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Električne naprave za potencialno eksplozivne atmosfere - Nadtlak "p"

Electrical apparatus for potentially explosive atmospheres - Pressurized apparatus "p"

ICS 29.260.20

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EUROPEAN STANDARD **EN 50016**

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English version

Electrical apparatus for potentially explosive atmospheres — Pressurized apparatus "p"

Matériel électrique pour atmosphères explosibles — Surpression interne "p"

Elektrische Betriebsmittel für explosionsgefährdete Bereiche — Überdruckkapselung "p"

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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

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Foreword

This European Standard was prepared by SC 31-7, Pressurization and other techniques, of the Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres.

It consists of the text of EN 50016:1995 and a new amendment (prA1:1999) which was submitted to the formal vote in April 1999 and was approved by CENELEC on 1999-10-01 for publication as a new edition of this European Standard.

This European Standard supersedes EN 50016:1995.

The European Standard was prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of the EC Directive 94/9/EC.

This European Standard is to be read in conjunction with EN 50014:1997 - Electrical apparatus for potentially explosive atmospheres — General requirements, and with the European Standards for the specific types of protection listed in the scope of EN 50014:1997. This European Standard should not be considered in conjunction with any editions of these standards and their amendments published before 1997.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2003-02-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-06-30

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard annex D is normative and annexes A, B and C are informative.

Contents

1 Scope

1.1 This European Standard specifies the requirements for the construction and testing of pressurized and purged electrical apparatus and “Ex” components forming part of the pressurized apparatus, with type of protection ‘p’, intended for use in potentially explosive atmospheres of gas vapour and mist.

1.2 This European Standard supplements EN 50014 in so far as it applies to pressurized and purged electrical apparatus with type of protection ‘p’.

1.3 This European Standard is applicable to electrical equipment and components of Group I Category M2 and of Group IIG Category 2 using the technique of pressurize and purge.

NOTE In this European Standard, the word “apparatus” has the same meaning as the word “equipment” in Directive 94/9/EC.

1.4 This European Standard includes the requirements for the construction of the enclosure and its associated components, including, if any, the inlet and outlet ducts for the protective gas, and for the safety provisions and devices necessary for the type of protection pressurization ‘p’.

1.5 This European Standard specifies the requirements for pressurized enclosures with or without an internal source of release, with the exceptions given in 1.7 and 1.8.

1.6 This European Standard specifies requirements for pressurized enclosures containing an unlimited source of release of flammable gas or vapour only where the unlimited source of release is from the surface of a liquid.

1.7 This European Standard does not contain requirements for pressurized rooms or analyser houses (for which another standard is in preparation).

1.8 This European Standard does not contain the requirements for pressurized enclosures where, in a containment system with limited or unlimited release there is:

a) air with an oxygen content greater than normal, or

b) oxygen in combination with inert gas in a proportion greater than 21 %.

1.9 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.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 50014	1997	Electrical apparatus for potentially explosive atmospheres — General requirements
A1	1999	
A2	1999	
EN 50015		Electrical Apparatus for potentially explosive atmospheres — Oil immersion ‘o’
EN 50017		Electrical apparatus for potentially explosive atmospheres — Powder filling ‘q’

EN 50018		Electrical apparatus for potentially explosive atmospheres — Flameproof enclosures ‘d’
EN 50019		Electrical apparatus for potentially explosive atmospheres — Increased safety ‘e’
EN 50020		Electrical apparatus for potentially explosive atmospheres — Intrinsic safety ‘i’
EN 50028		Electrical apparatus for potentially explosive atmospheres — Encapsulation ‘m’
EN 50033		Electrical apparatus for potentially explosive atmospheres — Caplights for mines susceptible to firedamp
EN 50039		Electrical apparatus for potentially explosive atmospheres — Intrinsically safe systems ‘i’
EN 954	Series	Safety of machinery — Safety related parts of control systems
EN 60034-1	1998	Rotating electrical machines — Rating and performance (IEC 60034-1:1996, modified)
EN 60034-5	1986	Rotating electrical machines — Part 5: Classification of degrees of protection provided by enclosures for rotating machines (IEC 60034-5:1981, modified)
EN 60529	1991	Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)
HD 214 S2	1980	Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions (IEC 60112:1979)

3 Definitions

For the purposes of this European Standard, the definitions of EN 50014 and also the following apply.

3.1
type of protection pressurization ‘p’
technique of applying a protective gas to an enclosure in order to prevent the formation of an explosive atmosphere inside the enclosure by maintaining an overpressure against the surrounding atmosphere, and where necessary by using dilution

3.2
pressurized enclosure
enclosure in which a protective gas is maintained at a pressure greater than that of the external atmosphere

3.3
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 4:1 as found in air, does not make the ignition and flammability properties, such as explosive limits, more onerous.

