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Gaseous fire-extinguishing systems - Physical properties and system design - Part 1: General requirements

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**Gaseous fire-extinguishing systems —
Physical properties and system design —**

**Part 1:
General requirements**

*Systèmes d'extinction d'incendie utilisant des agents gazeux —
Propriétés physiques et conception des systèmes —*

Partie 1: Exigences générales

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Contents

Page

1	Scope	1
2	Normative references	2
3	Terms and definitions	2
4	Use and limitations	5
5	Safety	7
6	System design	10
7	Extinguishant system design	16
8	Commissioning and acceptance	24
9	Inspection, maintenance, testing and training	27
	Annex A (normative) Working documents	30
	Annex B (normative) Determination of flame-extinguishing concentration of gaseous extinguishants by the cup burner method	32
	Annex C (normative) Fire extinguishment/area coverage fire test procedure for engineered and pre-engineered extinguishing units	38
	Annex D (normative) Method of evaluating inerting concentration of a fire extinguishant	58
	Annex E (normative) Door fan test for determining of minimum hold time	60
	Annex F (informative) System performance verification	75
	Annex G (informative) Safe personnel exposure guidelines	76
	Annex H (informative) Flow calculation implementation method and flow calculation verification and testing for approvals	83

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.

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 14520-1 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*.

This second edition cancels and replaces the first edition (ISO 14520-1:2000), which has been technically revised.

Annex C has been extensively revised to include polymeric sheet fuel array fire tests [polymethyl methacrylate (PMMA)], [polypropylene (PP)] and [acrylonitrile-butadiene-styrene (ABS)]. These tests are designed to more closely represent plastic fuel hazards such as may be encountered in information technology, telecommunications and process control facilities.

Annex E has been re-structured to accommodate lighter-than-air gases and to provide means for dealing with non-standard (as opposed to geometrically regular) hazard enclosures.

Also incorporated in this revision of ISO 14520-1 are safe personnel exposure guidelines. Annex G, recognizing physiologically based pharmacokinetic (PBPK) modelling and hypoxic guidelines to define safe human exposure limits.

ISO 14520 consists of the following parts, under the general title *Gaseous fire-extinguishing systems — Physical properties and system design*:

- Part 1: General requirements
- Part 2: CF_3I extinguishant
- Part 5: FK-5-1-12 extinguishant
- Part 6: HCFC Blend A extinguishant
- Part 8: HFC 125 extinguishant
- Part 9: HFC 227ea extinguishant
- Part 10: HFC 23 extinguishant
- Part 11: HFC 236fa extinguishant
- Part 12: IG-01 extinguishant
- Part 13: IG-100 extinguishant

- *Part 14: IG-55 extinguishant*
- *Part 15: IG-541 extinguishant*

Parts 3, 4 and 7, which dealt with FC-2-1-8, FC-3-1-10 and HCFC 124 extinguishants, respectively, have been withdrawn, as these types are no longer manufactured.

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Introduction

Fire fighting systems covered in this part of ISO 14520 are designed to provide a supply of gaseous extinguishing medium for the extinction of fire.

Several different methods of supplying extinguishant to, and applying it at, the required point of discharge for fire extinction have been developed in recent years, and there is a need for dissemination of information on established systems and methods. This part of ISO 14520 has been prepared to meet this need.

In particular, new requirements to eliminate the need to release extinguishants during testing and commissioning procedures are included. These are linked to the inclusion of enclosure integrity testing.

The requirements of this part of ISO 14520 are made in the light of the best technical data known to the working group at the time of writing but, since a wide field is covered, it has been impracticable to consider every possible factor or circumstance that might affect implementation of the recommendations.

It has been assumed in the preparation of this part of ISO 14520 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.

Attention is drawn to the Montreal Protocol on substances that deplete the ozone layer.

