

ANSI/ISA-12.04.01-2004 (IEC 60079-2 Mod)



Electrical Apparatus for Explosive Gas Atmospheres - Part 2 Pressurized Enclosures "p"



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ANSI/ISA-12.04.01(IEC 60079-2 Mod)
Electrical Apparatus for Explosive Gas Atmospheres – Part 2: Pressurized Enclosures “p”

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FOREWORD

All text of IEC 60079-2:2001 is included. U.S. National Deviations are shown by ~~strikeout~~ through text deleted and underline under text added. ~~Tables, or portions of tables, that are to be deleted are shown as shaded; figures to be deleted are marked with the overlay "X."~~ There are nine Annexes in this Standard. Annexes B, C, D, F, H, I and J are informative and are not considered part of this Standard. Annexes A, E and G are Normative and are considered part of this Standard.

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INTRODUCTION

~~This part of~~ ANSI/ISA-12.04.01 (IEC 60079-2 Mod) ~~IEC 60079~~ gives requirements for the design, construction, testing and marking of electrical apparatus for use in potentially explosive atmospheres in which:

- a) a protective gas maintained at a pressure above that of the external atmosphere, is used to guard against the formation of an explosive gas atmosphere within enclosures which do not contain an internal source of release of flammable gas or vapor and, where necessary,
- b) a protective gas, is provided in sufficient quantity to ensure that the resultant mixture concentration around the electrical parts is maintained at a value outside the explosive limit appropriate to the particular conditions of use. The protective gas is supplied to an enclosure containing one or more internal sources of release in order to guard against the formation of an explosive gas atmosphere.

This standard includes requirements for the apparatus and its associated equipment including the inlet and exhaust ducts, and also for the auxiliary control apparatus necessary to ensure that pressurization and/or dilution is established and maintained.

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1 Scope

- 1.1 This ~~part of the IEC 60079 standard~~ contains the specific requirements for the construction and testing of electrical apparatus with pressurized enclosures, type of protection type “p”, intended for use in ~~explosive gas atmospheres hazardous (classified) locations defined as Class I, Zone 1 or Zone 2 by the National Electrical Code (NEC®), ANSI/NFPA 70.~~

The requirements contained in this standard are supplementary to those in ~~IEC 60079-0~~ ANSI/ISA-12.00.01 (IEC 60079-0 Mod).

- 1.2 This standard specifies requirements for pressurized enclosures containing a limited release of a flammable substance.
- 1.3 This standard does not contain the requirements for pressurized enclosures where the containment system may release:
- a) air with an oxygen content greater than normal, or
 - b) oxygen in combination with inert gas in a proportion greater than 21%.
- 1.4 This standard does not contain requirements for pressurized rooms or analyser houses. ~~see IEC 60079-13 and IEC 60079-16.~~
- 1.5 Due to the safety factors incorporated in the type of protection, the uncertainty of measurement inherent in good quality, regularly calibrated measurement equipment is considered to have no significant detrimental effect and need not be taken into account when making the measurements necessary to verify compliance of the apparatus with the requirements of this standard.
- 1.6 When the user acts in the role of the manufacturer, it is the user’s responsibility to ensure that all relevant parts of this standard are applied to the manufacturing and testing of the apparatus.

2 Normative references

The following ~~normative~~ documents may contain provisions, which, through reference in this text, constitute provisions of this ~~standard part of the IEC 60079~~. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this ~~standard part of IEC 60079~~ are encouraged to investigate the possibility of applying the most recent additions of the ~~normative~~ documents indicated below. For updated references, the latest edition of the ~~normative~~ document referred to applies. Members of the IEC and ISO maintain registers of currently valid ~~international~~ standards. ANSI maintains registers of currently valid US National Standards.

IEC 60034-5, Rotating electrical machines – Part 5: Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code)

IEC 60050(151), International Electrotechnical Vocabulary – Chapter 151: Electrical and magnetic devices

IEC 60050-426, International Electrotechnical Vocabulary - Chapter 426: Electrical apparatus for explosive atmospheres

~~IEC 60079-0:1998, Electrical apparatus for explosive gas atmospheres — Part 0: General requirements~~

ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod), Electrical Apparatus for Use in Class I, Zones 0, 1, & 2 Hazardous (Classified) Locations - General Requirements

~~IEC 60112: 1979, Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions~~

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

~~IEC 60664-1:1992, Insulation coordination for equipment within low voltage systems — Part 1: Principles, requirements and tests~~

ANSI/NFPA 70, National Electrical Code (NEC®)

ANSI/ISA-12.13.01-2003, Performance Requirements for Combustible Gas Detectors.