3.4
purging
operation of passing a quantity of protective gas through the pressurized enclosure and ducts, so that:

a) when the protective gas is air, any explosive atmosphere in the pressurized enclosure is reduced to a safe concentration;

b) or when the protective gas is inert the concentration of oxygen in the pressurized enclosure is reduced to a safe level

3.5
static pressurization
maintenance of an overpressure within a pressurized enclosure without the addition of protective gas in a hazardous area

3.6
pressurization with leakage compensation
maintenance of an overpressure within a pressurized enclosure so that, when the outlet apertures are closed, the supply of protective gas is sufficient to compensate for any leakage from the pressurized enclosure and its ducts

3.7
pressurization with continuous flow of the protective gas
maintenance of an overpressure within a pressurized enclosure with continuous flow of the protective gas through the enclosure

3.8
internal source of release
point or location from which a flammable substance in the form of a flammable gas or vapour or liquid may be released into the pressurized enclosure such that in the presence of air an explosive gas atmosphere could be formed

3.9
containment system
part of the apparatus containing the flammable gas, vapour or liquid that may constitute an internal source of release

3.10
infallible containment system
construction of an infallible containment system is of such integrity that the possibility of a leak is so remote that it can be ignored

3.11
dilution
continuous supply of a protective gas, after purging, at such a rate that the concentration of a flammable mixture inside the pressurized enclosure is maintained at a value outside the explosive limits except in a dilution area

NOTE Dilution of oxygen by inert gas may result in a concentration of flammable gas above the UEL.

3.12
ignition capable apparatus
apparatus which in normal operation constitutes a source of ignition for a specified explosive atmosphere. This includes electrical apparatus not protected by a type of protection listed in clause 2

3.13
dilution area
area in the vicinity of a source of release where the concentration of flammable gas or vapour is not diluted to a safe concentration

3.14
limited release
release of flammable gas or vapour the maximum flow rate of which can be predicted

3.15
unlimited release
release of flammable gas or vapour the maximum flow rate of which cannot be predicted

NOTE This refers to liquids which can evolve flammable gas or vapour where the rate of release cannot be predicted.

3.16
lower explosive limit (LEL)
volume ratio of flammable gas or vapour in air below which an explosive gas atmosphere will not be formed

3.17
upper explosive limit (UEL)
volume ratio of flammable gas or vapour in air above which an explosive gas atmosphere will not be formed

3.18
volume ratio (v/v)
ratio of the volume of a component to the volume of the gas mixture under specified conditions of temperature and pressure

REQUIREMENTS FOR PRESSURIZED ENCLOSURES

4 Enclosures and ducting

4.1 General

The pressurized enclosure, including any apertures for moving parts but excluding apertures for the inlet and outlet of the protective gas, shall have a degree of protection in accordance with at least IP 40 of EN 60529, or in the case of a rotating electrical machine, EN 60034-5.

NOTE The degree of protection of IP 44 may be required on a coal face under humid and dusty conditions.

4.2 Spark and particle barriers

The pressurized enclosure and the ducting, if any, for the protective gas shall guard against the ejection of ignition capable sparks or particles into the hazardous area (see A.2).

4.3 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.

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 by the manufacturer to limit the maximum internal overpressure to a level below that which could adversely affect the type of protection.

4.4 Apertures

NOTE The location, size and number of apertures should be suitable for effective purging. The number of apertures should be chosen with regard to the design and disposition of the apparatus, particular consideration being given to the needs of subcompartments into which the apparatus might be divided.

4.4.1 In the case of static pressurization the enclosure shall have one or more apertures. After filling and pressurization all apertures shall be closed.

4.4.2 In the case of pressurization with leakage compensation the enclosure shall have one or more inlet apertures. It shall also have one or more outlet apertures constructed so that they can be closed after purging.

4.4.3 In the case of pressurization with continuous flow of protective gas, the enclosure shall have one or more inlet apertures and one or more outlet apertures for the connection of the inlet and outlet ducts for the protective gas.

4.5 Materials

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

4.6 Doors and covers

4.6.1 Group I apparatus: For Group I pressurized enclosures, doors and covers shall either:

- have special fasteners complying with 9.2 of EN 50014; or
- except for the case of static pressurization, be interlocked so that the electrical supply to apparatus not protected by a type of protection listed in clause 2 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 6.6 of this standard shall also apply.

In the case of static pressurization, doors and covers shall carry the following warning:

“Do not open in hazardous area”

4.6.2 Group II apparatus: The requirements for fasteners for doors and covers in 9.1, paragraph 1, of EN 50014 need not apply to Group II pressurized enclosures. 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 listed in clause 2 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 6.6 of this standard shall also apply.

In the case of static pressurization, doors and covers shall only be opened by the use of a tool, and shall carry the following warning:

“Do not open in hazardous area”

4.6.3 When doors and covers are provided to permit inspection in service, they shall carry the following warning:

“Do not open when energized”

except where provision is made for adjustment during operation, in which case the warning shall be

“See instructions before opening”

4.7 Insulating materials

For Group I apparatus, insulating materials subjected to electrical stresses capable of causing arcs in air and which result from rated currents of more than 16 A shall have a comparative tracking index equal to or greater than CTI 400M according to IEC 60112.

