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Explosive atmospheres - Part 13: Equipment protection by pressurized room "p" and artificially ventilated room "v" (IEC 60079-13:2017)

Atmosphères explosives - Partie 13: Protection du matériel par salle à surpression interne "p" et salle ventilée artificiellement "v" (IEC 60079-13:2017)

Explosionsgefährdete Bereiche - Teil 13: Schutz von Einrichtungen durch einen überdruckgekapselten Raum "p" und einen fremdbelüfteten Raum "v" (IEC 60079-13:2017)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 31/1309/FDIS, future edition 2 of IEC 60079-13, prepared by IEC/TC 31 "Equipment for explosive atmospheres" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60079-13:2017.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2018-04-06
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2020-10-06

This document supersedes EN 60079-13:2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60079-13:2017 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60079-2	NOTE	Harmonized as EN 60079-2.
IEC 60079-14	NOTE	Harmonized as EN 60079-14.
IEC 60079-17	NOTE	Harmonized as EN 60079-17.
IEC 60529	NOTE	Harmonized as EN 60529.
IEC 61285	NOTE	Harmonized as EN 61285.
IEC 61508 Series	NOTE	Harmonized as EN 61508 Series.
IEC 61511 Series	NOTE	Harmonized as EN 61511 Series.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60050-426	-	International Electrotechnical Vocabulary - Part 426: Equipment for explosive atmospheres	-	-
IEC 60079-0	-	Explosive atmospheres - Part 0: Equipment - General requirements	EN 60079-0	-
IEC 60079-10-1	-	Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres	EN 60079-10-1	-
IEC 60079-29	Series	Explosive atmospheres - Part 29: Gas detectors	EN 60079-29	Series

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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EXPLOSIVE ATMOSPHERES –

Part 13: Equipment protection by pressurized room "p" and artificially ventilated room "v"

FOREWORD

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International Standard IEC 60079-13 has been prepared by IEC technical committee 31: Equipment for explosive atmospheres

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) modification of the title of this document to include artificially ventilated room "v" in addition to pressurized room "p";
b) addition of types of protection "pb", "pc", and "vc" and removal of types of protection "px", "py", "pz" and "pv";
c) definition of the differences between pressurization and artificial ventilation types of protection;

d) removal of protection of rooms with an inert gas or a flammable gas from the scope of this document;

e) addition of an informative annex to include examples of applications where types of protection pressurization or artificial ventilation or pressurization and artificial ventilation can be used and associated guidelines.

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

FDIS	Report on voting
31/1309/FDIS	31/1317/RVD

Full information on the voting for the approval of this document 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.

This document is to be used in conjunction with the principles of hazardous area classification from IEC 60079-10-1 and artificial ventilation for the protection of analyser(s) houses from IEC 60079-16.

A list of all parts in the IEC 60079 series, published 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.

INTRODUCTION

This part of IEC 60079 gives requirements for the design, construction, assessment, verification and marking of rooms used to protect internal equipment by pressurization or artificial ventilation or both as applicable when located in an explosive gas atmosphere or combustible dust atmosphere hazardous area with or without an internal source of a flammable gas or vapour. It also includes a room located in a non-hazardous area that has an internal source of release of a flammable gas or vapour.

This document deals with rooms that are partially constructed in a manufacturer’s facility and intended to have the final installation completed on-site, as well as rooms that are constructed completely on-site. Rooms partially constructed in a manufacturer’s facility may include third-party verification. For rooms built on-site, this document can be used by plant operators as a guide for assessment of those facilities.

This document represents a major technical revision of the requirements for equipment protection by pressurized room "p" and artificially ventilated room "v" and should be considered as introducing all new requirements.

EXPLOSIVE ATMOSPHERES –

Part 13: Equipment protection by pressurized room "p" and artificially ventilated room "v"

1 Scope

This part of IEC 60079 gives requirements for the design, construction, assessment, verification and marking of rooms used to protect internal equipment:

– located in a Zone 1 or Zone 2 or Zone 21 or Zone 22 explosive atmosphere (an area normally requiring an equipment protection level (EPL) Gb, Gc, Db or Dc) without an internal source of gas/vapour release and protected by pressurization;

– located in a Zone 2 explosive atmosphere (an area normally requiring EPL Gc) with or without an internal source of gas/vapour release and protected by artificial ventilation;

– located in a non-hazardous area, containing an internal source of gas/vapour release and protected by artificial ventilation;

– located in a Zone 1 or Zone 2 or Zone 21 or Zone 22 explosive atmosphere (an area normally requiring EPL Gb, Gc, Db or Dc), containing an internal source of gas/vapour release and protected by both pressurization and artificial ventilation.

The term "room" used in this document includes single rooms, multiple rooms, a complete building or a room contained within a building. A room is intended to facilitate the entry of personnel and includes inlet and outlet ducts. An acoustic hood and other like enclosures designed to permit the entry of personnel can be considered as a room.

This document also includes requirements related safety devices and controls necessary to ensure that artificial ventilation, purging and pressurization is established and maintained.

A room assembled or constructed on site, can be either on land or off-shore. The room is primarily intended for installation by an end-user but could be constructed and assessed at a manufacturer’s facility, where the final construction such as ducting can be completed on site.

Rooms can be located in an explosive gas atmosphere requiring EPL Gb or Gc, or a combustible dust atmosphere requiring EPL Db, or Dc.

This document does not specify the methods that may be required to ensure adequate air quality for personnel with regard to toxicity and temperature within the room. National or other regulations and requirements may exist to ensure the safety of personnel in this regard.

Protection of rooms by using an inert gas or a flammable gas is outside of the scope of this document. It is recognized that such applications are special cases, which in part may be addressed using the principles from IEC 60079-2, but in all probability will also be the subject of additional, stringent engineering standards, procedures and practices. Pressurized enclosures for equipment that are not intended to facilitate the entry of personnel are addressed in IEC 60079-2, and are not in the scope of this document.

NOTE Maintenance recommendations are contained in Annex A until they can be included in IEC 60079-17.

This document supplements and modifies the general requirements of IEC 60079-0, except exclusions as indicated in Table 1. Where a requirement of this document conflicts with a requirement of IEC 60079-0, the requirement of this document takes precedence.