3 Terms and definitions

For the purposes of this standard the terms and definitions given in IEC 60050(426) and ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod), Electrical Apparatus for Use in Class I, Zones 0, 1, & 2 Hazardous (Classified) Locations - General Requirements and ~~IEC 60079-0~~ and the following apply.

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

3.1 alarm

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

3.2 containment system

part of the apparatus containing the flammable substance that may constitute an internal source of release.

3.3 dilution

continuous supply of a protective gas, after purging, at such a rate that the concentration of a flammable substance inside the pressurized enclosure is maintained at a value outside the explosive limits at any potential ignition source (that is to say, outside the dilution area).

NOTE — Dilution of oxygen by inert gas may result in a concentration of flammable gas or vapor above the upper explosive limit (UEL).

3.4 dilution area

area in the vicinity of an internal source of release where the concentration of a flammable substance is not diluted to a safe concentration.

3.5 enclosure volume

volume of the empty enclosure without internal apparatus. For rotating electrical machines, the free internal volume plus the volume displaced by the rotor.

3.6 flammable substance

gases, vapors, liquids or mixtures thereof that are capable of being ignited.

3.7 hermetically sealed device

device which is so constructed that the external atmosphere cannot gain access to the interior and in which any seal is made by fusion, for example, brazing, welding or the fusion of glass to metal.

3.8 ignition-capable apparatus (ICA)

apparatus which in normal operation constitutes a source of ignition for a specified explosive gas atmosphere. This includes electrical apparatus not protected by a type of protection listed in 7.13.

3.9 indicator

piece of apparatus that shows whether flow or pressure is adequate and is monitored periodically, consistent with the requirement of the application.

3.10 internal source of release

point or location from which a flammable substance in the form of a flammable gas or vapor or liquid may be released into the pressurized enclosure such that in the presence of air an explosive gas atmosphere could be formed.

3.11 leakage compensation

providing a flow of protective gas sufficient to compensate for any leakage from the pressurized enclosure and its ducts.

3.12 overpressure

pressure above ambient pressure within a pressurized enclosure.

3.13 pressurization

technique of guarding against the ingress of the external atmosphere into an enclosure or room by maintaining a protective gas therein at a pressure above that of the external atmosphere.

3.14 pressurization system

grouping of components used to pressurize and monitor a pressurized enclosure.

3.15 pressurized enclosure

enclosure in which a protective gas is maintained at a pressure greater than that of the external atmosphere.

3.16 protective gas

air or inert gas used for purging and maintaining an overpressure and, if required, dilution.

NOTE — For the purpose of this standard inert gas means nitrogen, carbon dioxide, argon or any gas which, when mixed with oxygen in the ratio 4 parts inert to 1 part oxygen as found in air, does not make the ignition and flammability properties, such as explosive limits, more onerous.

3.17 protective gas supply

compressor, blower, or compressed gas container that provides the protective gas at a positive pressure. The supply includes inlet (suction) pipes or ducts, pressure regulators, outlet pipes, ducts, and supply valves. Components of the pressurization system are not included.

3.18 purging

in a pressurized enclosure, the operation of passing a quantity of protective gas through the enclosure and ducts, so that the concentration of the explosive gas atmosphere is brought to a safe level.

3.19 routine test

test to which each individual device (equipment) is subjected during or after manufacture to ascertain whether it complies with certain criteria. (IEV 60050-151-04-16)

3.20 static pressurization

maintenance of an overpressure within a pressurized enclosure without the addition of protective gas in a hazardous area.

3.21 type px pressurizing

pressurization that reduces the classification within the pressurized enclosure from zone 1 to unclassified non-hazardous or Group I to non-hazardous.

NOTE — Type px pressurizing has historically been known as “type X pressurizing” in the US.

3.22 type py pressurizing

pressurization that reduces the classification within the pressurized enclosure from zone 1 to zone 2.

NOTE — Type py pressurizing has historically been known as “type Y pressurizing” in the US.

3.23 type pz pressurizing

pressurization that reduces the classification within the pressurized enclosure from zone 2 to unclassified non-hazardous.

NOTE — Type pz pressurizing has historically been known as “type Z pressurizing” in the US.

3.24 type test

test of one or more devices made to a certain design to show that the design meets certain specifications (IEV 60050-151-04-15).

3.25 ventilated equipment

equipment, such as motors, that requires airflow for heat dissipation as well as pressurization to prevent entrance of flammable gases, vapors, or dusts.

3.26 hazardous area

an area in which a flammable 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 electrical apparatus. (IEC 60050-426-03-01)

NOTE — The NEC uses “Hazardous (Classified) Location” to describe these areas. The definition for hazardous location is “A location in which fire or explosion hazards may exist due to a flammable atmosphere of flammable gases or vapors, flammable liquids, combustible dust, or easily ignitable fibers or flyings.”

