# SLOVENSKI STANDARD
# oSIST prEN 12101-6:2020

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**Sistemi za nadzor dima in toplote - 6. del: Sistemi za zagotovitev tlačnih razlik - Oprema**

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

Rauch- und Wärmefreihaltung - Teil 6: Festlegungen für Differenzdrucksysteme - Bausätze



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



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# 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 relatives aux systèmes à différentiel de pression - Kits

Rauch- und Wärmefreihaltung - Teil 6: Festlegungen für Differenzdrucksysteme - Bausätze

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 191.

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**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**



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## European foreword

This document (prEN 12101-6:2020) has been prepared by Technical Committee CEN/TC 191 “Fixed firefighting systems”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document together with prEN 12101-13 will replace EN 12101-6:2005, which will be withdrawn.

This document has the general title “Smoke and heat control systems” and consists of the following 13 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*;

— Part 11: *Smoke control in covered vehicle parks;*

— Part 12: *SHEVS – Time dependant Fires;*

— Part 13: *Pressure differential systems (PDS) design and calculation methods, acceptance testing, maintenance and routine testing of installation.*

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

a) Gas extinguishing systems (EN 12094 and 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).

# Introduction

### Objectives of pressure differential systems

Pressure differential systems offer the facility of maintaining tenable conditions in protected spaces, for example: escape routes, firefighting access routes, firefighting lift shafts, lobbies, staircases, and other areas that require being kept free of smoke. 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 from the protected space to the unprotected space (fire room) while the doors are closed, and an airflow while the doors are open.

### Smoke control methods

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

a) Pressurization;

b) Depressurization.

### System components



A typical pressure differential system will comprise three basic components:

a) the means for providing supply air and to extract air;

b) the means for controlling the pressure difference between the area with higher pressure and the adjoining area with lower pressure;



c) the means for releasing air flowing through the door between the area with higher pressure to those with lower pressure (to prevent unwanted pressure build up in this area).

This document covers kits made up from items a) and b) only. The effect of item c) is considered only in terms of the resistance to air flow that it exerts.

Installations of pressure differential systems (PDS) may comprise:

- fans (temperature rated) if necessary;
- air ducts to provide a passageway for the transmission of air or smoke;
- ventilation openings to provide leakage of air (including dampers, active or passive controlled);
- power supply;
- connecting cables;
- means of activation;
- means of pressure control;
- control panel;
- fire/smoke dampers in branches from the ductwork where the ductwork is situated outside the protected enclosure;
- grilles and diffusers;
- door closers.

The design of pressure differential systems is covered in prEN 12101-13.

# 1 Scope

This document applies to pressure differential system kits, positioned on the market and intended to operate as part of a pressure differential system. The purpose of a pressure differential system is to prevent protected spaces from smoke spread by using pressure difference and airflow. This document specifies characteristics and test methods for components and kits for pressure differential systems to produce and control the required pressure differential and airflow between protected and unprotected space.

# 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.

EN 1363-1, *Fire resistance tests — Part 1: General requirements*

EN 12101-2, *Smoke and heat control systems — Part 2: Natural smoke and heat exhaust ventilators*

EN 12101-3, *Smoke and heat control systems — Part 3: Specification for powered smoke and heat control ventilators (Fans)*

EN 12101-7, *Smoke and heat control systems — Part 7: Smoke duct sections*



EN 12101-8, *Smoke and heat control systems — Part 8: Smoke control dampers*

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

EN 1366-10, *Fire resistance tests for service installations — Part 10: Smoke control dampers*

# 3 Terms, definitions, symbols and abbreviated terms

## 3.1 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in EN ISO 13943 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

**3.1.1**
**air inlet**
connection to outside air which allows the entry of air from outside to the construction works

**3.1.2**
**air release**
means by which pressurizing air or a mixture of pressurizing air and smoke is able to escape from the accommodation or other unpressurized space to outside the building

**3.1.3**
**control panel**
multi-operational device to activate and/or control a PDS

**3.1.4**
**depressurization**
smoke control using pressure differentials between the protected space and the unprotected space with a lower pressure in the unprotected space