Table 1 – Exclusion of specific clauses or subclauses of IEC 60079-0

Clause of IEC 60079-0		IEC 60079-0 application to IEC 60079-13
Ed. 6.0 (2011) (Informative)	Clause / subclause title (Normative)	
4	Equipment grouping	Applies
4.1	Group I	Excluded
4.2	Group II	Applies
4.3	Group III	Applies
4.4	Equipment for a particular explosive atmosphere	Applies
5.1	Environmental influences	Applies
5.1.1	Ambient temperature	Applies
5.1.2	External source of heating or cooling	Applies
5.2	Service temperature	Applies
5.3.1	Determination of maximum surface temperature	Applies
5.3.2.1	Group I electrical equipment	Excluded
5.3.2.2	Group II electrical equipment	Applies
5.3.2.3	Group III electrical equipment	Applies
5.3.3	Small component temperature for Group I and Group II electrical equipment	Excluded
6.1	General	Applies
6.2	Mechanical strength	Excluded
6.3	Opening times	Excluded
6.4	Circulating currents	Excluded
6.5	Gasket retention	Excluded
6.6	Electromagnetic and ultrasonic radiating equipment	Applies
7.1	General	Excluded
7.2	Thermal endurance	Excluded
7.3	Resistance to light	Modified
7.4	Electrostatic charges on external non-metallic materials	Excluded
7.5	Accessible metal parts	Excluded
8	Metallic enclosures and metallic parts of enclosures	Excluded
9	Fasteners	Excluded
10	Interlocking devices	Excluded
11	Bushings	Excluded
12	Materials used for cementing	Excluded
13	Ex components	Excluded
14	Connection facilities and termination compartments	Excluded
15	Connection facilities for earthing and bonding conductors	Excluded
16	Entries into enclosures	Excluded
17	Supplementary requirements for rotating electrical machines	Excluded
18	Supplementary requirements for switchgear	Excluded
19	Supplementary requirements for fuses	Excluded
20	Supplementary requirements for plugs and sockets	Excluded
21	Supplementary requirements for luminaires	Excluded
22	Supplementary requirements for caplights and handlights	Excluded
23	Equipment incorporating cells and batteries	Excluded
24	Documentation	Applies
25	Compliance of prototype or sample with documents	Applies
26.1	General	Applies
26.2	Test configuration	Applies
26.3	Tests in explosive test mixtures	Excluded

Clause of IEC 60079-0		IEC 60079-0 application to IEC 60079-13
Ed. 6.0 (2011) (Informative)	Clause / subclause title (Normative)	
26.4	Tests of enclosures	Excluded
26.5	Thermal tests	Excluded
26.6	Torque test for bushings	Excluded
26.7	Non-metallic enclosures or non-metallic parts of enclosures	Excluded
26.8	Thermal endurance to heat	Excluded
26.9	Thermal endurance to cold	Excluded
26.10	Resistance to light	Applies
26.11	Resistance to chemical agents for Group I electrical equipment	Excluded
26.12	Earth continuity	Excluded
26.13	Surface resistance test of parts of enclosures of non-metallic materials	Excluded
26.14	Measurement of capacitance	Excluded
26.15	Verification of ratings of ventilating fans	Excluded
26.16	Alternative qualification of elastomeric sealing O-rings	Excluded
27	Routine tests	Applies
28	Manufacturers responsibility	Applies
29.1	Applicability	Applies
29.2	Location	Modified
29.3	General	Modified
29.4	Ex marking for explosive gas atmospheres	Modified
29.5	Ex marking for explosive dust atmospheres	Applies
29.6	Combined types of protection	Applies
29.7	Multiple types of protection	Excluded
29.8	Ga using two independent Gb types of protection	Excluded
29.9	Ex components	Excluded
29.10	Small equipment and small Ex components	Excluded
29.11	Extremely small equipment and extremely small Ex components	Modified
29.12	Warning markings	Applies
29.13	Alternate marking of equipment protection levels (EPLs)	Excluded
29.14	Cells and batteries	Applies
30	Instructions	Modified
Annex A	Supplementary requirements for Ex cable glands	Excluded
Annex B	Requirements for Ex components	Excluded
Annex C	Example of rig for resistance to impact test	Excluded
Annex D	Introduction to an alternative risk assessment method encompassing "equipment protection levels" for Ex equipment	Applies

Applies: this requirement of IEC 60079-0 is applied without change.

Excluded: this requirement of IEC 60079-0 does not apply.

Modified: this requirement of IEC 60079-0 is modified as detailed in this document.

NOTE The applicable requirements of IEC 60079-0 are identified by the clause title which is normative. This table was written against the specific requirements of IEC 60079-0, Ed 6.0.

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: Equipment for explosive atmospheres*

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

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

IEC 60079-29 (all parts), *Explosive atmospheres – Gas detectors*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-426, IEC 60079-0 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

NOTE Unless otherwise specified, the terms "voltage" and "current" mean the RMS values of an alternating, direct or composite voltage or current.

3.1
airlock
means of egress, consisting of two interdependent doors designed to maintain the internal pressure of the room in order to prevent or significantly reduce the entry of a surrounding explosive atmosphere

3.2
alarm
piece of apparatus that generates a visual or audible signal that is intended to attract attention

[SOURCE: IEC 60050-426:2008, 426-09-05]

3.3
clean air
air that is essentially free of combustible dust, and contains no more than trace amounts of flammable vapour or gas

3.4
dilution
mixing of flammable vapour or gas with air which, over time, will reduce the flammable concentration

Note 1 to entry: For safety reasons, dilution to a level lower than the lower explosive limit (LEL) can be required if associated with the potential release there is an additional toxic or asphyxiant risk. Further guidance can be found in IEC 61285.

[SOURCE: IEC 60079-10-1:2015, 3.5.2, modified – The note to entry has been added.]

3.5
internal source of release
point or location indoors from which a gas, vapour, mist or liquid may be released into the atmosphere such that an explosive gas atmosphere could be formed

3.6
limiting value
lowest concentration value of the lower flammable limit (LFL) of each component involved, taking account of the most onerous conditions of concentration that may occur from every internal source of release within the room

3.7
lower flammable limit
LFL
volume fraction of flammable gas or vapour in air below which an explosive gas atmosphere will not form, expressed as a percentage

Note 1 to entry: Although the lower explosive limit (LEL) is often used in place of the lower flammable limit (LFL), it should be recognized that the LFL is often slightly lower than the LEL.

Note 2 to entry: See IEC 60079-20-1.

[SOURCE: IEC 60079-2:2014, 3.24, modified – In the definition, the parentheses have been moved to a second note to entry, and the existing note has been replaced by a new note.]

3.8
opening
inlet, outlet, door or non-airtight fixed panel

3.9
pressurization
technique of guarding against the ingress of the external atmosphere into a room by maintaining clean air therein at a pressure above that of the external atmosphere

3.10
pressurization system
grouping of safety devices and other components used to pressurize and monitor or control a pressurized room

3.11
restricted access door
door with controlled or limited use or alarmed when open

3.12
safety device
item used to implement or maintain the integrity of the type of protection

3.13
pressurized room
room volume protected by pressurization and of sufficient size to permit the entry of a person who may occupy the room

3.14
artificially ventilated room
room volume protected by artificial ventilation and of sufficient size to permit the entry of a person who may occupy the room

Note 1 to entry: The room volume can be an entire room (general) or part of a room (local ventilation).