3.27 non-hazardous area

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, installations and use of electrical apparatus. (IEC 60050-426-03-02)

NOTE — The NEC uses “unclassified” to describe these areas.

3.28 autoignition temperature

the minimum temperature required to initiate or cause self-sustained combustion of a solid, liquid, or gas independently of the heating or heated element.

3.29 protected equipment

The electrical equipment internal to the protected enclosure.

4 Protection types

Protection by pressurization is subdivided into three protection types (px, py, and pz) which are selected based upon the external hazardous (classified) location ~~explosive atmosphere Group 1~~ (Zone 1, or Zone 2), whether there is the potential for an internal release, and whether the apparatus within the pressurized enclosure is ignition-capable, see Table 1. The protection type then defines design criteria for the pressurized enclosure and the pressurization system, see Table 2.

Table 1 — Determination of protection type

Flammable substance in the containment system	External Zone classification	Enclosure contains ignition-capable apparatus	Enclosure does not contain ignition-capable apparatus
No containment system	1	Type px ^a	Type py
No containment system	2	Type pz	No pressurization required
Gas/vapor	1	Type px ^a	Type py
Gas/vapor	2	Type px (and ignition-capable apparatus is not located in the dilution area)	Type py ^b
Liquid	1	Type px ^a (inert) ^c	Type py
Liquid	2	Type pz (inert) ^c	No pressurization required ^d
NOTE — If the flammable substance is a liquid, normal release is never permitted			
a) ~~Protection type px also applies to Group I~~ b) If no normal release, see Annex E c) The protective gas shall be inert if "(inert)" is shown after the pressurization type, see Clause 13. d) Protection by pressurization is not required since it is considered unlikely that a fault causing a release of liquid will simultaneously occur with a fault in the equipment that would provide an ignition source.			

Table 2 — Design criteria based upon protection type

Design criteria	Type px	Type py	Type pz with indicator	Type pz with alarm
Degree of enclosure protection according to IEC 60529 or IEC 60034-5	IP4X minimum	IP4X minimum	IP4X minimum	IP3X minimum
Resistance of enclosure to impact	IEC 60079-0, Table 4	IEC 60079-0, Table 4	IEC 60079-0, Table 4	IEC 60079-0, half the value in Table 4
Verifying purge period	Requires a timing device and monitoring of pressure and flow	Time and flow marked	Time and flow marked	Time and flow marked
Preventing incandescent particles from exiting a normally closed relief vent into a Zone 1 area	Spark and particle barrier required, see 5.8, unless incandescent particles not normally produced.	No requirement (Note 1)	Spark and particle barrier required, see 5.8, unless incandescent particles not normally produced.	Spark and particle barrier required, see 5.8, unless incandescent particles not normally produced.
Preventing incandescent particles from exiting a normally closed relief vent into a Zone 2 area	No requirement (Note 2)	No requirement (Note 2)	No requirement (Note 2)	No requirement (Note 2)
Preventing incandescent particles from exiting a vent open to a Zone 1 area in normal operation.	Spark and particle barrier required, see 5.8.	Spark and particle barrier required, see 5.8.	Spark and particle barrier required, see 5.8.	Spark and particle barrier required, see 5.8.
Preventing incandescent particles from exiting a vent open to a Zone 2 area in normal operation.	Spark and particle barrier required, see 5.8, unless incandescent particles not normally produced.	No requirement (Note 1).	Spark and particle barrier required, see 5.8, unless incandescent particles not normally produced.	Spark and particle barrier required, see 5.8, unless incandescent particles not normally produced.
Door/cover requiring a tool to remove	Warning, see 5.3 and 6.2 b) ii)	Warning, see 5.3 (Note 1)	Warning, see 5.3 and 6.2 b) ii)	Warning, see 5.3 and 6.2 b) ii)
Door/cover not requiring a tool to remove	Interlock, see 7.12 (No internal hot parts)	Warning, see 5.3 (Note 1)	No requirement (Note 3)	No requirement (Note 3)
Internal hot parts that require a cool-down period before opening enclosure	Comply with 6.2 b) ii)	Not applicable	Warning, see 5.3 and 6.2 b) ii)	Warning, see 5.3 and 6.2 b) ii)
Clause 6.2 b) ii) is not applicable for type py since neither hot internal parts nor normally created incandescent particles are permitted There is no requirement for spark and particle barriers since in abnormal operation where the relief vent opens, it is unlikely that the external atmosphere is within the explosive limits. There is no requirement for marking or tool accessibility on a pz enclosure since in normal operation the enclosure is pressurized with all covers and doors in place. If a cover or door is removed, it is unlikely that the atmosphere is within the explosive limits.				

5 Constructional requirements for pressurized enclosures

5.1 Enclosure

The pressurized enclosure shall have a degree of protection in accordance with Table 2.

