NSAI Standards

Irish Standard
I.S. EN 12101-6:2005

Smoke and heat control systems - Part 6: Specification for pressure differential systems - Kits

I.S. EN 12101-6:2005

Incorporating amendments/corrigenda issued since publication:

EN 12101-6:2005/AC:2006

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard – national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation - recommendation based on the consensus of an expert panel and subject to public consultation.

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This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

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Údarás um Chaighdeáin Náisiúnta na hÉireann

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12101-6:2005/AC

August 2006
Août 2006
August 2006

ICS 13.220.99

English version
Version Française
Deutsche Fassung

Smoke and heat control systems - Part 6: Specification for pressure differential systems - Kits

Systèmes pour le contrôle des fumées et de la chaleur - Partie 6: Spécifications pour les systèmes à différentiel de pression - Kits

Anlagen zur Kontrolle von Rauch- und Wärmesströmungen - Teil 6: Anforderung an Differenzdrucksysteme - Bausätze

This corrigendum becomes effective on 9 August 2006 for incorporation in the three official language versions of the EN.

Ce corrigendum prendra effet le 9 août 2006 pour incorporation dans les trois versions linguistiques officielles de la EN.

Die Berichtigung tritt am 9.August 2006 zur Einarbeitung in die drei offiziellen Sprachfassungen der EN in Kraft.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No.:EN 12101-6:2005/AC:2006 D/E/F

English version

Replace the following equations:

$$A_e = \left(\frac{1}{A_1^2} + \frac{1}{A_2^2} + \frac{1}{A_3^2} + ... + \frac{1}{A_N^2} \right)^{-\frac{1}{2}} \quad \text{(A.3)}$$

$$A_e = \left(\frac{1}{A_1^2} + \frac{1}{A_2^2} + \frac{1}{A_3^2} + \frac{1}{A_4^2} \right)^{-\frac{1}{2}} \quad \text{(A.3a)}$$

$$A_{1/10} = \frac{A_{1/2} \times A_{3/10}}{\left(A_{1/2}^2 + A_{3/10}^2 \right)^{\frac{1}{2}}} \quad \text{(A.10)}$$

$$Q_{Ld} = 0{,}83 \times \left(\frac{1}{A_t^2} + \frac{1}{A_F^2} \right)^{-\frac{1}{2}} \times P_L^{\frac{1}{2}} \quad \text{(A.12)}$$

$$A_{PV} = \frac{Q_{fr} - Q_p}{0{,}83 \times 60^{\frac{1}{2}}} \quad \text{(A.25)}$$

Version française

Remplacer les équations suivantes:

$$A_e = \left(\frac{1}{A_1^2} + \frac{1}{A_2^2} + \frac{1}{A_3^2} + ... + \frac{1}{A_N^2} \right)^{-\frac{1}{2}} \quad \text{(A.3)}$$

$$A_e = \left(\frac{1}{A_1^2} + \frac{1}{A_2^2} + \frac{1}{A_3^2} + \frac{1}{A_4^2} \right)^{-\frac{1}{2}} \quad \text{(A.3a)}$$

$$A_{1/10} = \frac{A_{1/2} \times A_{3/10}}{\left(A_{1/2}^2 + A_{3/10}^2 \right)^{\frac{1}{2}}} \quad \text{(A.10)}$$

$$Q_{Ld} = 0{,}83 \times \left(\frac{1}{A_t^2} + \frac{1}{A_F^2} \right)^{-\frac{1}{2}} \times P_L^{\frac{1}{2}} \quad \text{(A.12)}$$

$$A_{\mathrm{PV}} = \frac{Q_{\mathrm{fr}} - Q_{\mathrm{p}}}{0{,}83 \times 60^{\frac{1}{2}}} \qquad (A.25)$$

Deutsche Fassung

Die Berechnung (A.25) ist wie folgt zu ersetzen:

$$A_{\mathrm{PV}} = \frac{Q_{\mathrm{fr}} - Q_{\mathrm{p}}}{0{,}83 \times 60^{\frac{1}{2}}} \qquad (A.25)$$

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12101-6

June 2005

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English version

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This European Standard was approved by CEN on 17 January 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN 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 CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 12101-6:2005) has been prepared by Technical Committee CEN/TC 191 “Fixed firefighting systems”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2005, and conflicting national standards shall be withdrawn at the latest by December 2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 89/106/EEC.