**3.1.5**
**over-pressure relief**
provision for releasing excess pressurizing air from the pressurized space

**3.1.6**
**over-pressure relief vent**
device which opens automatically at a certain pressure difference (design pressure difference) to give a free flow path from a pressurized space (e.g. a staircase or lift shaft) to the open air

**3.1.7**
**pressure differential system**
**PDS**
combination of at least one kit and additional components intended to produce pressure differential and airflow between protected and unprotected spaces



**3.1.8**
**pressurization**
smoke control using pressure differentials between the protected space and the unprotected space with a higher pressure in the protected space



**3.1.9**
**test rig**
test equipment used for testing the pressure differential system kit

**3.1.10**
**pressure differential systems – kit**
**PDS kit**
combination of at least two components which are necessary to produce and control the required pressure differential and airflow-between protected and unprotected space

Note 1 to entry: The type of kit is dictated by the PDS design and objectives. Schematic overviews of different types are given in Annex A.

**3.1.11**
**active control**
pressure control actuated from measured pressure and using external energy (e.g. motor driven damper, frequency inverter-controlled fans, etc.)

**3.1.12**
**barometric relief damper**
damper being activated by local pressure difference between both sides of the damper blade(s) and permits airflow to control pressure

**3.1.13**
**activation signal**
signal to initiate from stand-by to the active mode of the pressure differential system

## 3.2 Symbols

The symbols and abbreviations below are used in the document:

| Symbol | Unit | Description |
|---|---|---|
| $\dot{V}_{ar}$ | m³/h | measured air release volume flow rate from test room 1 (representing the protected space in the building) to test room 2 (representing the unprotected space in the building) via open air release path during the test (nominal value given by the manufacturer) |
| $\dot{V}_{RL}$ | m³/h | required leakage flow rate if necessary for the function of the PDS kit. If the building leakages (always present) are at the same rate or larger, during the test (nominal value given by the manufacturer), the component to produce the defined leakage is part of the PDS kit under test |
| $\dot{V}_{TO_{ps}}$ | m³/h | volume flow rate through temporary openings (e.g. open doors from staircases on different levels from fire level, open escape/exit door) in case of pressurization during the test (nominal value given by the manufacturer) |
| $\dot{V}_{TO_{dp}}$ | m³/h | volume flow rate through temporary openings (e.g. open doors from staircases on different levels from fire level, open escape/exit door) in case of **de**pressurization during the test (nominal value given by the manufacturer) |
| $\dot{V}_{ex}$ | m³/h | exhaust volume flow rate out of the test room 2 for depressurization and combined systems |
| $\dot{V}_{rl}$ | m³/h | required minimum leakage volume flow rate at nominal pressure difference $\Delta p_{Nom}$ |
| $\dot{V}_{ar,ll}$ | m³/h | lower limit of volume flow rate through air release $\dot{V}_{ar,ll} = 0,9 * \dot{V}_{ar}$ |
| $\dot{V}_{sa}$ | m³/h | supply air volume flow rate measured at inlet nozzle |
| $\dot{V}_{TC}$ | m³/h | total controlled volume flow rate of the PDS kit as sum of flow rate air release $\dot{V}_{ar}$ + flow rate through temporary openings $\dot{V}_{TC}$ (nominal value given by the manufacturer) |
| $\dot{V}_{BP}$ | m³/h | bypass air volume flow rate |
| $\Delta p_{tr1}$ | Pa | pressure differential between test room 1 and reference pressure (static pressure in test hall) |
| $\Delta p_{tr2}$ | Pa | pressure differential between test room 2 and reference pressure (static pressure in test hall) |