5 Temperature limits

5.1 The pressurized enclosure shall be classified in accordance with the temperature classification requirements of EN 50014.

The maximum surface temperature shall be determined either:

a) by the temperature of the hottest point of the external surface of the enclosure; or

b) by the temperature of the hottest point of the surface of the internal parts which are protected by any of the types of protection listed in EN 50014, and which remain energized even when the supply of protective gas is removed (e.g. electrical heaters).

5.2 If during normal service the temperature of any surface within the pressurized enclosure exceeds the maximum value permitted in EN 50014 for the temperature class, appropriate measures shall be taken to prevent, if pressurization ceases, any explosive atmosphere which may exist making contact with that surface before it has cooled below the permitted maximum value. This may be achieved either by the design and construction of the joints of the pressurized enclosure and ducts or by other means, e.g. by bringing auxiliary ventilation systems into operation or by arranging that the hot surface within the enclosure is in a gas tight or encapsulated housing.

When determining the temperature for rotating electrical machines the duty type according to EN 60034-1 as specified by the manufacturer shall be considered.

6 Safety provisions and safety devices (except for static pressurization)

6.1 All safety devices used to prevent electrical apparatus protected by pressurization from causing an explosion shall themselves not be capable of causing an explosion or shall be mounted outside the hazardous area.

6.2 The safety devices required by this standard form safety related parts of a control system. It is the responsibility of the manufacturer to assess that the safety and integrity of the control system is consistent with the level of safety required by this standard.

NOTE See also EN 954, Safety of machinery — Safety related parts of a control system.

6.3 The safety devices shall be provided by the manufacturer of the apparatus or by the user. In the latter case the apparatus shall be marked “X” and the description documents shall contain all necessary information required by the user to ensure conformity with the requirements of this standard.

NOTE An example of the information to be supplied by the manufacturer is given in annex C.

6.4 Where the safety related control system forms part of the apparatus a functional sequence diagram shall be provided by the manufacturer, for example 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 required to verify conformity to the diagram. These tests need only be carried out under normal atmospheric conditions unless otherwise specified by the manufacturer.

6.5 The manufacturer shall specify the maximum and minimum action levels and tolerances of the safety devices. The safety devices shall be used within the normal operational limits as specified by the manufacturer taking due account of the most onerous conditions specified for normal service.

6.6 Safety devices, such as time delay relays and devices for monitoring the flow of protective gas shall be provided to prevent electrical apparatus within a pressurized enclosure becoming energized until purging has been completed.

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

- following the initiation of the sequence, the purging flow through and the overpressure in the enclosure shall be monitored in accordance with this standard;
- when the minimum flowrate of protective gas is achieved and the overpressure is within the specified limits the purge timer can be started;
- after the expiry of the time the apparatus is then available to be energized.

In the event of failure of any step in the sequence the circuit shall be arranged to reset to the beginning.

6.7 Where the protective gas is air, the concentration of flammable gas after purging shall not exceed 25 % of the LEL.

Where the protective gas is other than air, the concentration of oxygen after purging shall not exceed 2 % by volume.

The minimum flow rate of protective gas required for purging is the rate specified by the manufacturer and verified by the type tests in 15.3 and 15.4. The minimum purging duration is the duration also specified by the manufacturer and verified by the type tests. The purging flow rate shall be monitored at the outlet of the pressurized enclosure.

NOTE To determine the free space of the associated ducts and to set up the additional purging time for the given minimum flowrate is the responsibility of the user. The purge duration shall be increased by the time necessary to purge the free volume of those associated ducts which are not part of the certified apparatus by at least five times their volume at the minimum flow rate specified by the manufacturer.

6.8 One or more automatic safety devices shall be provided to operate when the overpressure falls below the minimum value specified by the manufacturer. It shall be possible to check the correct operation of the safety devices. Their location and setting shall take into account the requirements of 6.9.

When a minimum rate of flow of protective gas is specified by the manufacturer one or more automatic safety device(s) shall be provided to operate when the flow rate of protective gas at the outlet falls below the specified minimum value.

NOTE The purpose(s) for which the automatic safety device(s) are used (i.e. to disconnect power or to sound an alarm or otherwise ensure the safety of the installation) is the responsibility of the user.

6.9 A minimum overpressure of 50 Pa shall be maintained relative to the external pressure at every point within the enclosure and its associated ducts, at which leakage can occur.

The manufacturer shall specify the minimum and maximum overpressure in service and the maximum leakage rate at the maximum overpressure.

The distribution of pressure in different systems and ducts is illustrated in Figures A.1 to A.4.

NOTE It is essential for the safety of an installation of pressurized enclosures that the installation of the associated ducts and of the compressor or fan does not introduce a hazard. The basic recommendations for the installation of ducting systems are given in annex A.

For variable speed motors, consideration must be given to the operational speed range to determine the position and pressurization of the minimum pressure point within the enclosure.