

**SLOVENSKI STANDARD**  
**oSIST prEN ISO 21805:2021**  
**01-julij-2021**

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**Navodilo za projektiranje, izbiro in vgradnjo prezračevalnih naprav za zagotavljanje strukturne integritete namestitvenih prostorov, zaščitениh s sistemi za gašenje s plinom (ISO/DIS 21805:2021)**

Guidance on design, selection and installation of vents to safeguard the structural integrity of enclosures protected by gaseous fire-extinguishing systems (ISO/DIS 21805:2021)

Anleitung für die Konstruktion, Auswahl und Installation von Entlüftungen zur Gewährleistung der strukturellen Integrität von Gehäusen, die durch ortsfeste Gaslöschanlagen geschützt sind (ISO/DIS 21805:2021)

Lignes directrices pour la conception, la sélection et l'installation d'évents pour préserver l'intégrité structurelle des enceintes protégées par des systèmes fixes de lutte contre l'incendie à gaz (ISO/DIS 21805:2021)

**Ta slovenski standard je istoveten z: prEN ISO 21805**

**ICS:**

|           |                                    |  |
|-----------|------------------------------------|--|
| 13.220.10 | Gašenje požara                     | Fire-fighting                            |
| 91.140.30 | Prezračevalni in klimatski sistemi | Ventilation and air-conditioning systems |

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# DRAFT INTERNATIONAL STANDARD

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## Guidance on design, selection and installation of vents to safeguard the structural integrity of enclosures protected by gaseous fire-extinguishing systems

*Lignes directrices pour la conception, la sélection et l'installation d'évents pour préserver l'intégrité structurelle des enceintes protégées par des systèmes fixes de lutte contre l'incendie à gaz*

ICS: 91.140.30; 13.220.10

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## ISO/DIS 21805:2021(E)

### Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and firefighting, Subcommittee SC 8, Gaseous media and firefighting systems using gas*.

This edition cancels and replaces ISO/TS 21805:2018, which has been technically revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The guidance presented here is based on the results of a joint research program conducted in 2006 and 2007 by several fire protection system manufacturers and interested parties. The program of work consisted of several series of tests to evaluate the peak pressure response and pressure-relief vent area effects for each agent addressed in this document. The key data used in the development of this document were the values of peak enclosure pressure response (P<sub>MAX</sub>) at each value of the volume-normalized pressure-relief vent area of the test enclosure, hereinafter referred to as the “leakage-to-volume ratio” or LVR. Other test parameters (enclosure temperature, agent quantity, discharge time, and humidity) were held constant or varied in a specified manner. For each test series employing a single agent, the several pairs of LVR and resultant P<sub>MAX</sub> values were graphically analysed, and a best-fit correlation curve was determined.

The LVR vs. P<sub>MAX</sub> correlation curve for each agent or system forms the basis of the associated equations in cases where the discharge of the agent results in cooling the air temperature below its dew point. (See Humidity effects and humidity correction factor below.) In most cases, only halocarbon agents cause sufficient cooling to cause humidity related effects on the peak enclosure pressure. Thus, a correction for humidity effects is included in the equations for estimating vent area and maximum pressure on the discharge of the following agents:

- FK-5-1-12
- HFC-23
- HFC-125
- HFC-227ea

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The humidity corrections used in this document are based on the results of tests conducted with HFC-227ea at different conditions of humidity. prEN ISO 21805:2021

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The resulting values for humidity correction will be assumed to be equally applicable to the agents FK-5-1-12, HFC-125 and HFC-23 until further data or analysis indicate otherwise.

The correlations of LVR to maximum negative pressure and maximum positive pressure were based on test work performed in a test chamber at a relative humidity (RH) of approximately 38 %. If the RH in a protected enclosure differs from 38 % then a correction to the estimated maximum negative and positive pressures may be required. See 7.8 and 7.9 for further information on the effect of humidity. The temperature of the test enclosure was 21°C (nominal) for all tests that form the basis of the estimating methods given in this document.

In conducting the research program, described above, a large number of different venting arrangements were created in the test enclosure. The equivalent leakage area (ELA) for each test was determined by a “door fan test” and data analysis. The average enclosure pressure in effect during the many door fan tests varied from test to test. All values of ELA were normalized to an equivalent enclosure differential pressure of 125 Pa. The resulting enclosure correlations of peak pressure vs. LVR, and any resulting estimate of enclosure pressure-relief vent area, reflect a pressure-relief vent area calculated at an effective enclosure pressure of 125 Pa for a vent with a discharge coefficient of 0,61.