| Symbol | Unit | Description |
|---|---|---|
| $\Delta p_{norm}$ | Pa | nominal pressure differential to be maintained by the PDS kit with closed air release opening and closed temporary openings (static conditions) |
| $\Delta p_{ar}$ | Pa | pressure difference across the open-air release path |
| $\Delta p_{ex}$ | Pa | pressure difference exhaust path measured between test room 2 and exhaust fan (at depressurization kit), (nominal value given by the manufacturer) |
| $\Delta p_{Nom,ul}$ | Pa | Upper limit of nominal pressure differential $\Delta p_{Nom,ul} = 1,2^* \Delta P_{Nom}$ |
| $\Delta t_V$ | s | Time period needed to establish volume flow rate $\dot{V}_{ar,ll}$ (flow criteria – see Figure 7) |
| $\Delta t_p$ | s | Pressure stabilizing time period (pressure criteria - see 5.7) |
| $\Delta t_{V,i}$ | s | time to establish volume flow rate in TCS cycle i |
| $\Delta t_{p,i}$ | s | pressure stabilizing time in TCS cycle i |
| fr | $s^{-1}$ | frequency of the frequency inverter from the PDS kit where equipped |
| $fr_{min}$ | $s^{-1}$ | minimal frequency of the frequency inverter at the passed test with all openings closed and at lowest required leakage – shall be stated in the test report |
| $fr_{max}$ | $s^{-1}$ | highest frequency of the frequency inverter at the passed test with air release path and temporary opening open and at highest required leakage – shall be stated in the test report |
| $I_{fan}$ | A | absorbed current of the fan (motor) |
| TCS | | test cycle sequence |



# 4 Characteristics

## 4.1 General

The kit shall be shown to be able to fulfil the specific pressure differential application that it is designed to provide. To demonstrate this, certain components have their own requirements and will need to fulfil these. Any component with no specific characteristics shown below shall be listed as part of the kit and included in the kit testing.

- Where there is a need for air release to the outside or air supply into the building through an opening (e.g. roof vent, windows, etc.) a natural smoke and heat exhaust ventilator shall be used;
- Where air volume and pressure are to be controlled using mechanical pressure relief a barometric damper or controlled damper in accordance with this document shall be used;
- Where ambient air is to be supplied using fans, the fans shall be further shown to be in accordance with this document;

- Where air is to be extracted by the pressure differential systems this shall be done using powered heat exhaust ventilators (smoke control fans);
- Where air is to be extracted using ductwork, the ductwork shall be smoke control duct (Builders work shafts may be used as an option and this is not within the scope of this document);
- Where dampers are needed to open and close to provide a path for smoke to the outside and maintain compartmentation, these shall be smoke control dampers;
- Where volume control around high temperature fans is to be provided using control dampers these shall be hot gas control dampers in accordance with this document;

This section gives details of the characteristics and additional test details.

## 4.2 Nominal activation conditions/sensitivity

### 4.2.1 Kit

The PDS kit shall be activated automatically by smoke detectors and it shall be possible to trigger it manually by an external switch.

The following proxy characteristics shall be taken into account:

a) the response time – see 4.3; and

b) the operational reliability – see 4.4.



In addition, the following components shall have their own characteristics when functioning as a part of the kit.



### 4.2.2 Components

#### 4.2.2.1 Natural smoke and heat exhaust ventilators

The characteristics for nominal activation conditions/sensitivity in EN 12101-2 shall be met before inclusion in a kit – see 5.2.2.1.

#### 4.2.2.2 Pressure control damper (e.g. barometric dampers, control dampers)

The following proxy characteristics shall be taken into account:

a) the response time – see 4.3; and

b) the operational reliability – see 4.4.

#### 4.2.2.3 Fans

##### 4.2.2.3.1 Ambient air supply fans

The following proxy characteristics shall be taken into account:

a) the response time – see 4.3; and

b) the operational reliability – see 4.4.

##### 4.2.2.3.2 Smoke control fans (powered smoke and heat exhaust ventilators)

In addition to any response time required by the kit (4.3.1), the characteristics for nominal activation conditions/sensitivity in EN 12101-3 shall be met before inclusion in a kit – see 5.2.2.3.2.

#### 4.2.2.4 Smoke control ducts

Smoke control ducts have no nominal activation conditions/sensitivity requirements as they have no moving parts.

#### 4.2.2.5 Smoke control dampers

The characteristics for nominal activation conditions/sensitivity in EN 12101-8 shall be met before inclusion in a kit – see 5.2.2.5.

#### 4.2.2.6 Hot gas control dampers

The following proxy characteristics shall be taken into account:

a) the response time – see 4.3; and

b) the operational reliability – see 4.4; and

c) characteristics as determined in Annex B.