3.15
purging
operation of passing a quantity of clean air through the room and ducts in a pressurized or artificially ventilated room, so that the concentration of the explosive gas atmosphere is brought to a safe level

3.16
room volume
<of the pressurized or artificially ventilated room> volume of the empty room and including any associated ducting without internal equipment

3.17
pressurization "pb"
pressurized room that provides an equipment protection level Gb or Db

3.18
pressurization "pc"
pressurized room that provides an equipment protection level Gc or Dc

3.19
artificial ventilation "vc"
artificial ventilation of a room with or without an internal source of release, such that the room provides an equipment protection level Gc

3.20
artificial ventilation
technique of guarding against an explosive atmosphere by the use of mechanical means to provide for the movement of air

3.21
ventilation system
complete installation required to produce artificial ventilation

4 Requirements for all rooms

4.1 General

Protection by pressurization and protection by artificial ventilation are separately described but may be combined to protect against hazards where required. Where both techniques are combined, then requirements for both shall apply. Unless otherwise identified in Clauses 6 or 7, the requirements in 4.2 to 4.10 apply to both protection techniques.

NOTE Annex C provides examples of applications and associated guidelines.

4.2 Type and level of protection

4.2.1 Pressurization "p"

Rooms with pressurization "p" and located in a hazardous area shall be one of the following:

a) Level of protection "pb" (EPL Gb or Db). The pressurized room maintains an internal overpressure reducing the risk of ingress of an explosive atmosphere and is suitable for use in an area requiring EPL Gb or Db, permitting unprotected equipment to be installed within the pressurized room except for pressurization safety devices (see 6.3.1).

b) Level of protection "pc" (EPL Gc or Dc). The pressurized room maintains an internal overpressure reducing the risk of the ingress of an explosive atmosphere and is suitable for use in an area requiring EPL Gc or Dc, permitting unprotected equipment to be installed within the pressurized room except for pressurization safety devices (see 6.3.1).

4.2.2 Artificial ventilation "v"

The artificial ventilated room maintains artificial ventilation to dilute a release of flammable substance to reduce a hazardous area inside such that the required EPL is reduced from either Gb or Gc to non-hazardous or from Gb to Gc.

Rooms with artificial ventilation "v" and located in a hazardous area shall be:

- level of protection "vc" (EPL Gc). The ventilated room maintains artificial ventilation to dilute a release of flammable substance to reduce a hazardous area such that unprotected equipment can be installed within the artificially ventilated room, and is suitable for use in an area requiring EPL Gc.

NOTE This permits equipment with a lower EPL to be installed within the artificially ventilated room except for ventilation safety devices (see 7.3.1).

Rooms may be protected by either general or local artificial ventilation. General artificial ventilation applies to an entire room or significant portion of a room and local artificial ventilation applies to restricted regions, for example an extraction hood.

4.3 Construction

The protected room shall, at a minimum, be designed to allow pressurization or artificial ventilation to be used in accordance with Clauses 6 or 7.

NOTE The room construction requirements could be affected by the location, occupancy requirements, and functionality.

For pressurized rooms and rooms protected by artificial ventilation, provision shall be made to ensure adequate purging of dead air spaces created within the room, for example by avoiding suspended ceilings, trenches, or raised floors.

4.4 Mechanical strength

The room and any ducts and their connecting parts shall be designed to withstand the maximum pressure of the pressurization or ventilation system. This shall be verified by the design documentation or by the overpressure test of 6.4.2. National or regional building requirements may also apply.

Test for mechanical strength need not be carried out on the completed room but may instead be applied to all parts such as windows, gland plates, penetrations, doors, inlets or outlets of the room which are not made of steel or concrete but which are integral to the type of protection. In this case, the tests may be carried out on the parts themselves, appropriately mounted for the test.

4.5 Penetrations and seals

The entry of cables, electrical conduits and other penetrations into the room shall be sealed so that the necessary pressure differential or artificial ventilation integrity is maintained.

Measures shall be taken to minimize the exchange of atmosphere between the inside and the outside of the room where this may lead to another hazard, for example displacement of vapours via floor drainage facilities.

Barriers may need to be considered for certain room designs to minimize ingress or egress of gases or vapours, for example this may include liquid seals such as s-bends in drain piping.

4.6 Personnel access doors

Where protection against ingress of a flammable atmosphere is required, doors for personnel access shall be automatically self-closing, close fitting, and designed to close and latch

against the normal pressure differential. Restricted access doors are not required to be self-closing.

NOTE Refer to IEC 60079-10-1 for additional guidance on doors.

4.7 Inlets and outlets

For pressurization and general artificial ventilation, the location of air inlets and outlets shall be arranged to ensure even distribution of the clean air flow to minimize pockets where gases or vapours could accumulate, taking into account the density of those gases and vapours. Verification shall be according to 6.4.4 or 7.5.3.

Where it is not possible to avoid pockets where gases and vapours can accumulate, alternative methods of detection and control shall be used.

4.8 Ducts

In order to minimize the entry of contaminated air in the duct or loss of system performance, the fan suction and discharge ducts should be suitably designed to be free of leaks and protected against foreseeable mechanical damage.

NOTE Ducts for the pressurization system or ventilation system can be subject to applicable national or regional standards for building fire requirements.

4.9 Purging and cleaning

4.9.1 General

Purging of flammable gases or removal of combustible dusts from a pressurized room or an artificially ventilated room is required at both the initial commissioning of the room and following loss of pressurization or loss of flow, respectively.

Administrative procedures or other controls during loss of pressurization or artificial ventilation may be deemed by the user sufficient to ensure a gas free atmosphere under some conditions, for example during short time loss of pressurization or artificial ventilation and when no other abnormal situations are present. However, the means for purging shall still be provided.

4.9.2 Gases – Purging

4.9.2.1 General

Before energizing any electrical equipment which is not suitable for the EPL required in a pressurized room or an artificially ventilated room, it is necessary to ensure the concentration of flammable gas is not more than 25 % of the limiting value (see 3.6) by purging with clean air.

Purging shall be verified by either:

a) flow measurement at the dedicated outlet to detect flow below the minimum purge rate determined for the system;

b) detection of the room pressure above that determined for the pressure at the minimum purge rate in conjunction with

   – flow sensing at the dedicated outlet, or

   – gas detectors, where there is not a dedicated outlet, or flow detection is not practicable at the outlet, to confirm the purge has been effective and that the concentration of flammable gas within the room is at or below 25 % of the limiting value. Gas detection cannot be used as to reduce the initial purge requirement of 4.9.2.2 but may be used to extend the purge time where appropriate.

4.9.2.2 Purge volume and flow rate

The purge volume for pressurization and for general artificial ventilation shall be a minimum of 10 room volumes unless a reduced purge volume can be verified by 6.4.4 or 7.5.3 or determined from other analysis.

The purging flow rate shall be a minimum of five air changes per hour.

4.9.3 Enclosures within the room

During purging of the room, any enclosure which exceeds 5 % of the total internal volume of the room and that contains electrical equipment which is not suitable for the EPL required shall be

a) vented to the exterior (if not an explosive atmosphere) or to the room so as to facilitate flow into and out of the enclosure, or

b) individually purged, or

c) individually pressurized to meet the required EPL.

For vented enclosures, top and bottom vents providing not less than 1 cm^2 of vent area for each 1 000 cm^3 with a minimum vent size of 6,3 mm diameter are commonly considered sufficient for adequate purging.