The effectiveness of a gaseous total flooding firefighting system depends, in part, on retention of the air-extinguishant mixture within the protected volume for a period of time. Retention of the extinguishant-air mixture requires that gas exchange (“leakage”) between the enclosure and the ambient environment be restricted. To limit the rate of gas exchange the enclosure boundary should have a high degree of integrity. To put it another way, the total of the areas of the various penetrations in an enclosure’s bounding surfaces should be low, at least during the gas-retention period (hold time) after the end of the extinguishant discharge.

The addition of a gaseous firefighting extinguishant to an enclosure having limited pressure-relief vent area will naturally result in a change of pressure therein. If the enclosure is sealed too tightly during the extinguishant discharge, i.e. too little pressure-relief vent area, the pressure change could exceed the

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structural strength of one or more of its bounding surfaces — windows, doors, walls, ceiling. Conversely, if the enclosure has too much pressure-relief vent area then gas exchange with the ambient atmosphere will occur rapidly, leading to a short retention time of the extinguishant within the protected volume.

Thus, the use of gaseous firefighting systems should address two performance considerations:

- a) Pressure management within the protected volume during the period of extinguishant discharge, and;
- b) Retention of the extinguishant-air mixture within the enclosure for a specified period of time after the completion of the discharge.

This document provides guidance for limiting pressure extremes in an enclosure during the discharge of a clean agent fire extinguishing system. This document does not provide the information necessary to determine all of the requirements related to the design, installation, service, maintenance, inspection, test, and/or requalification of fire suppression systems.

Some limitations and restrictions apply to the use of the equations contained in this document. Please refer to the text and notes that follow.

The information in this document does not supersede the manufacturer's guidance. The information contained in this document is presented as supplementary to the guidance provided by the respective system manufacturers. Guidance from the system manufacturer should always be followed and used for purposes of system design, installation, operation, and maintenance.

It has been assumed in the preparation of this document that the execution of its provisions is entrusted to people appropriately qualified and experienced in the specification, design, installation, testing, approval, inspection, operation and maintenance of systems and equipment, for whose guidance it has been prepared, and who can be expected to exercise a duty of care to avoid unnecessary release of extinguishant.

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# Guidance on design, selection and installation of vents to safeguard the structural integrity of enclosures protected by gaseous fire-extinguishing systems

## 1 Scope

This document provides guidance on fulfilling the requirements contained in ISO 6183:2009, 6.4.1 and 7.4.1 and ISO 14520-1:2015, 5.2.1 (h) and 5.3 (h), in respect to over and under pressurization venting and post-discharge extract.

It considers the design, selection and installation of vents to safeguard the structural integrity of enclosures protected by fixed gaseous extinguishing systems and the post-discharge venting provisions where used.

## 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.

ISO 14520-1, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 1: General requirements*

EN 15004-1, *Fixed firefighting systems — Gas extinguishing systems — Part 1: Design, installation, and maintenance* <https://standards.iteh.ai/catalog/standards/sist/ee49c23-7d0c-41f2-a123-2603a1bdf028/osist-pren-iso-21805-2021>

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

Note 1 to entry For the purposes of this document, the term “bar” signifies “gauge”, unless otherwise indicated. Concentrations or quantities expressed in percentages (%) signify by volume unless otherwise indicated.

### 3.1

#### **back pressure**

pressure downstream of a vent

### 3.2

#### **fire damper**

device designed to prevent the spread of fire

### 3.3

#### **free pressure-relief vent area**

sum of the free pressure-relief vent areas of the pressure-relief vents provided

Note 1 to entry: Note to entry: This is determined by the gross pressure-relief vent area x the vent efficiency.

