilation		60
Figure C.6 – Volumetric flow rate of fresh air per m ² of equivalent effective opening area.....		63
Figure C.7 – Example of opposing ventilation driving forces		64
Figure D.1 – Chart for estimating hazardous area distances		66
Figure E.1 – Degree of dilution (Example No. 1)		69
Figure E.2 – Hazardous distance (Example No. 1)		70
Figure E.3 – Zone classification (Example No. 1).....		70
Figure E.4 – Degree of dilution (Example No. 2)		72

Figure E.5 – Hazardous distance (Example No. 2)	73
Figure E.6 – Degree of dilution (Example No. 3)	75
Figure E.7 – Hazardous distance (Example No. 3)	76
Figure E.8 – Zones classification (Example No. 3)	76
Figure E.9 – Degree of dilution (Example No. 4)	78
Figure E.10 – Hazardous distance (Example No. 4)	79
Figure E.11 – Zones classification (Example No. 4)	79
Figure E.12 – Degree of dilution (Example No. 5)	82
Figure E.13 – Hazardous distance (Example No. 5)	83
Figure E.14 – Enclosed compressor handling natural gas	85
Figure E.15 – Example of area classification for a compressor facility handling natural gas (elevation)	91
Figure E.16 – Example of area classification for a compressor facility handling natural gas (plan)	92
Figure F.1 – Schematic approach to classification	93
Figure F.2 – Schematic approach to classification for continuous grade releases	94
Figure F.3 – Schematic approach to classification for primary grade releases	95
Figure F.4 – Schematic approach to classification for secondary grade releases	96
Table A.1 – Hazardous area classification data sheet – Part I: Flammable substance list and characteristics	31
Table A.2 – Hazardous area classification data sheet – Part II: List of sources of release	32
Table B.1 – Suggested hole cross sections for secondary grade of releases	39
Table B.2 – Effect of hazardous zones on openings as possible sources of release	47
Table C.1 – Indicative outdoor ventilation velocities (u_w)	52
Table D.1 – Zones for grade of release and effectiveness of ventilation	65
Table E.1 – Compressor facility handling natural gas	86
Table E.2 – Hazardous area classification data sheet – Part I: Flammable substance list and characteristics	88
Table E.3 – Hazardous area classification data sheet – Part II: List of sources of release (1 of 2)	89
Table K.1 – Examples of codes and standards	105

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 second edition of IEC 60079-10-1 cancels and replaces the first edition, published in 2008, and constitutes a technical revision. The significant technical changes with respect to the previous edition are as follows:

		Type		
Changes	Clause	Minor and editorial changes	Extension	Major technical changes
Complete restructuring and dividing into sections to identify possible methodologies for classifying hazardous areas and to provide further explanation on specific assessment factors	Main body of the text	X	X	X
Introducing new terms and the definitions	3		X	
Introducing clauses for alternative methods of area classification	5		X	X
Updating examples for presentation of hazardous area classification	Annex A		X	X
Updating calculations for release rate	Annex B		X	X
Complete re-write with a new approach based upon the degree of dilution instead of the degree of ventilation	Annex C		X	X
Introduced as a new Annex for zone extents	Annex D		X	
Updated with new examples to explain the methodology set forth in Annexes A, B, C and D	Annex E			X
Update of the flow chart illustrating the area classification procedure by dividing it into four sections	Annex F		X	
Introduced as a new Annex on hydrogen	Annex H		X	
Introduced as a new Annex on hybrid mixtures	Annex I		X	
Introduced as a new Annex with supplementary equations	Annex J		X	
Introduced as a new Annex for reference to national and industry codes with specific examples of hazardous area classification	Annex K		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:**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

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/253/FDIS	31J/256/RVD

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

This publication 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.

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

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

A bilingual version of this publication may be issued at a later date.

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.