For relationship with EU Directive(s), see informative Annex ZA which is an integral part of this document.

This European Standard has the general title "*Smoke and heat control systems"* and consists of the following eleven parts:

Part 1: *Specification for smoke barriers*;

Part 2: *Specification for natural smoke and heat exhaust ventilators*;

Part 3: *Specification for powered smoke and heat exhaust ventilators*;

Part 4: *Fire and smoke control installations – Kits*;

Part 5: *Design and calculation for smoke and exhaust ventilation systems (published as CR 12101-5)*;

Part 6: *Specification for pressure differential systems – Kits*;

Part 7: *Smoke control ducts*;

Part 8: *Specification for smoke control dampers*;

Part 9: *Control panels and emergency control panels*;

Part 10: *Power supplies*;

EN 12101 is included in a series of European Standards planned to cover also:

a) Gas extinguishing systems (EN 12094 and EN ISO 14520);

b) Sprinkler systems (EN 12259);

c) Powder systems (EN 12416);

d) Explosion protection systems (EN 26184);

e) Foam systems (EN 13565);

g) Hose reel systems (EN 671);

h) Water spray systems (EN 14816).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

0 Introduction

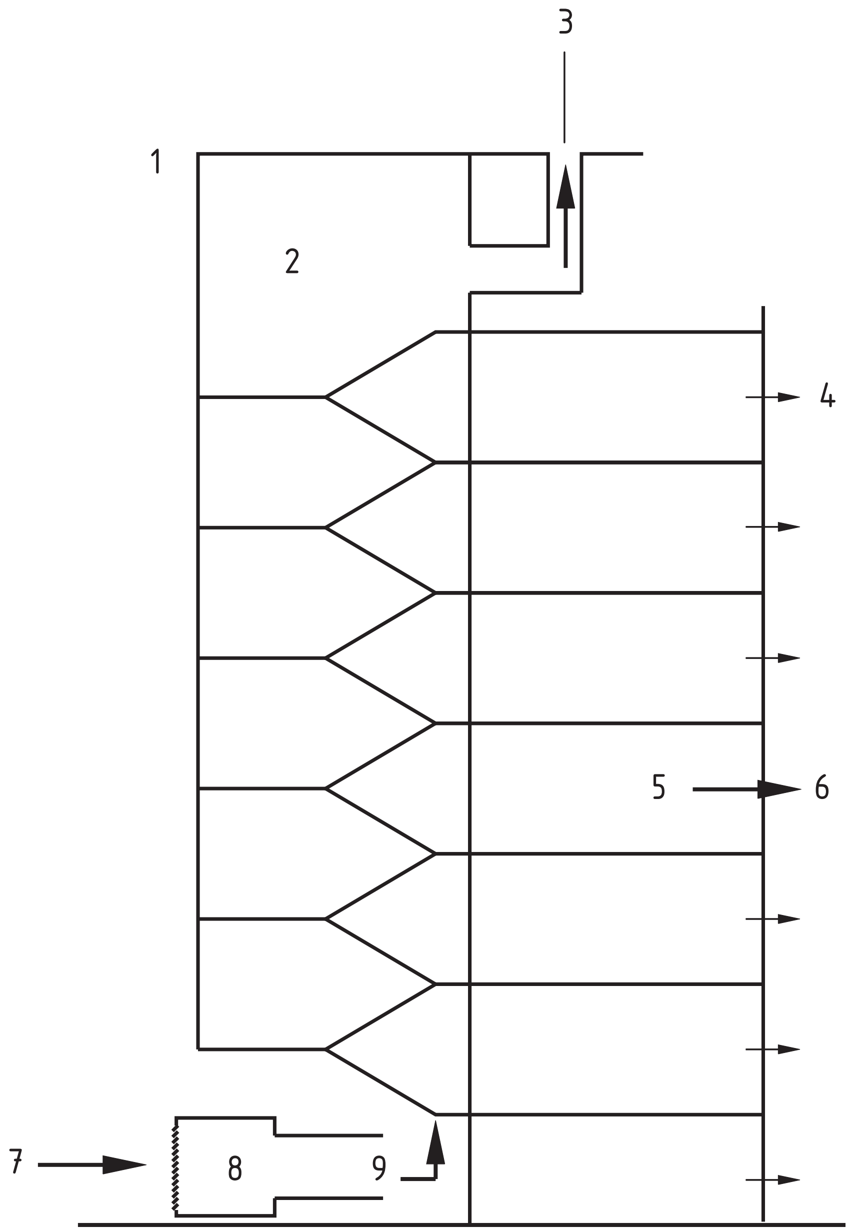
0.1 Smoke movement in the building

This document covers information and requirements on the design, calculation methods, installation and testing of systems intended to limit the spread of smoke by means of pressure differentials.