### 4.3 Response delay (response time)

#### 4.3.1 Kit

#### 4.3.1.1 General



The proxy characteristics in 4.3.1.2 and 4.3.1.3 shall be taken into account.



#### 4.3.1.2 Initial response time

The kit must achieve operating status within $t_p \leq 60$ seconds after the activation signal. This shall be tested in accordance with 5.4.1.



#### 4.3.1.3 Response time of door opening and door closing

The kit shall achieve at least 90 % of the nominal airflow rate within 3 s of a door being fully opened (opening angle 90°) in accordance with test method in 5.4.1.2.

The kit shall reach the nominal pressure differential in the protected space $\Delta p_{nom}$ ± 20 % within 3 s after a door to the unprotected space or a temporary opening is closed completely. The pressure differential shall not exceed $\Delta p_{nom,ul} = \Delta p_{nom} * 1,2$ for a time period of more than 3 s. This shall be demonstrated in accordance with the test method in 5.4.1.

The kit shall stay in a stable operating condition even in the case of several door closing/opening cycles in accordance with test method in 5.4.1.

In addition, the following components shall have their own requirements when functioning as a part of the kit.

#### 4.3.2 Components

#### 4.3.2.1 Natural smoke and heat exhaust ventilators

The characteristics for response delay (response time) in EN 12101-2 shall be met before inclusion in a kit – see 5.3.2.1.

#### 4.3.2.2 Pressure control damper (e.g. barometric dampers, control dampers)

The overpressure device shall meet the response time characteristics as shown in 4.3.1 when tested as part of the kit – see 5.3.2.2.

#### 4.3.2.3 Fans

##### 4.3.2.3.1 Ambient air supply fans

The ambient supply fans shall meet the response time characteristics as shown in 4.3.1 when tested as part of the kit – see 5.3.2.3.1.

##### 4.3.2.3.2 Smoke control fans (powered smoke and heat exhaust ventilators)

In addition to any response time required by the kit (4.3.1), the characteristics for nominal activation conditions/sensitivity in EN 12101-3 shall be met before inclusion in a kit – see 5.3.2.3.2.

#### 4.3.2.4 Smoke control ducts

Smoke control ducts have no response delay requirements as they have no moving parts.

#### 4.3.2.5 Smoke control dampers

The characteristics for response delay (response time) in EN 12101-8 shall be met before inclusion in a kit – see 5.3.2.5.

#### 4.3.2.6 Hot gas control dampers

The characteristics shown in Annex B shall be reported against the listed classifications. The damper shall meet the requirements in 4.3.1 and move to the required position in less than 3 s (4.3.1) and be proven that the average operation time as determined in Annex B at temperature is no more than 20 % of that determined at ambient temperature.



### 4.4 Operational reliability



#### 4.4.1 Kit



The following proxy characteristics shall be taken into account: the ability of the kit to fulfil the volume flow rate and pressurization values as part of the functionality test – see 5.4.1.

Complete 10 000 cycles.

In addition, the following components shall have their own requirements when functioning as a part of the kit.

#### 4.4.2 Components

##### 4.4.2.1 Natural smoke and heat exhaust ventilators

The characteristics for operational reliability in EN 12101-2 shall be met before inclusion in a kit – see 5.4.2.1.

#### 4.4.2.2 Pressure control damper (e.g. barometric dampers, control dampers) dampers

The overpressure device shall meet the operational reliability as shown in 4.4.1 when tested as part of the kit – see 5.4.2.2.

#### 4.4.2.3 Fans

##### 4.4.2.3.1 Ambient air supply fans

The ambient supply fans shall meet the operational reliability characteristics as shown in 4.4.1 when tested as part of the kit – see 5.4.2.3.1.

#### 4.4.2.3.2 Smoke control fans (Powered smoke and heat exhaust ventilators)

In addition to any operational reliability required by the kit test (4.4.1), the smoke control fans shall meet the operational reliability requirements of EN 12101-3 – see 5.4.2.3.2.