INTRODUCTION

In areas where dangerous quantities and concentrations of flammable gas or vapour may arise, protective measures need to be applied in order to reduce the risk of explosions. This part of IEC 60079 sets out the essential criteria against which the ignition hazards can be assessed, and gives guidance on the design and control parameters which can be used in order to reduce such hazards.

EXPLOSIVE ATMOSPHERES –

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

1 Scope

This part of IEC 60079 is concerned with the classification of areas where flammable gas or vapour hazards may arise and may then be used as a basis to support the proper selection and installation of equipment for use in hazardous areas.

It is intended to be applied where there may be an ignition hazard due to the presence of flammable gas or vapour, mixed with air, but it does not apply to:

- a) mines susceptible to firedamp;
- b) the processing and manufacture of explosives;
- c) catastrophic failures or rare malfunctions which are beyond the concept of abnormality dealt with in this standard (see 3.7.3 and 3.7.4);
- d) rooms used for medical purposes;
- e) 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;
- f) domestic premises;
- g) where a hazard may arise due to the presence of combustible dusts or combustible flyings but the principles may be used in assessment of a hybrid mixture (refer also IEC 60079-10-2).

NOTE Additional guidance on hybrid mixtures is provided in Annex I.

Flammable mists may form or be present at the same time as flammable vapour. In such case the strict application of the details in this standard may not be appropriate. Flammable mists may also form when liquids not considered to be a hazard due to the high flash point are released under pressure. In these cases the classifications and details given in this standard do not apply. Information on flammable mists is provided in Annex G.

For the purpose of this standard, an area is a three-dimensional region or space.

Atmospheric conditions include variations above and below reference levels of 101,3 kPa (1 013 mbar) and 20 °C (293 K), provided that the variations have a negligible effect on the explosion properties of the flammable substances.

In any process plant, irrespective of size, there may be numerous sources of ignition apart from those associated with equipment. Appropriate precautions will be necessary to ensure safety in this context. This standard is applicable with judgement for other ignition sources.

This standard does not take into account the consequences of ignition of an explosive atmosphere.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For

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

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0 and the following apply.

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426.

3.1

explosive atmosphere

mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour, dust, fibres, or flyings, which, after ignition, permits self-sustaining flame propagation

[SOURCE: IEC 60079-0:2013, 3.30]

3.2

explosive gas atmosphere

mixture with air, under atmospheric conditions, of flammable substances in the form of gas or vapour, which, after ignition, permits self-sustaining flame propagation

Note 1 to entry: Although a mixture which has a concentration above the upper flammable limit (UFL) is not an explosive gas atmosphere, it can readily become so and, generally for area classification purposes, it is advisable to consider it as an explosive gas atmosphere.

Note 2 to entry: There are some gases and vapours which are explosive with the concentration of 100 % (e.g. acetylene, CAS no. 74-86-2, C_2H_2 ; monovinyl acetylene, CAS no. 689-97-4, C_4H_4 ; 1-propyl nitrate (vapour), CAS no. 627-13-4, $CH_3(CH_2)_2NO_3$; isopropyl nitrate (vapour), CAS no. 1712-64-7, $(CH_3)_2CHONO_2$; ethylene oxide (vapour), CAS no. 75-21-8, $(CH_2)_2O$; hydrazine (vapour), CAS no. 302-01-2, H_4N_2).

[SOURCE: IEC 60079-0:2013, 3.32, modified (addition of Notes to entry)]

3.3

hazardous areas and zones

3.3.1

hazardous area (on account of explosive gas atmospheres)

an area in which an explosive gas atmosphere is or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment

Note 1 to entry: The interior of many items of process equipment are commonly considered as a hazardous area even though a flammable atmosphere may not normally be present to account for the possibility of air entering the equipment. Where specific controls such as inerting are used the interior of process equipment may not need to be classified as a hazardous area.

3.3.2

non-hazardous area (on account of explosive gas atmospheres)

an area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of equipment

3.3.3

zones

hazardous area classification based upon the frequency of the occurrence and duration of an explosive atmosphere