TECHNICAL SPECIFICATION

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Gaseous media fire-extinguishing systems — Area coverage fire test procedure — Engineered and pre-engineered extinguishing units

Systèmes d'extinction d'incendie utilisant des agents gazeux — Mode opératoire de couverture de la zone enflammée — Unités extinctrices centralisées et modulaires

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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.

ISO/TS 20885 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 8, *Gaseous media fire extinguishing systems*.

Introduction

The need for the tests specified in this Technical Specification arises from the fact that the Class A fire test currently used, which employs wood crib, heptane pan and heptane can test fires in an enclosure of 100 m^3, may not indicate extinguishing concentrations suitable for the protection of plastics fuel hazards such as may be encountered in electronic data processing, telecommunications and process control facilities.

The test protocol which forms the subject of this Technical Specification was developed by a special working group of ISO/TC 21/SC 8. It comprises tests for determination of the extinguishing concentrations and system performance, and is designed to allow individual installers to use their system and to carry out all of the extinguishing tests themselves. Different extinguishing concentrations are proposed that may result from tests involving the same fuel/agent combination; in addition different nozzles and nozzle heights are used in order to reflect various room heights and fire behaviour. Owing to the fact that the given extinguishing concentrations for each agent are only dependent on fuel and not on the type of system, the working group proposes to separate the agent tests (determination of extinguishing concentrations) from the system tests.

In the future, ISO/TC 21/SC 8 intends to restructure the current Annex C of ISO 14520-1:2000, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 1: General requirements* to include polymeric sheet fuel arrays [polymethyl methacrylate (PMMA), polypropylene (PP) and acrylonitrile-butadiene-styrene (ABS)] and polyvinyl chloride (PVC) cable arrays (heptane pan ignited).

Gaseous media fire-extinguishing systems — Area coverage fire test procedure — Engineered and pre-engineered extinguishing units

1 Scope

This Technical Specification specifies a test method for determination of the extinguishing concentrations and system performance of engineered or pre-engineered extinguishing system units designed to mix and distribute the extinguishant, and to totally flood the enclosure.

It is designed to allow individual installers to use their system and to carry out all of the extinguishing tests themselves.

2 Application

2.1 When tested in accordance with the requirements contained in 5.1, 5.2 and 6.2, an extinguishing system unit shall extinguish all visible flaming within 30 s after the end of extinguishant discharge. When tested in accordance with the requirements contained in 6.1 an extinguishing system unit shall extinguish all visible flaming and prevent re-ignition of the fires after a 10 min soak period (also measured from the end of extinguishant discharge). When tested in accordance with the requirements contained in 6.3 and 6.4 an extinguishing system unit shall extinguish all visible flaming within 60 s after the end of extinguishant discharge. The system unit shall also prevent re-ignition of the fires after a 10 min soak period (also measured from the end of extinguishant discharge).

NOTE The 60 s time limit for “no flaming” is provisional. At the time of preparation of this Technical Specification there was no published information providing details of the manner of extinguishment of plastics fires test articles. One laboratory reports that upon discharge of an HFC agent at the same concentration which satisfactorily extinguishes the wood crib test article, the following behaviour of the plastic was observed.

a) The flame size was reduced within 1 min to a very small edge-effect flame measuring approximately 20 mm to 30 mm in size.

b) The time at which the edge-effect flame became extinguished varies but may be longer than 60 s.

c) The edge-effect flame on the plastic test articles is analogous to the persistent smouldering observed to be in effect during the post-flame-out period of the wood crib test (see 6.1.2 to 6.1.4).

d) The 10 min hold period allows the hot test article, wood or plastic, to cool to the point where the low-level combustion reactions cease.

2.2 The tests described in this Technical Specification take into consideration the intended use and limitations of the extinguishing system unit with specific reference to

a) the area coverage for each type of nozzle,

b) the operating temperature range of the system,

c) the location of nozzles in the protected area,

d) either the maximum length and size of piping and number of fittings to each nozzle, or the minimum nozzle pressure,

e) the maximum discharge time,

f) the maximum fill density, and

g) the extinguishing concentrations for specific fuels.