4.10 Ignition prevention under system failure

Upon failure of the pressurization system or ventilation system, appropriate measures shall be taken to prevent any ignition after power shut off from becoming active, for example hot surfaces above the ignition temperature.

NOTE This could be achieved either by the design and construction of the room or of the ventilation system, for example air locks or by providing sufficiently early shutdown to allow equipment to cool before the flammable concentration approaches the LFL. Other means such as bringing auxiliary pressurization systems into operation or other provisions could also be considered. See also Annex B.

5 Clean air supply

5.1 General

Unless otherwise identified in Clauses 6 or 7, the requirements of Clause 5 apply to both types of protection (by pressurization and by artificial ventilation).

5.2 Source of clean air

The source of clean air shall be determined from the nature of the process and the physical layout and should be from a non-hazardous area. Under certain conditions as prescribed below and in 6.1.2 and in 7.1.2, the source may be from a Zone 2 area.

When the air intake is from a Zone 2 area, in addition to the pressurization or ventilation system requirements, the following apply:

a) there shall be at least one flammable gas detector with alarm in the air intake; and

b) there shall be at least one flammable gas detector with alarm within the room; and

c) flammable gas detection in the air intake shall be arranged to shut down the intake of air containing flammable vapour or gas into the room on detection of 25 % of the limiting value; and

d) flammable gas detection and all other electrical equipment used for alarming and emergency actions/interlocks and the supply fan and motor shall have an EPL suitable for the area without pressurization or ventilation system.

Any clean air duct in a hazardous area shall throughout its length operate above atmospheric pressure in order to preclude the entry of any flammable or combustible material. Alternatively, a fan may be installed at the entrance to a room (thus operating the duct below atmospheric pressure) provided that the conditions above in 5.2 are met.

NOTE This allows for reasonable assurance that the internal atmosphere of the room is clean at all times, either by operating the duct at a positive pressure or by operating the duct at atmospheric pressure and monitoring the atmosphere of the room with a gas detector.

5.3 Environmental and air temperature conditions

The appropriate environmental and air temperature conditions for design as determined for the pressurization or ventilation system shall be documented.

5.4 Heating, ventilation and air conditioning services

The clean air supply may include heating, ventilation, and air conditioning equipment. Any outdoor air used by heating, ventilation and air conditioning equipment shall be provided from the clean air supply.

6 Requirements for pressurized rooms

6.1 General

6.1.1 Design

The room shall be designed to minimize the entry of flammable gases and vapours and combustible dusts by being pressurized in accordance with pressurization "pb" or pressurization "pc".

6.1.2 Source of clean air

6.1.2.1 Pressurization "pb"

For pressurization "pb", the clean air shall come from a non-hazardous area.

6.1.2.2 Pressurization "pc"

For pressurization "pc", the air intake may be located in a Zone 2 area using air that is essentially free of contaminants or foreign matter and contains no more than trace amounts of flammable vapour or gas under normal operating conditions.

6.1.3 Flow

The continuous flow of clean air through the pressurized room need only be sufficient to compensate for leakage and maintain the pressure differential. Loss of air flow shall be detected at the discharge end of the fan and shall activate an alarm.

6.1.4 Pressurization system

6.1.4.1 Room pressure differential

The pressurization system shall be capable of maintaining a pressure of at least 25 Pa in the room with respect to adjacent spaces, with 50 % of all outlets (not doors) open. Failure of a pressurization system shall be determined by pressure differential below 25 Pa.

Loss of pressure differential shall be detected by a sensor located in the room and shall have the capability to activate an alarm.

Activation of the alarm can be delayed if the drop in pressure is a result of an open door and there is sufficient air flow into the room, see 6.1.7. This may require door position sensors to verify a door is open and air-flow sensing.

NOTE Unless an airlock is used, the pressure differential could be lost when a door is opened and this could result in unnecessary alarms.

6.1.4.2 Power for pressurization system

The pressurization system shall be energized independently from the electrical power to the room.

6.1.5 Preventing the explosive atmosphere from entering through an open door

Entry of an explosive atmosphere through an open door shall be prevented or significantly reduced by one of the following:

- an airlock according to 6.1.6; or
- a minimum outward velocity of air through the open door according to 6.1.7.

This does not apply for the following:

- doors marked "restricted access";
- doors used only for infrequent movement of equipment or maintenance if – under conditions of management control – these doors are marked to restrict use, are not used for egress, and are secured in the closed position;
- doors used only as emergency exits and that only open from the inside.

6.1.6 Airlock

Where an airlock is used, provision shall be made to ensure that it either has a continuous flow of clean air equivalent to at least five volumes of the airlock per hour, or gas detectors shall be installed within the airlock arranged to alarm at 25 % of the limiting value. See 6.3.3.

NOTE It is normally the user's responsibility to provide prompt restorative action if the gas detectors within the airlock indicate a level in excess of 25 % of the limiting value for a period of time.

Each door of the airlock should be fitted with a device to indicate at a prominent location in the room when both doors are not closed.

Any electrical equipment within the airlock shall be suitable for the EPL required external to the room.

Warning signs viewable upon entry or egress shall indicate that one door needs to be closed before the other is open. See 8.2.

6.1.7 Outward air velocity through a door

Where an airlock is not provided, the minimum velocity through an open door shall be 0,3 m/s. The outward velocity shall be measured with 50 % of the available outlet area from all other outlets, capable of being opened, simultaneously open. A drop in pressure below 25 Pa is permissible during the time that these openings are open and the specified outward air velocity is maintained (see 6.1.4.1 and 6.1.5).

Openings that are not considered capable of being opened include:

- doors that are specified as an exception in 6.1.5;
- gland or bulkhead plates or other similar covers that cannot be removed without the use of a key or tool.

The minimum outward velocity of air specified in 6.1.5 is based upon low wind condition and may need to be increased for local conditions.

6.1.8 Air consuming device

If there is an air consuming device (such as a compressor or laboratory hood) in the room, sufficient air shall be supplied to accommodate its needs as well as the needs of the pressurization system. Alternatively, the air supply to such a device shall be supplemented by a separate source of clean air.

6.1.9 Action when pressurization system fails

6.1.9.1 Pressurization "pb"

Upon failure of the pressurization system, a cut-off switch shall be incorporated to de-energize power automatically from all equipment within the room not having an acceptable EPL, or operation shall be continued under administrative controls. Acceptable EPLs are as follows:

- Ga or Gb for pressurization "pb" used in an explosive gas atmosphere; or
- Da or Db for pressurization "pb" used in a combustible dust atmosphere.

NOTE Examples of administrative controls include:

- power to the equipment is continued for a short period if loss of pressure differential has resulted from an open door and the room is equipped with gas detectors to confirm the room has not exceeded 25 % of the limiting value (see 6.3.3);
- power to the equipment is continued for a short period if immediate loss of power would result in a more hazardous condition and the room is equipped with gas detectors to confirm the room has not exceeded 25 % of the limiting value (see 6.3.3);
- operations under a work permit.