Pressure differential systems can be achieved by two methods:

i) pressurization – maintaining a positive pressure within the protected spaces (see Figure 1a), or

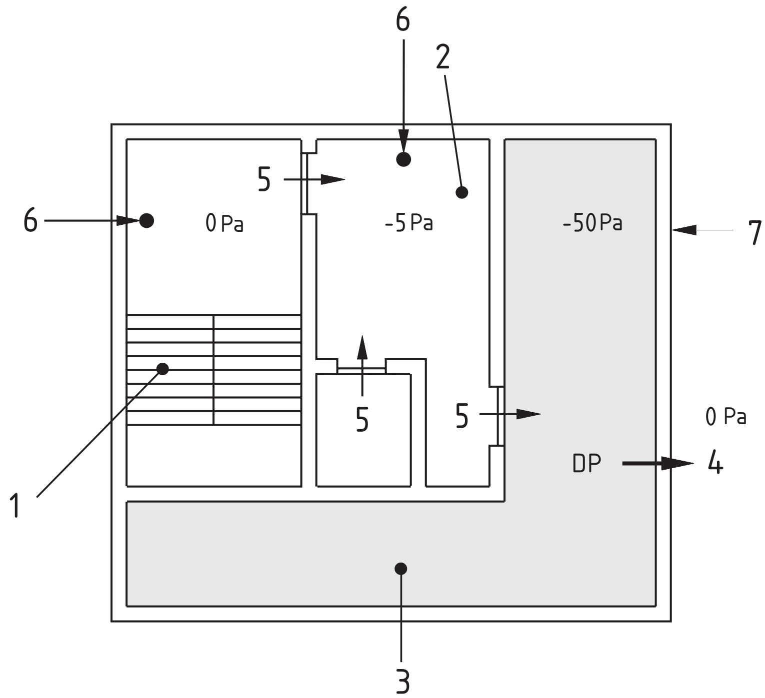
ii) depressurization – removing hot gases from the fire zone at a lower pressure than the adjacent protected space (see Figure 1b).



Key

1 Outside
2 Pressurized space
3 Overpressure relief
4 External leakage
5 Fire zone
6 Air release vents
7 Air intake
8 Supply fan
9 Supply ductwork

Figure 1 a) — Examples of pressurization and depressurization systems



Key

1 Stair

2 Lobby

3 Accommodation (DP Depressurized space)

4 Exhaust (Depressurize)

5 Leakage path through doors etc.

6 Replacement air

7 Fire-resisting construction

Figure 1 b) — Example of a depressurization system – basements or other spaces with no external windows

In the event of fire, the smoke produced follows a pattern of movement arising from the following main driving forces.

Buoyancy experienced by hot gases on the fire storey. Within the fire zone, smoke produced by the fire experiences a buoyancy force owing to its reduced density. In a building this can result in upwards smoke movement between storeys if leakage paths exist to the storey above. In addition, this buoyancy can cause smoke to spread through leakage paths in vertical barriers between rooms, e.g. doors, walls, partitions. The pressure differential typically causes smoke and hot gases to leak out of gaps at the top of a door and cool air to be drawn in through gaps at the bottom.