#### 4.4.2.4 Smoke control ducts

Smoke control ducts have no operational reliability requirements as they have no moving parts.

#### 4.4.2.5 Smoke control dampers

The characteristics for operational reliability in EN 12101-8 shall be met before inclusion in a kit – see 5.3.2.5.

#### 4.4.2.6 Hot gas control dampers

The 10 operations at ambient and 10 operations at temperature (see Annex B) shall be met before being part of the kit test – see 4.4.1.

### 4.5 Effectiveness of smoke/hot gas extraction

#### 4.5.1 Kit

The following proxy characteristic shall be taken into account:

- the ability of the kit to fulfil the operational reliability requirements – see 4.4.



#### 4.5.2 Components

#### 4.5.2.1 Natural smoke and heat exhaust ventilators



The aerodynamic free area and relevant loading reliability requirements of EN 12101-2 shall be met before inclusion in a kit – see 5.5.2.1.

#### 4.5.2.2 Pressure control damper (e.g. barometric dampers, control dampers)

As a proxy characteristic the pressure control damper shall meet the response time (4.3.1) and operational reliability (4.4.1) when tested as part of the kit – see 5.5.2.2.

#### 4.5.2.3 Fans

#### 4.5.2.3.1 Ambient air supply fans

The ambient supply fans shall meet the operational reliability characteristics as shown in 4.4.1 when tested as part of the kit – see 5.5.2.3.1

#### 4.5.2.3.2 Smoke control fans (Powered smoke and heat exhaust ventilators)

In addition to any operational reliability required by the kit test (see 4.4.1), the smoke control fans shall meet the operational reliability requirements of EN 12101-3 – see 5.5.2.3.2.

#### 4.5.2.4 Smoke control ducts

The maintenance of cross-sectional area and no collapse requirements of EN 12101-7 shall be met – see 5.5.2.4.

#### 4.5.2.5 Smoke control dampers

The maintenance of cross-sectional area requirements of EN 12101-8 shall be met – see 5.5.2.4.

#### 4.5.2.6 Hot gas control dampers

As a proxy characteristic the hot gas control damper shall meet the response time (see 4.3.1) and operational reliability (4.4.1) when tested as part of the kit – see 5.5.2.6.

### 4.6 Performance parameters under fire conditions

#### 4.6.1 Kit

The following proxy characteristic shall be taken into account:

- the ability of the kit to fulfil the operational reliability requirements – see 4.4.

#### 4.6.2 Components

#### 4.6.2.1 Natural smoke and heat exhaust ventilators

The aerodynamic free area and relevant loading reliability requirements of EN 12101-2 shall be met before inclusion in a kit – see 5.6.2.1.

#### 4.6.2.2 Pressure control damper (e.g. barometric dampers, control dampers)

As a proxy characteristic the overpressure device shall meet the response time (4.3.1) and operational reliability (4.4.1) when tested as part of the kit – see 5.6.2.2.

#### 4.6.2.3 Fans



#### 4.6.2.3.1 Ambient air supply fans

The ambient supply fans shall meet the operational reliability characteristics as shown in 4.4.1 when tested as part of the kit – see 5.6.2.3.1.



#### 4.6.2.3.2 Smoke control fans (powered smoke and heat exhaust ventilators)

In addition to any operational reliability required by the kit test (4.4.1), the smoke control fans shall meet the operational reliability requirements of EN 12101-3 – see 5.6.2.3.2.

#### 4.6.2.4 Smoke control ducts

The maintenance of cross-sectional area and no collapse requirements of EN 12101-7 shall be met – see 5.5.2.4.

#### 4.6.2.5 Smoke control dampers

The maintenance of cross-sectional area requirements of EN 12101-8 shall be met – see 5.6.2.5.

#### 4.6.2.6 Hot gas control dampers

As a proxy characteristic the hot gas control damper shall meet the response time (see 4.3.1) and operational reliability (see 4.4.1) when tested as part of the kit – see 5.6.2.6.

### 4.7 Pressurization/depressurization performance

#### 4.7.1 Kit

The following proxy characteristic shall be taken into account:

- the ability of the kit to fulfil the operational reliability requirements – see 4.4.