Details of the tests are given in Table 1.

Table 1 — Test objectives and details

Test objective	Enclosure size	Test fires	Subclause
Nozzle distribution verification			
Nozzles minimum height/maximum area coverage	to suit nozzle	heptane test cans	5.1
Nozzles maximum height	$\geqslant$100 m^3 no side less than 4 m in height, to suit nozzle	heptane test cans	5.2
Extinguishing concentration	$\geqslant$100 m^3 height, h: 3,5 m $\leqslant h \leqslant$ 4 m	a) wood crib b) heptane c) polymeric sheet i) PMMA ii) PP iii) ABS d) PVC cable tray	6.1 6.2 6.3 6.4

3 Extinguishing system

3.1 For the extinguishing tests described in 5.1 and 5.2, the agent containers shall be conditioned to the minimum operating temperature specified in the manufacturer's installation instructions.

The extinguishing system shall be assembled as follows:

a) *pre-engineered-type extinguishing system unit* — using the maximum piping limitations with respect to the number of fittings and length of pipe to the discharge nozzles and nozzle configuration(s) as specified in the manufacturer's design and installation instructions;

b) *engineered-type extinguishing system unit* — using a piping arrangement that results in the minimum nozzle design pressure at 20 °C $^{+2}_{0}$ °C.

3.2 For the extinguishing tests described in 6.1, 6.2, 6.3 and 6.4, the agent containers shall be conditioned at 20 °C ± 2 °C for a minimum period of 16 h prior to conducting the test. In these tests the jet energy from the nozzles shall not influence the development of the fire. Therefore the nozzle(s) shall direct agent parallel to the test enclosure ceiling.

3.3 For all tests, the extinguishing system shall be arranged and dimensioned with regard to the following.

For liquefied extinguishants, the time for the discharge of the pre-liquid gas phase plus the two-phase flow shall be 8 s to 10 s.

For non-liquefied extinguishants, the discharge time shall be 50 s to 60 s, limited by cutting off the discharge with an appropriate means positioned close to the nozzle.

4 Extinguishing concentration

4.1 The extinguishing concentration for each test shall be 76,9 % (i.e. 100 divided by the safety factor, where the safety factor is 1,3) of the intended end use design concentration specified in the manufacturer's design and installation instructions at an ambient temperature of approximately 20 °C within the enclosure. In the tests described in 5.1 and 5.2, the same extinguishing concentration shall be used as in the test described in 6.2.

The quantity to reach the concentration within the enclosure can be established using Equation (1).

4.2 A cold discharge test using the same quantity of extinguishant shall be conducted to verify the actual concentration of extinguishant.

For liquefied extinguishants, the agent concentration shall be measured in the cold discharge test.

For non-liquefied extinguishants, the agent concentration or alternatively the oxygen concentration shall be measured. The extinguishant concentration is then calculated from the oxygen concentration using the following formula:

$$\varphi_E = 100\left(1 - \frac{\varphi_{O_2}}{20,9}\right) \quad (1)$$

where

φ_E is the extinguishant concentration, expressed as a volume fraction in percent;

φ_{O_2} is the oxygen concentration measured in the test enclosure, expressed as a volume fraction in percent.

5 Nozzle distribution verification tests

5.1 Nozzles minimum height/maximum area coverage test

5.1.1 Test facility

5.1.1.1 Construction

The test enclosure shall meet the following requirements.

a) The area (ab) and height (h) of the enclosure (see Figure 1) shall correspond to the maximum nozzle area coverage and minimum nozzle height respectively specified by the manufacturer.

b) A means of pressure relief shall be provided.

c) Closable openings shall be provided directly above the test cans to allow for venting prior to system actuation.

d) One baffle shall be installed between the floor and the ceiling (at height h), halfway between the nozzle location and one of the corners of the enclosure (Figure 1 illustrates a 360° nozzle and Figure 2 illustrates a 180° nozzle). The baffle shall be perpendicular to the line connecting the nozzle location and the enclosure corner (see Figures 1 and 2), and shall have a length equal to 20 % of the length of the short wall of the enclosure.