6.1.9.2 Pressurization "pc"

For pressurization "pc", power to the room may be maintained upon failure of the pressurization system for a limited duration. If the pressurization system is not restored following this limited duration period, power to the room shall be de-energized to all equipment within the room not having an acceptable EPL, or operation shall be continued under administrative controls. Acceptable EPLs are as follows:

- Ga, Gb or Gc for pressurization "pc" used in an explosive gas atmosphere;
- Da, Db or Dc for pressurization "pc" used in a combustible dust atmosphere.

NOTE Examples of administrative controls include:

- if the area external to the room is known not to have exceeded 40 % of the limiting value with the concurrent failure of the pressurization system, power could be maintained – use of gas detectors could be one means of verifying this condition (see 6.3.3);
- operations under a work permit.

6.1.10 Re-energizing the room

Provisions shall be made to energize the equipment in the room safely after failure of the pressurization system. Such provisions include purging of gases in accordance with 6.2.2 or removing combustible dust by cleaning in accordance with 6.2.3.

6.2 Purging of rooms

6.2.1 General

In addition to 4.9, the requirements in 6.2.2 and 6.2.3 apply for pressurized rooms.

6.2.2 Sequence of operations of the purging safety devices

The sequence of operations of the safety devices shall be as follows.

a) Following the initiation of the sequence, the purging flow through and the pressure differential between the internals of the room and the external atmosphere shall be monitored in accordance with this document.

b) The purge timer shall start once the following conditions are satisfied:

   1) the purging flow through the room is established; and

   2) the minimum pressure differential is established.

c) When the purge time has elapsed, the purging flow rate may be reduced to the level sufficient to maintain the required pressure differential in the room. At that point, the equipment may be energized.

This sequence of operations shall be automated for pressurization "pb".

In the event of failure of any step in the sequence, the purging cycle shall be restarted except as specified below.

If the minimum specified pressure differential is not maintained and a door switch indicates that the door is not closed, the timer shall be halted until the pressure differential is re-established. If the loss of pressure differential persists for longer than 60 s, the purging cycle shall be restarted regardless of the status of the door switch.

6.2.3 Dusts – Cleaning

Before energizing any electrical equipment which is not suitable for the EPL required external to the room, excessive quantities of combustible dust shall be removed from the room and its contents.

6.3 Minimum safety provisions, safety devices and electrical disconnects

6.3.1 Safety devices

The safety devices consisting of the pressurization system, its controls, means of disconnection of electrical power, the system fan and its motor and (optional) gas detectors or other devices listed in Table 2 shall be suitable for the EPL required without the pressurization system.

All parts of the system in contact with the room, including inside the inlet duct, are considered to be in the explosive atmosphere.

The safety devices shall be used within their ratings.

Alarms shall be located where they will be perceived by the responsible personnel.

The safety devices required by this document form safety-related parts of a control system.

This control system shall meet a level of reliability consistent with the fault tolerance required for the relevant types of protection:

- for pressurization "pb",– a single fault;
- for pressurization "pc" – normal operation.

NOTE For the integrity of safety functions, IEC 61511 (all parts), IEC 61508 (all parts) or similar standards could be used.

6.3.2 Safety devices based upon level of protection

Table 2 provides the minimum required safety devices for pressurized rooms according to the level of protection.

Table 2 – Safety devices for pressurized rooms

Design criteria	Pressurization "pb"	Pressurization "pc"
Device to detect loss of min. pressure differential	Pressure sensor (see 6.1.4.1)	Pressure sensor (see 6.1.4.1)
Device to verify purge period	Timing device (see 6.2.2)	Time and flow marked
Device for doors	Switch	Switch, if required for delayed alarms (see 6.1.4.1)
Device for detecting loss of air flow during purge	Flow sensor (see 4.9.2.1)	Flow sensor (see 4.9.2.1)
Device for detecting loss of air flow if required for delayed alarm	Not applicable	Flow sensor (see 6.1.4.1)
Device to detect presence of flammable gas	Gas detector, when an airlock is used without continuous flow (see 6.1.6)	Gas detector, if air intake in Zone 2 area (see 6.1.2.2)
Shut-down device(s)	Contacts to disconnect power	Manual
Device to permit delayed shut-down	Optional door switch or gas detector (see 6.1.9.1)	None
Device to warn against entering a room due to risk of exposure to gas or explosion	Alarm (see 6.3.1)	Alarm (see 6.3.1)

6.3.3 Gas detectors

The type, quantity and placement of detectors installed shall be based upon an end-user process risk evaluation and IEC 60079-29 (all parts). The safety requirements resulting from the risk assessment may be fulfilled by documented proven-in-use equipment.

6.4 Verification for pressurized rooms

6.4.1 General

Subclause 6.4 addresses verification either on-site or at the manufacturer’s facility where the room is built, and ducting may be completed on site. All assessments and tests shall be carried out by persons having the appropriate competence.

An assessment and test report documenting the safety aspects of the pressurized room and the findings of this verification process shall be retained in the technical documentation.

Tests judged to be unnecessary may be omitted provided justification for the omission(s) is included in the technical documentation.

6.4.2 Tests

The room shall be subjected to the following tests as applicable:

- overpressure test;
- purging test;
- minimum pressure differential test;
- confirmation of the ratings of the safety devices;

- verification of sequence of operation of the safety devices.

6.4.3 Overpressure test

A pressure equal to the maximum pressure that can be achieved by the pressurization system shall be applied to the room and associated ducts and their connecting parts where they are an integral part of the room.

The test shall be applied for a minimum of 5 min.

The test is satisfactory if no permanent deformation occurs which would invalidate the type of protection.

6.4.4 Purging test

The room shall be visibly filled with chemical smoke. As soon as the room is filled, the smoke supply shall be turned off and the clean air supply turned on at the minimum purging rate. By the completion of the specified purging time, all visible smoke shall have been removed from the room.

The room does not have to be completely filled with smoke at one time, but smoke could be added to locations sequentially to determine if there are poorly ventilated spaces.

6.4.5 Minimum pressure differential test

A test shall be made to verify that the pressurization system is capable of maintaining a minimum pressure differential of 25 Pa with 50 % of the outlets open at the minimum pressurization flow rate.

6.4.6 Confirmation of the ratings of the safety devices

Safety devices shall have an EPL suitable for the location of each device without pressurization. Functional and safety requirements according to 6.3.1 shall be confirmed.

6.4.7 Verification of sequence of operation of the safety devices

The sequence of operation of the safety devices as specified shall be verified to be in accordance with 6.2.2.

7 Requirements for artificially ventilated rooms

7.1 General

7.1.1 Design

The process in the room shall be designed to minimize the possibility of the liberation, accidental or otherwise, of an abnormal volume of gas or liquid from giving rise to flammable concentrations of any gas or vapour which may not be controlled by the ventilation system in accordance with artificial ventilation.

The hazardous area shall first be classified without any ventilation so that the requirements for safety controls can be determined.