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## 3.4

**gross pressure-relief vent area**

total area of the pressure-relief vent

## 3.5

**negative pressure**

pressure in the protected room which is lower than the pressure immediately outside the enclosure boundary

## 3.6

**peak pressure**

maximum pressure (positive and negative) generated within an enclosure caused by the discharge of the gaseous agent

## 3.7

**positive pressure**

pressure immediately outside the enclosure boundary

## 3.8

**enclosure strength**

specified differential pressure limit for the protected enclosure

## 3.9

**pressure-relief area**

sum of the free pressure-relief vent area and the enclosure leakage area

## 3.10

**pressure-relief vent**

device that provides a flow path through an enclosure boundary to limit the pressure therein

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## 4 Symbols and abbreviated terms

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$A_N$  pressure-relief vent area to limit negative pressure to a specified  $P_N$ , cm<sup>2</sup> (in<sup>2</sup>)

$A_P$  pressure-relief vent area to limit positive pressure to a specified  $P_P$ , cm<sup>2</sup> (in<sup>2</sup>)

$C$  agent design concentration, in percent by volume

$M_{AIR}$  is the molecular weight of air = 0,029 (kg/mol)

$M_{AGT}$  the molecular weight of the agent, (kg/mol)

$Q$  minimum design quantity of agent (kg)

$P$  pressure (Pa)

$P_N$  negative pressure, psf (Pa)

$P_P$  positive pressure, psf (Pa)

$P_N$  and  $P_P$  represent either

— Design pressure limits for estimating  $A_N$  or  $A_P$ , or

— Estimates of maximum values of  $P_N$  or  $P_P$  for given values of  $A_N$  or  $A_P$

$R$  gas law constant, 8,314 (J/mol-K)

% RH relative humidity in hazard space at 21 °C (70 °F), %

|          |   |
|----------|---|
| $s$      | the specific volume of the agent at the design temperature ( $\text{m}^3/\text{kg}$ )                                   |
| $s_H$    | the specific volume of the homogenous agent-air mixture ( $\text{m}^3/\text{kg}$ ), which is the inverse of the density |
| $t$      | agent discharge time, s   |
| $V$      | the volume of the protected space ( $\text{m}^3$ )  |
| $\rho_H$ | agent-air mixture density ( $\text{kg}/\text{m}^3$ )  |

## 5 Use and limitations

This document is for the use by those competent in the design, installation, servicing, and maintenance of fixed gaseous firefighting systems. It also serves as guidance for those involved in the design, construction, and operation of buildings in which such systems are installed.

It does not replace the need for the person responsible for the design, construction, and operation of the building to fulfil their obligations in respect to providing adequate structural provisions.

There may be other trades and services involved in the complete system and the document is limited to providing the guidance outlined in the document and does not purport to be an expert in all areas.

After applying the enclosure peak pressure and pressure-relief vent area analysis of this document, the user may conclude that an enclosure may require additional pressure-relief vent area to avoid exceeding specified maximum pressure values upon discharge of a gaseous agent system. If that is the case, it is recommended that the user advise the supplier of a supplemental venting device that such device be specified and selected by use of this document.

The maximum pressure developed in an enclosure on the discharge of a clean agent fire extinguishing system is affected by several characteristics of the system itself and the enclosure being protected. Of particular importance are the thermodynamic properties of the agent and the discharge characteristics of the hardware. Each of the following sections contains correlation equations that are specific to the agent type and manufacturer's hardware. The equations can be used to make estimates of the following:

- enclosure pressure-relief vent area given a specified enclosure pressure limit;
- maximum positive or negative pressure developed in an enclosure given a stated or calculated pressure-relief vent area.

**NOTE** The formulae in this document for halocarbon agents have a limited range of applicability based on the parametric limitations of the data from which they were derived. [Table 1](#) indicates the applicable limits of design concentration, discharge time, and enclosure pressure response for the use of this document. The maximum peak pressure estimates (both positive and negative) based on data obtained for each agent are given in [Table 1](#).

**Caution:** It is physically possible to develop pressures greater than those covered by this document during system discharges.

**Table 1 — Summary of equation application limits**

| Agent     | Minimum agent Conc % vol | Maximum agent Conc % vol | Minimum discharge time | Maximum discharge time | Maximum over-pressure pfs (Pa) | Maximum under pressure pfs (Pa) |
|-----------|--------------------------|--------------------------|------------------------|------------------------|--------------------------------|---------------------------------|
| FK-5-1-12 | 4,2                      | 6                        | 6                      | 10                     | 5 (239)                        | 25 (1 197)                      |
| HFC-23    | 18                       | 30                       | 6                      | 10                     | 30 (1 437)                     | n/a                             |
| HFC-125   | 8                        | 10,5                     | 6                      | 10                     | 10 (479)                       | 10 (479)                        |
| HFC-227ea | 6,25                     | 10,5                     | 6                      | 10                     | 8 (383)                        | 20 (958)                        |

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## 6 Safety

### 6.1 Structural safety

The provision of correctly designed and engineered pressure venting of enclosures protected by gaseous fire-extinguishing systems is essential to prevent the possibility of failure of structural integrity. This is essential to mitigate forces exerted by the changes in enclosure pressure when gaseous fighting media are discharged into an enclosure.

