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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



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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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).

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).

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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.

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

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.

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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_{MAX}) 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_{MAX} values were graphically analysed and a best-fit correlation curve was determined.

The LVR vs. P_{MAX} correlation curve for each agent or system forms the basis of the associated equations in cases where 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

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

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 indicates 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 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. In order to limit the rate of gas exchange the enclosure boundary should have a high degree of integrity. To put it another way, the sum 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 extinguishant discharge.

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 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.