7.1.2 Source of clean air

For artificial ventilation, the clean air requirements of 5.2 apply. For "vc", the air intake may be located in a Zone 2 area using air that is essentially free of contaminants or foreign matter and contains no more than trace amounts of flammable vapour or gas under normal operating conditions.

7.1.3 Minimum flow rate

7.1.3.1 General

The required artificial ventilation flow rate and arrangement shall be determined such that it is sufficient to control the internal source of release or achieve the required dilution for the anticipated release conditions. This shall be determined in accordance with IEC 60079-10-1.

If conformity assessment (third party) is sought, it is not a requirement of this document that the conformity body confirm conformance to IEC 60079-10-1. The manufacturer, or end user as relevant, includes the basis of compliance in the documentation, see 9.3.

The area to be protected shall be managed to reduce the concentration of the gas or vapour to less than 25 % of the lower flammable limit.

7.1.3.2 Requirements for process equipment installed in an artificially ventilated room

The installation of the equipment should be such that internal sources of release are kept to a minimum, for example reserves of non-inert gas or liquid should be mounted outside or in an adjoining building.

All pipes that lead flammable substances into the room shall be capable of being isolated outside the room.

The diameters of the gas and liquid inlet and outlet pipes should be the minimum necessary to provide the maximum flow of gas needed by the equipment and have adequate strength.

Pressure relief devices and flow restrictors should be incorporated whenever necessary to limit to a minimal value any resulting escape of flammable substances into the room.

7.1.4 Ventilation system

7.1.4.1 General

The diluted gases or vapours shall be discharged into a position in the open air, free from any constructional features in which "pocketing" could occur, and remote from any source of clean air.

Consideration should be given to provision of backup ventilation systems where loss of ventilation could cause undesirable shut-down.

7.1.4.2 General artificial ventilation

General artificial ventilation shall be arranged to ensure there is adequate air flow to control the movement of a release and meet the requirements of 4.3 and 7.1.3.

7.1.4.3 Local artificial ventilation

The inlet shall be situated as near as practicable to any sources of release. The whole of the ducting between the point of capture and the exhaust shall operate below atmospheric pressure to prevent any flammable air mixture from leaking out into the area being ventilated, i.e. the exhaust fan shall be outside the boundary of the building or room.

In the case of open vessels from which flammable vapour can escape, extraction can often be facilitated by the use of an overlapping hood placed over the vessel and connected to the exhaust system. Where the distance between the vessel and the hood needs to be sufficient to allow access for attention to the contents, the extraction effect can be augmented by a duct

perforated at intervals, fitted around the rim of the vessel, and connected to the exhaust system.

NOTE Excessive heat loss from a room, consequent on a rate of artificial ventilation sufficient to exhaust a considerable volume of gas or vapour escaping from a local source, can, in some cases, be prevented or significantly reduced by the provision of a clean air inlet near the source, so constructed as to supply the air for dilution and extraction which would otherwise be drawn from the room as a whole.

7.1.4.4 Power for ventilation system

The ventilation system shall be energized independently from the electrical power to the ventilated area.

7.1.5 Air consuming device

If there is an air consuming device (such as a compressor or laboratory hood) in the room, sufficient air shall be supplied to accommodate its needs as well as the needs of the ventilation system. Alternatively, the air supply to such a device shall be taken from a separate source of clean air.

7.1.6 Safety actions when ventilation system fails

Upon failure of the ventilation system, actions shall be taken to ensure safety in accordance with Table 3.

Table 3 – Safety actions for artificial ventilation failure

EPL required inside the room (without artificial ventilation)	EPL of equipment inside the room	Safety actions on loss of artificial ventilation	Optional use of controls
Gb	Non-hazardous	Isolate power or internal source of release Additional alarm optional	Not applicable
Gb	Gc	Alarm	Not applicable
		Shut down power or internal source of release after limited duration	Shut-down not required where gas detector is used in accordance with 7.3.4 or backup artificial ventilation is provided. Not applicable to local artificial ventilation.
Gc	Non-hazardous	Alarm	Not applicable
		Shut down power or internal source of release after limited duration	Shut-down not required where gas detector is used in accordance with 7.3.4 or backup artificial ventilation is provided. Not applicable to local artificial ventilation.

7.1.7 Energizing the artificially ventilated area

Artificial ventilation shall be confirmed before the electrical supply to the equipment within the artificially ventilated area is connected or the flammable substance is introduced to the ventilated area.

Provisions shall be made to energize the equipment in the ventilated area safely after failure of the ventilation system if required. Such provisions include purging of gases, see 7.2.2.

7.2 Purging of artificially ventilated rooms

7.2.1 General

In addition to 4.9, the requirements in 7.2.2 apply for an artificially ventilated room with a release of a flammable substance where the internal source of release is not shut down on loss of artificial ventilation.

7.2.2 Sequence of operations of the purging safety devices

The sequence of operations of the safety devices shall be as follows.

a) Following the initiation of the sequence, the purging flow through the room shall be monitored in accordance with this document.

b) The purge time shall start once the purging flow rate through the room is established.

c) When the purge time has elapsed, the required artificial ventilation flow rate is commenced to maintain the required dilution through the room. At that point, the equipment that is not suitable for the required EPL is permitted to be energized.

If the minimum specified purging flow rate is not maintained, the timer shall be halted until the purging flow rate is re-established. If the loss of purging flow rate persists for longer than 60 s, the purging cycle shall be restarted.

7.3 Minimum safety provisions, safety devices and electrical disconnects

7.3.1 Safety devices

The safety devices consisting of the ventilation system, its controls, means of disconnection of electrical power, the system fan and its motor and (optional) gas detectors or other devices listed in Table 4 shall be suitable for the required EPL without the artificial ventilation.

All parts of the system in contact with the room, including inside the inlet duct, are considered to be in the explosive atmosphere. The safety devices shall be used within their ratings.

Alarms shall be located where they will be perceived by the responsible personnel.

The safety devices required by this document form safety-related parts of a control system.

The safety and integrity of the control system shall meet a level of reliability consistent with the fault tolerance required for the relevant types of protection:

- EPL Gb without artificial ventilation – a single fault;
- EPL Gb without artificial ventilation with the EPL Gc equipment – a single fault;
- EPL Gc without artificial ventilation – normal operation.

NOTE For the integrity of safety functions, IEC 61511 (all parts), IEC 61508 (all parts), or similar standards could be used.

Devices for disconnection of electrical power to the room shall be located in a non-hazardous area or shall be explosion protected.

7.3.2 Safety devices based upon equipment protection level

Table 4 provides the minimum required safety devices for artificially ventilated rooms according to the EPL.