~~NOTE — The degree of protection of IP44 may be required on a coal face under humid and dusty conditions.~~

5.2 Materials

The materials used for the enclosure, ducts and connecting parts shall not be adversely affected by the specified protective gas.

5.3 Doors and covers

~~5.3.1 — For Group I pressurized enclosures, doors and covers shall either:~~

~~— have special fasteners complying with 9.2 of IEC 60079-0, or~~

~~— be interlocked so that the electrical supply to apparatus not protected by a type of protection listed in 7.13 of this standard is disconnected automatically when they are opened and so that the supply cannot be restored until they are closed. The requirements of 7.6, shall also apply.~~

~~5.3.2 — For Group I pressurized enclosures with static pressurization, doors and covers shall have special fasteners complying with 9.2 of IEC 60079-0 and shall be marked:~~

~~WARNING - DO NOT OPEN IN HAZARDOUS AREA.~~

~~5.3.3 — For Group II pressurized enclosures, The requirements for fasteners in 9.2 of IEC 60079-0 do not apply.~~

For Type px, Doors and covers, except for those which can be opened only by the use of a tool or key, shall be interlocked so that the electrical supply to electrical apparatus not protected by a type of protection given in one of the other standards listed in the ~~IEC 60079-0~~ ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod) is disconnected automatically when they are opened and so that the supply can not be restored until they are closed.

NOTE — High internal pressures may cause doors or covers to open violently. Operators and maintenance personnel should be protected from injury by methods such as the following:

- a) use multiple fasteners so that the enclosure will safely vent before all fasteners are released; or
- b) use a two-position fastener to allow safe venting of the pressure when opening the enclosure; or
- c) limit the maximum internal pressure to not greater than 2.5 kPa.

~~5.3.4 — For Group II pressurized enclosures with static pressurization, doors and covers shall only be opened by the use of a tool, and shall be marked:~~

~~WARNING - DO NOT OPEN IN HAZARDOUS AREA.~~

~~5.3.5 — For type px, a pressurized enclosure that contains hot parts requiring a cool-down period shall not open readily without the use of a key or tool.~~

5.4 Mechanical strength

The pressurized enclosure ducts, if any, and their connecting parts shall withstand a pressure equal to 1.5 times the maximum overpressure specified by the manufacturer for normal service with all outlets closed with a minimum of 200 Pa (8 in of water).

If a pressure can occur in service that can cause a deformation of the enclosure ducts, if any, or connecting parts, a safety device shall be fitted to limit the maximum internal overpressure to a level below that which could adversely affect the type of protection. If the manufacturer does not provide the safety device, the apparatus shall be marked "X" according to 27.2 (i) of ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod) and the description documents shall contain all necessary information required by the user to ensure conformity with the requirements of this standard.

5.5 Apertures, partitions, compartments and internal components

5.5.1 Apertures and partitions shall be located in such a way that effective purging is ensured.

NOTE 1 Unpurged areas can be eliminated by the proper location of the protective gas supply inlet and outlet and by consideration of the effect of partitions.

NOTE 2 For gases or vapors that are heavier than air the inlet for the protective gas should be near the top of the pressurized enclosure, with the outlet near the bottom of the enclosure.

NOTE 3 For gases or vapors that are lighter than air, the inlet for the protective gas should be near the bottom of the enclosure, with the outlet near the top of the enclosure.

NOTE 4 Locating inlets and outlets at opposite sides of the enclosure promotes cross ventilation.

NOTE 5 Internal partitions (for example, circuit boards) should be located so the flow of protective gas is not obstructed. The use of a manifold or baffles can also improve the flow around obstructions.

NOTE 6 The number of apertures should be chosen with regard to the design of the apparatus, particular consideration being given to purging of sub-compartments into which the apparatus might be divided.

5.5.2 Internal compartments shall be vented to the main enclosure or separately purged.

NOTE — Vents providing not less than 1 cm² of vent area for each 1000 cm³, with a minimum vent size of 6.3 mm diameter should be sufficient for adequate purging.

5.5.3 Cathode ray tubes (CRTs) and other hermetically sealed devices do not require purging.

5.5.4 Components with a free internal volume less than 20 cm³ are not considered to be internal compartments requiring purging as long as the total volume of all such components is not more than 1% of the free internal volume of the pressurized apparatus.

NOTE 1 The 1% is based upon 25% of the lower explosive limit (LEL) of hydrogen, see Clause A.2.

NOTE 2 Electrical components considered to be environmentally sealed such as transistors, microcircuits, capacitors, etc., are not included in the calculation of the total component volume.

5.5.5 In the case of static pressurization the enclosure shall have one or more aperture(s). After filling and pressurization all apertures shall be closed.