Thermal expansion of hot gases in the fire zone. Fire induced expansion of gases can result in a build up of pressure, accompanied by a flow of hot gases out of the compartment. However, in most cases the initial expansion forces may dissipate quickly and may be ignored.

Stack effect throughout the building. In cold ambient conditions, the air in a building is generally warmer and less dense than the external air. The buoyancy of the warm air causes it to rise within vertical shafts in the building, and a pressure gradient is set up in the column such that cold air is drawn into the bottom of the shaft and warm air is forced out at the top. In warm ambient conditions, when the air inside the building can be cooler than that outside, the reverse condition may exist, i.e. air is forced out at the bottom of the stack and drawn in at the top. In either case, at some intermediate point a neutral pressure plane is formed where the pressures of the external and the internal air are equal.

Wind pressure forces. When wind blows towards the side of a building, it is slowed down, resulting in a build-up of pressure on the windward face. At the same time the wind is deflected and accelerated around the side walls and over the roof, creating a reduction in pressure on the leeward side of the building, i.e. suction in these areas. The greater the speed of the wind, the greater the suction. The main effect of these pressures is to produce a horizontal movement of air through the building from the windward to the leeward sides. If the building envelope is leaky, e.g. with openable doors and windows, then the effect will be more pronounced. In a fire, if a broken window exists on the windward side of the building, the wind can force the smoke through the building horizontally or in some circumstances vertically. It can be difficult to predict accurately the wind pressures that will be exerted on buildings or the resultant internal airflows, and computer or wind tunnel analysis may be necessary for a full understanding.

NOTE Guidance on wind loading is given in prEN 1991-2-4.

HVAC systems. HVAC systems can supply air to the fire zone and aid combustion, or transport smoke rapidly to areas not within the zone of the source of the fire, and are often shut down in the event of fire. However, such systems can often be modified to assist in restricting smoke spread or be used in conjunction with pressure differential system air supply and/or release systems.

0.2 Objectives of pressure differential systems

The objective of this document is to give information on the procedures intended to limit the spread of smoke from one space within a building to another, via leakage paths through physical barriers (e.g. cracks around closed doors) or open doors.

Pressure differential systems offer the facility of maintaining tenable conditions in protected spaces, for example escape routes, firefighting access routes, firefighting shafts, lobbies, staircases, and other areas that require to be kept free of smoke. This document offers information with regard to life safety, firefighting and property protection within all types of buildings. It is necessary to determine not only where the fresh air supply for pressurization is to be introduced into a building but also where that air and smoke will leave the building and what paths it will follow in the process. Similar considerations apply to depressurization schemes, i.e. the route for the exhaust air, plus consideration for the inlet replacement air and the paths it will follow.

The aim therefore is to establish a pressure gradient (and thus an airflow pattern) with the protected escape space at the highest pressure and the pressure progressively decreasing in areas away from the escape routes.

Pressure differential systems provide one means of improving the level of fire safety within a building. A decision as to whether such a system is appropriate to a particular project should be taken in context with the overall design strategy for means of escape, firefighting and property protection within the building. This will lead to design assumptions which are expected to be appropriate to the particular project, especially in regard of the most likely leakage paths caused by simultaneous open doors as outlined in Clause 5.

Drawings that accompany the text in this document are intended only to clarify points made in the text. It should be assumed that the arrangements shown are informative only.

When the designer is unable to comply with this document in full, an alternative fire safety engineered approach can be adopted. The engineered solution should adopt the functional requirements set out in this document wherever appropriate.