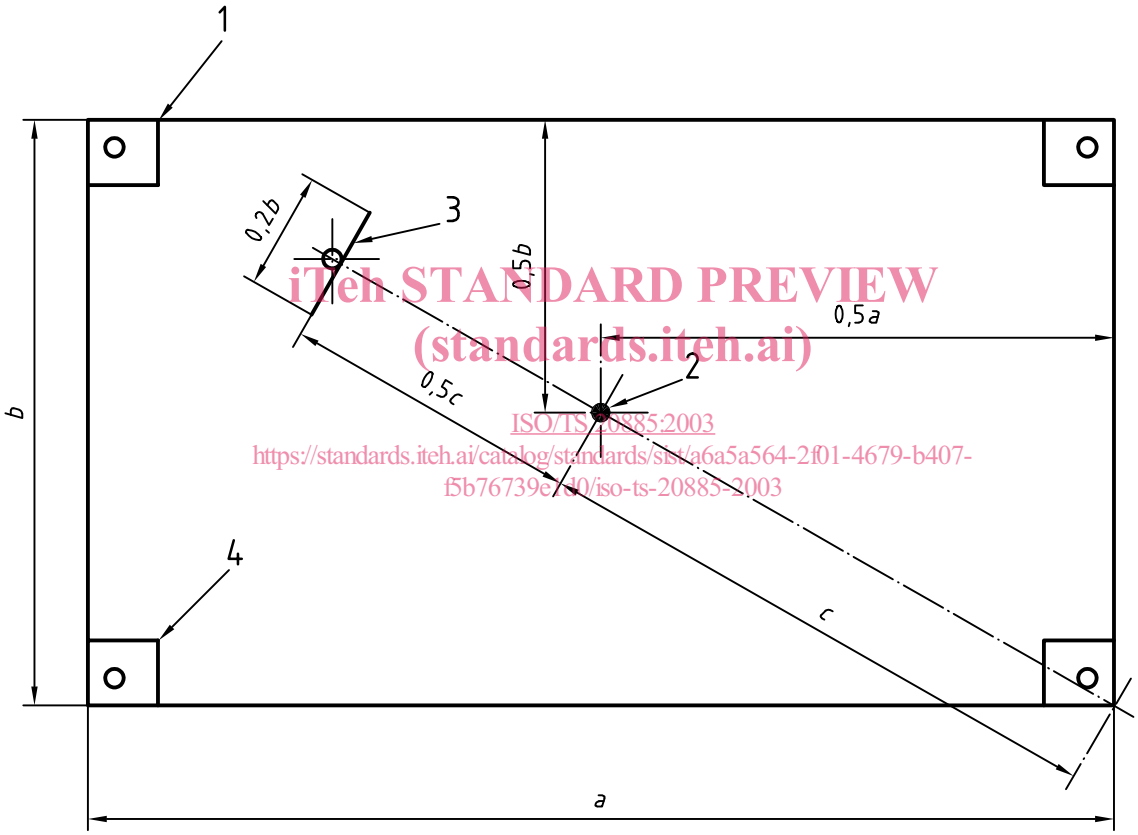
5.1.1.2 Instrumentation

5.1.1.2.1 Oxygen concentration

The sampling and storage of data from the sensors described in this subclause shall occur at a rate of at least 4 Hz.

The oxygen concentration shall be measured using a calibrated oxygen analyser capable of measuring the percentage oxygen to within at least one decimal place (0,1 %). The sensing equipment shall be capable of continuously monitoring and recording the oxygen concentration inside the enclosure throughout the duration of the test. The accuracy of the measuring devices shall not be influenced by any of the fire products.