Table 4 – Required safety devices for artificial ventilation

Design criteria	EPL required inside the room Gb (without artificial ventilation) and non-hazardous equipment	EPL required inside the room Gb (without artificial ventilation) and EPL Gc equipment	EPL required inside the room Gc (without artificial ventilation) and non-hazardous equipment
Device to detect loss of min. flow	Flow sensor (see 7.1.3)	Flow sensor (see 7.1.3)	Flow sensor (see 7.1.3)
Device to verify purge period	Timing device	Time and flow marked	Time and flow marked
Device for detecting loss of air flow during purge (when possible refer to 4.9.2.1)	Flow sensor (see 7.2.2)	Flow sensor (see 7.2.2)	Flow sensor (see 7.2.2)
Device to detect presence of flammable gas	Gas detector, if air intake in Zone 2 area (see 7.1.2)	Gas detector, if air intake in Zone 2 area (see 7.1.2)	Gas detector, if air intake in Zone 2 area (see 7.1.2)
Shut-down device(s)	Valves to shut off flow of flammable substance Contacts to disconnect power automatically	Manual	Manual
Device to avoid shut-down	Not applicable	Gas detector (see 7.3.4)	Gas detector (see 7.3.4)
Device to warn against entering a room due to risk of exposure to gas or explosion	Alarm (see 7.3.1)	Alarm (see 7.3.1)	Alarm (see 7.3.1)

7.3.3 Artificial ventilation protection

Precautions against failure of artificial ventilation can be taken in the form of air-flow switches or pressure-operated switches fitted at suitable points in the air ducting and arranged to give an alarm and, where circumstances require, to disconnect equipment installed in the affected area and which does not meet the required EPL without artificial ventilation.

NOTE In practice, this means that in an area requiring EPL Gb without artificial ventilation, failure of the artificial ventilating system causes the supply to be disconnected, whereas in an area requiring EPL Gc without artificial ventilation, failure of the artificial ventilating system causes visual or audible warnings to be initiated.

Alternatively, gas detectors maybe used to give an alarm or to effect the disconnection of the supply or both (see 7.3.4).

7.3.4 Gas detectors

The type, quantity and placement of detectors installed shall be based upon an end-user process risk evaluation and the specific IEC standards for gas detection. The location of gas detectors will depend on the gas properties, particularly density (see IEC 60079-29 (all parts)).

Gas detectors shall operate to isolate electrical power or supply of flammable substance if the gas concentration exceeds 25 % of the limiting value.

7.4 Loss of artificial ventilation

In a room where loss of artificial ventilation could contribute to a build-up of flammable gases or vapours, safety devices shall be arranged to provide audible and visual alarms to warn personnel against entering the room due to the existence of a potentially dangerous condition. Alarms shall also be audible inside the room warning personnel to leave the room. The room shall be marked in accordance with 8.3.

7.5 Verification for artificially ventilated rooms

7.5.1 General

Subclause 7.5 addresses verification either on-site or at the manufacturer's facility where the room is built, and ducting may be completed on-site. All assessments and tests shall be carried out by persons having the appropriate competence.

An assessment and test report documenting the safety aspects of the ventilated room and the findings of this verification process shall be retained in the technical documentation.

Tests judged to be unnecessary may be omitted provided justification for the omission(s) is included in the technical documentation.

7.5.2 Tests

The room shall be subjected to the following tests as applicable:

- purging test;
- minimum ventilation flow rate test;
- confirmation of the ratings of the safety devices;
- verification of sequence of operation of the safety devices;
- testing of ventilation system.

7.5.3 Purging test

The room shall be visibly filled with chemical smoke. As soon as the room is filled, the smoke supply shall be turned off and the clean air supply turned on at the minimum purging rate. By the completion of the specified purging time, all visible smoke shall have been removed from the room.

The room does not have to be completely filled with smoke at one time, but smoke may be added to locations sequentially to determine if there are poorly ventilated spaces.

7.5.4 Minimum ventilation flow rate test

A test shall be made to verify that the ventilation system is capable of maintaining the minimum flow rate required with 50 % of the outlets closed.

7.5.5 Confirmation of the ratings of the safety devices

Safety devices shall have the required EPL without artificial ventilation and ratings, and meet performance requirements. Functional and safety requirements according to 7.3.1 shall be confirmed.

Verification of ratings and performance requirements may be by manufacturer's documentation.

7.5.6 Verification of sequence of operation of the safety devices

The sequence of operation of the safety devices as specified shall be verified to be in accordance with 7.2.2.

7.5.7 Testing of ventilation system

7.5.7.1 General

Tests shall be conducted to prove that the ventilation system is suitable for the environmental situation in which the electrical equipment is installed. Any systems purporting to comply with this document shall be so tested.

7.5.7.2 Ventilation test

Where there is a continuous or primary internal source of release, the ventilation system and the process shall be run under normal conditions of operation for at least 5 min.

During and on completion of this period, the concentration of flammable air mixture shall not exceed 25 % of the lower flammable limit in the region to be protected.

Where there is a secondary internal source of release, the results of calculation or modelling may be used to verify the ventilation.

7.5.7.3 Safety device

7.5.7.3.1 Air-flow sensing devices

Air-flow sensing devices provided for the operation of alarm and electrical trip devices shall be tested to operate when the air velocity falls below the permitted minimum value.

7.5.7.3.2 Gas detectors

Gas detectors provided for the operation of alarm and electrical trip devices shall be tested to operate before the flammable concentration of gas or vapour exceeds 25 % of the lower flammable limit.

8 Marking

8.1 General

In addition to the requirements of IEC 60079-0, the marking shall include the symbol for each type (or level) of protection used:

- "pb": pressurization (for EPL Gb or Db);
- "pc": pressurization (for EPL Gc or Dc);
- "vc": artificial ventilation (for EPL Gc).

Where types (or levels) of protection are used together, marking shall be as given in IEC 60079-0.

8.2 Marking of pressurized rooms

Pressurized rooms shall be marked at a readily visible location as follows:

- the wording: "Pressurized Room";
- the name of the manufacturer or agent responsible for the installation;
- the name or designation of the pressurized room;
- the groups and temperature class of explosion protected equipment in the pressurized room;
- the volume of the pressurized room, the minimum purge flow rate and minimum purge duration;

- the minimum pressure differential in operation.

Markings using equivalent text may be used.

The isolating switch shall be clearly marked:

"WARNING – Run purge system for T min before energizing the installation, unless the atmosphere inside the room is known not to be hazardous."

where T is the minimum specified time to purge the room.

All doors to the pressurized room shall be clearly marked on the inside and the outside with the following:

"WARNING – Pressurized room – Keep door closed."

Each infrequently used entrance to a room in an area requiring EPL Gc or Gb or Dc or Db for the internal equipment shall be marked to restrict access such as with the following:

"RESTRICTED ACCESS"

An airlock shall be clearly marked with the following:

"WARNING – Verify other door is closed before opening this door."

Each entrance to a room where loss of pressurization could result in an alarm indicating an explosion hazard from build-up of flammable gas or vapours shall be clearly marked with the following:

"DANGER – Do not enter when alarm sounds, room contains a dangerous level of explosive atmosphere and is an explosion hazard."

8.3 Marking for artificially ventilated rooms

Artificially ventilated rooms shall be marked at a readily visible location as follows:

- the wording: "Ventilated Room protected by artificial ventilation";
- the name of the manufacturer or agent responsible for the installation;
- the name or designation of the ventilated room;
- the groups and temperature class of explosion protected equipment in the ventilated room;
- the volume of the ventilated room, the minimum purge flow rate and minimum purge duration;
- the required artificial ventilation flow rate.