0.3 Smoke control methods

The effect of the air movement forces described above is to create pressure differentials across the partitions, walls and floors which can add together and can cause smoke to spread to areas removed from the fire source. The techniques most commonly used to limit the degree of smoke spread, or to control its effects, are:

a) smoke containment using a system of physical barriers to inhibit the spread of smoky gases from the fire affected space to other parts of the building, e.g. walls and doors;

b) smoke clearance, using any method of assisting the fire service in removing smoky gases from a building when smoke is no longer being produced, i.e. post extinction;

c) smoke dilution, deliberately mixing the smoky gases with sufficient clean air to reduce the hazard potential;

d) smoke (and heat) exhaust ventilation, achieving a stable separation between the warm smoky gases forming a layer under the ceiling, and those lower parts of the same space requiring protection from the effects of smoke for evacuation of occupants and firefighting operations. This normally requires the continuous exhaust of smoke using either natural or powered ventilators, and the introduction of clean replacement air into the fire affected space beneath the smoke layer;

e) pressurization, see 3.1.27;

f) depressurization, see 3.1.10.

This document provides guidance and information on smoke control using pressure differentials, i.e. only the techniques given in items e) and f).

Items a) - d) are not discussed further within this document.

Smoke control using pressure differentials generally requires lower ventilation rates than b) or c) above but is limited to the protection of enclosed spaces adjacent to spaces being smoke logged in the event of a fire.

0.4 Analysis of the problem

The purpose of a pressure differential system, whether used for the protection of means of escape, firefighting operations or property protection, can have a significant influence on the system design and specification. It is, therefore, essential that the fire safety objectives are clearly established and agreed with the appropriate authorities at an early stage in the design process.

The acceptability of any system ultimately depends upon whether the necessary pressure differential levels and the airflow rates are achieved. Guidance on the means of calculating the air supply rates to achieve these levels are given within this document. However, providing that the functional objectives of the systems (see subclauses a), b) and c) below) are met then the designer may choose to use other calculation procedures, as appropriate, in substantiation of their design.

The objectives addressed in this document are as follows:

a) **Life safety**. It is essential that tenable conditions for life safety are maintained in protected spaces for as long as they are likely to be in use by the building occupants.

b) **Dedicated firefighting routes**. To enable firefighting operations to proceed efficiently, protected firefighting access routes (e.g. firefighting shafts) should be maintained essentially free of smoke so that access to the fire affected storey can be achieved without the use of breathing apparatus. The pressure differential system should be designed so as to limit the spread of smoke into the dedicated firefighting route under normal firefighting conditions.

c) **Property protection**. The spread of smoke should be prevented from entering into sensitive areas such as those containing valuable equipment, data processing and other items that are particularly sensitive to smoke damage.

1 Scope

This document specifies pressure differential systems designed to hold back smoke at a leaky physical barrier in a building, such as a door (either open or closed) or other similarly restricted openings. It covers methods for calculating the parameters of pressure differential smoke control systems as part of the design procedure. It gives test procedures for the systems used, as well as describing relevant, and critical, features of the installation and commissioning procedures needed to implement the calculated design in a building. It covers systems intended to protect means of escape such as stairwells, corridors and lobbies, as well as systems intended to provide a protected firefighting bridgehead for the Fire Services.

The systems incorporate smoke control components in accordance with the relevant Parts of EN 12101 and kits comprising these and possibly other components (see 3.1.18). This document gives requirements and methods for the evaluation of conformity for such kits.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 1505, *Ventilation for buildings —Sheet metal air ducts and fittings with rectangular cross section — Dimensions*

EN 1506, *Ventilation for buildings —Sheet metal air ducts and fittings with circular cross section — Dimensions*

prEN 12101-4, *Smoke and heat control systems — Part 4: Fire and smoke installations — Kits*

prEN 12101-7, *Smoke and heat control systems — Part 7: Smoke control ducts*

prEN 12101-9, *Smoke and heat control systems — Part 9: Control panels*

prEN 12101-10, *Smoke and heat control systems — Part 10: Power supplies*

prEN 13501-3, *Fire classification of construction products and building elements — Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers*

prEN 13501-4, *Fire classification of construction products and building elements — Part 4: Classification using data from fire resistance tests on components of smoke control systems*

EN ISO 9001:2000, *Quality management systems — Requirements (ISO 9001:2000)*

EN ISO 13943:2000, *Fire safety — Vocabulary (ISO 13943:2000)*