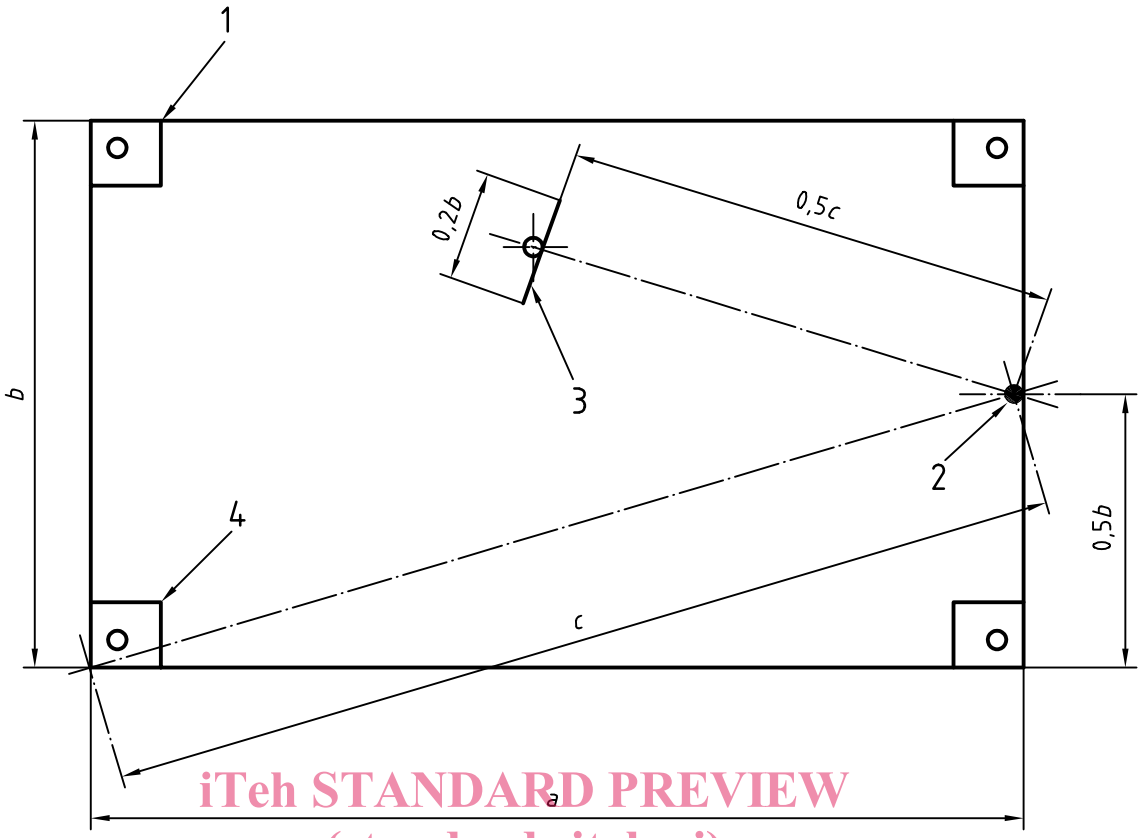
Three sensors shall be located within the enclosure (see Figure 3). They shall be located at a distance of 850 mm to 1 250 mm from the centre of the room and at the following heights above the floor: 0,1h, 0,5h and 0,9h (where h is the height of the enclosure).



Key

h minimum nozzle height specified by manufacturer
ab maximum nozzle area coverage for a single nozzle
1 test cans
2 nozzle
3 baffle
4 vents

Figure 1 — Example configuration for nozzles minimum height/maximum area coverage test for 360° nozzles



Key

h minimum nozzle height specified by manufacturer

ab maximum nozzle area coverage for a single nozzle

1 test cans

2 nozzle

3 baffle

4 vents

Figure 2 — Example configuration for nozzles minimum height/maximum area coverage test for 180° nozzles

5.1.1.2.2 Carbon dioxide (CO_2) and carbon monoxide (CO) concentration

The CO_2 concentration should be monitored.

Fire products such as CO and CO_2 shall not influence the evaluation of the extinguishing capacity of the investigated extinguishing gas.

5.1.1.2.3 Nozzle pressure

The nozzle pressure during system discharge shall be recorded by a pressure transducer in the pipe work at a distance not greater than 1 m from the nozzle.

5.1.1.2.4 Enclosure temperature

The temperature shall be measure at a position located 850 mm to 1 250 mm horizontally from the centre of the room and at a height 0,5*h* above the floor (see Figure 3).

It is recommended to use K-type thermocouples (Ni-CrNi) of 1 mm diameter.