Markings using equivalent text may be used.

If not a complete room, then similar markings may be applied close to the ventilated area, for example on the ventilation hood.

Where purging is required, the isolating switch shall be clearly marked with the following:

"WARNING – Run fan for T min before energizing the installation, unless the atmosphere inside the room is known not to be hazardous."

where T is the minimum specified time to purge the room.

Where the position of a door is significant with respect to the ventilation performance, it shall be clearly marked on the inside and the outside with the position that is to be maintained, for example:

"WARNING – Ventilated room – Keep door closed."

9 Instructions

9.1 General

The documentation shall include all instructions as required by IEC 60079-0. In addition, 9.2 to 9.4 apply.

9.2 Technical documentation for pressurized rooms

For pressurized rooms, the documentation shall also include the following as a minimum:

- the internal volume of the room including the volume of the ducts;
- minimum quantity of clean air required for purging;
- minimum purging flow rate;
- minimum purging duration;
- minimum pressure differential;
- the point or points at which the pressure is to be monitored;
- location of the air intakes, and outlets when outlets are used. For example, documentation shall identify whether the location of the air intake is in a Zone 2 location;
- range of temperatures for the clean air at the inlets to the room, see 5.3;
- permitted range of operating temperature within the room;
- information regarding any internal or external equipment intended to remain energized when the pressurization system is not active;
- gas detection as applicable.

For pressurization "p", a functional sequence diagram shall be provided – for example a truth table, state diagram, flow chart, etc. – to define the action of the control system. The sequence diagram shall clearly identify and show the operational states of the safety devices and ensuing actions. Functional tests shall be conducted to verify conformity to the diagram, see 6.4.7. The diagram shall include the following:

a) purging cycle;

b) delays programmed in if pressure differential device trips, but door is detected to be open;

c) delays programmed in if pressure differential device trips, but gas detector shows no hazardous atmosphere.

9.3 Technical documentation for artificially ventilated rooms

For ventilated rooms, the documentation shall also include the following as a minimum:

– all information relating to the use of IEC 60079-10-1;

– the internal volume of the room including the volume of the ducts;

– the maximum surface temperature of equipment within the room;

– minimum quantity of clean air required for purging;

– minimum purging flow rate;

– minimum purging duration;

– required artificial ventilation flow rate;
– location of the air intakes, and outlets when outlets are used. For example, documentation shall identify whether the location of the air intake is in a Zone 2 location;
– range of temperatures for the clean air at the inlets to the room, see 5.3;
– permitted range of operating temperature within the room;
– information regarding any internal or external equipment intended to remain energized when the ventilation system is not active;
– gas detection as applicable.

For artificial ventilation "v", a functional sequence diagram shall be provided – for example a truth table, state diagram, flow chart, etc. – to define the action of the control system. The sequence diagram shall clearly identify and show the operational states of the safety devices and ensuing actions. Functional tests shall be conducted to verify conformity to the diagram.

The diagram shall include the following:

a) purging cycle;
b) delays programmed in if ventilation device trips;
c) delays programmed in if ventilation device trips, but gas detector shows no hazardous atmosphere.

9.4 Technical documentation for rooms protected by pressurization and artificial ventilation combined

Documentation for pressurized and artificially ventilated rooms shall include the following:

- a list of equipment installed inside the pressurized room and, where applicable, the type of protection, apparatus grouping and temperature class of each;
- the manufacturers' safety instructions for all installed equipment;
- the settings of all protective devices;
- details of the ventilation system and operational instructions;
- the minimum operating pressure and air flow;
- results of test measurements of pressures within the pressurized room under purge and normal operating conditions;
- values of the minimum purge flow rate and minimum purge duration time for the pressurized room;
- such characteristics of non-explosion protected apparatus as may affect safety;
- date of installation and of commissioning tests;
- date and nature of any modification (see 9.5).

9.5 Modifications

The instructions given in 9.2 and 9.3 shall be revised when any modifications are made to the pressurized room or artificially ventilated room after construction and commissioning and after any changes affecting the specifications.

Annex A
(informative)

Maintenance

A.1 Periodic verification

In addition to the activities required by IEC 60079-17, the following should be verified on a periodic basis:

- performance of safety devices and functions;
- integrity of ducting;
- integrity of penetrations;
- whether the documentation required in Clause 9 for safe shut-down and start-up is still appropriate;
- instructions.

A.2 Modifications

Modification of the room and its contents (e.g. electrical equipment, safety device, or plant design and maintenance factors that may affect the potential for an internal release) should be assessed to ensure that it does not compromise the type of protection. The results of the assessment should be documented.

Annex B
(informative)

Guidelines when pressurization or artificial ventilation is not immediately restored

Rooms will sometimes contain equipment and circuits which due to their criticality of operation have to remain in service even in the presence of failed pressurization or artificial ventilation. Some acts and regulations even recognize that it is preferable to maintain an energized circuit where it can be demonstrated that to de-energize and shut down would lead to a more unsafe condition. In such cases, additional layers of protection can be required, especially for circuits whose nature of application and operation may require energization at all times. Examples include but are not limited to, fire and gas detection systems and essential plant controls.

Annex C
(informative)

Examples of applications and associated guidelines

C.1 Examples of applications

Examples of applications where this document can be used include, but are not limited to, an analyser room/gas analyser, a metering station, a control room/compartment, a quality laboratory, and a gas turbine enclosure or room.

It is normal industry practice that when an internal source of flammable substance exists, in addition to artificial ventilation, gas detection is used to verify that the concentration of flammable substance has not exceeded 25 % of the limiting value.

C.2 Guidelines for gas turbine enclosure/package

Industry studies have demonstrated that for the design of gas turbine enclosures and ventilation systems, a gas analysis and modelling tool such as computational fluid dynamics (CFD) may be the best tool to determine the appropriate purge rate and locations for gas detectors.

It is normal industry practice to accept that when pressurization or artificial ventilation is lost, critical functions necessary for protection of personnel, and process monitoring or protection of the equipment within the room or enclosure may remain energized provided that:

- immediately upon detection of pressurization or artificial ventilation loss or in the case when the concentration of flammable substance exceeds 25 % of the limiting value, the flammable substance supply is shut off external to the room or enclosure; and
- the internal piping or containment of the flammable substance is depressurized and vented to a non-hazardous area external to the room or enclosure until all the electrical equipment is de-energized or artificial ventilation or pressurization can be re-established, and the concentration of the flammable substance is below 25 % of the limiting value.

Bibliography

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

IEC 60079-17, *Explosive atmospheres – Part 17: Electrical installations inspection and maintenance*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61285, *Industrial-process control – Safety of analyser houses*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61511 (all parts), *Functional safety – Safety instrumented systems for the process industry sector*

IEC TR 61831, *On-line analyser systems – Guide to design and installation*

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