### 6.2 Personnel safety

The operation of pressure-relief vents or extract systems requires the displacement of mixtures of air/gaseous media from a protected enclosure to the atmosphere or another area not necessarily protected. The safety issue may arise due to exposures to the extinguishants themselves or products of combustion and/or extinguishant breakdown products. Also, any hazards arising from the operation of the over/under pressurization vents themselves should be considered.

## 7 System design — Pressure-relief venting

### 7.1 General

The basic design principle is to limit the pressure excursions imposed on the structure of the protected enclosure by the discharge of gaseous extinguishant to that within the limits the enclosure can withstand.

A room integrity test can be used to determine the equivalent leakage area, or simply the "vent" area that exists at the time of evaluation. The methods of this document can use the known or estimated pressure-relief vent area to estimate the maximum pressure that will be developed on the discharge of a clean agent system. If the estimated maximum pressure exceeds a specified design threshold, the methods of this document may be used to estimate a pressure-relief vent area sufficient to limit the development of pressure upon system discharge to an acceptable value.

### 7.2 Extinguishant characteristics

Consideration should be given to positive pressurization created by all extinguishants and additionally to negative pressurization created by some extinguishants as defined in [Table 2](#).

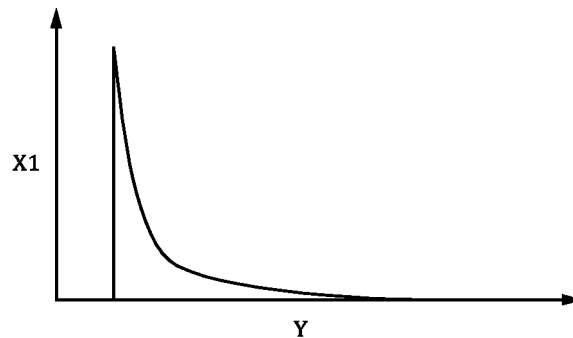
**Table 2 — Pressure effects of gaseous extinguishant**

| Extinguishant name | Positive pressure created | Negative pressure created |
|--------------------|---------------------------|---------------------------|
| FK-5-1-12          | Yes                       | Yes                       |
| HFC-125            | Yes                       | Yes                       |
| HFC-227ea          | Yes                       | Yes                       |
| HFC-23             | Yes                       | No                        |
| IG 01              | Yes                       | No                        |
| IG 100             | Yes                       | No                        |
| IG 55              | Yes                       | No                        |
| IG 541             | Yes                       | No                        |
| CO <sub>2</sub>    | Yes                       | No <sup>1</sup>           |

NOTE Negative pressure has been observed, with adverse effects. It can occur in certain cases where large quantities of CO<sub>2</sub> are released into a space having low leakage to ambient.

### 7.2.1 Pressure graphs

The graphs below illustrate the typical pressure excursions that would occur during discharge within the protected area. See [Figure 1](#) below.

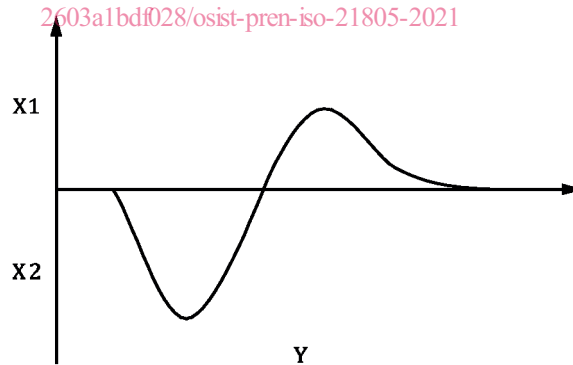


a) Inert gas



b) Inert gas (constant flow)

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c) Halocarbon gas

#### Key

X1 positive pressure

X2 negative pressure

Y time: (a): inert gas, (b): inert gas (constant flow), (c): halocarbon gas

**Figure 1 — Typical pressure excursions**

### 7.3 Enclosure characteristics

It is the client's responsibility and not the fire protection system supplier to determine room strength. The client should advise the allowable pressure differential the protected enclosures can withstand without sustaining damage.