It is important that the fire protection of a building or plant be considered as a whole. Gaseous extinguishant systems form only a part, though an important part, of the available facilities, but it should not be assumed that their adoption necessarily removes the need to consider supplementary measures, such as the provision of portable fire extinguishers or other mobile appliances for first aid or emergency use, or to deal with special hazards.

Gaseous extinguishants have for many years been a recognized effective medium for the extinction of inflammable liquid fires and fires in the presence of electrical and ordinary Class A hazards, but it should not be forgotten, in the planning of comprehensive schemes, that there may be hazards for which these media are not suitable, or that in certain circumstances or situations there may be dangers in their use requiring special precautions.

Advice on these matters can be obtained from the appropriate manufacturer of the extinguishant or the extinguishing system. Information may also be sought from the appropriate fire authority, the health and safety authorities and insurers. In addition, reference should be made as necessary to other national standards and statutory regulations of the particular country.

It is essential that fire fighting equipment be carefully maintained to ensure instant readiness when required. Routine maintenance is liable to be overlooked or given insufficient attention by the owner of the system. It is, however, neglected at peril to the lives of occupants of the premises and at the risk of crippling financial loss. The importance of maintenance cannot be too highly emphasized. Installation and maintenance should only be done by qualified personnel.

Inspection preferably by a third party, should include an evaluation that the extinguishing system continues to provide adequate protection for the risk (protected zones as well as state of the art can change over time).

The test protocol contained in Annex C of this part of ISO 14520 was developed by a special working group of ISO/TC 21/SC 8. Annex C deals with the tests for determination of the extinguishing concentrations and system performance and they are designed in such a way to allow individual installers to use his/her system and carry out all of the extinguishing tests. The need for the tests presented in Annex C was established by the fact that the previously used Class A fire test involved wood crib, heptane pan and heptane can test fires in an enclosure of 100 m³, and did not necessarily indicate extinguishing concentrations suitable for the protection of plastic fuel

hazards such as may be encountered in information technology, telecommunications and process control facilities.

As a consequence of the above, the current Annex C of this part of ISO 14520 has been revised as described in the Foreword.

Specific parts 3, 4 and 7 have been withdrawn on the basis that the extinguishing media have not been commercialized, and a new agent specific part 5 has been introduced to cover FK-5-1-12 (dodecafluoro-2-methylpentan-3-one) systems.

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Gaseous fire-extinguishing systems — Physical properties and system design —

Part 1: General requirements

1 Scope

This part of ISO 14520 specifies requirements and gives recommendations for the design, installation, testing, maintenance and safety of gaseous fire fighting systems in buildings, plant or other structures, and the characteristics of the various extinguishants and types of fire for which they are a suitable extinguishing medium.

It covers total flooding systems primarily related to buildings, plant and other specific applications, utilizing electrically non-conducting gaseous fire extinguishants that do not leave a residue after discharge and for which there are sufficient data currently available to enable validation of performance and safety characteristics by an appropriate independent authority. This part of ISO 14520 is not applicable to explosion suppression.

This part of ISO 14520 is not intended to indicate approval of the extinguishants listed therein by the appropriate authorities, as other extinguishants may be equally acceptable. CO₂ is not included as it is covered by other International Standards.

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This part of ISO 14520 is applicable to the extinguishants listed in Table 1. It is essential that it be used in conjunction with the separate parts of ISO 14520 for specific extinguishants, as cited in Table 1.

Table 1 — Listed extinguishant

Extinguishant	Chemical	Formula	CAS No.	International Standard
CF ₃ I	Trifluoriodomethane	CF ₃ I	2314-97-8	ISO 14520-2
FK-5-1-12	Dodecafluoro-2-methylpentan-3-one	CF ₃ CF ₂ C(O)CF(CF ₃) ₂	756-13-8	ISO 14520-5
HCFC Blend A				
HCFC-123	Dichlorotrifluoroethane	CHCl ₂ CF ₃	306-83-2	ISO 14520-6
HCFC-22	Chlorodifluoromethane	CHClF ₂	75-45-6	
HCFC-124	Chlorotetrafluoroethane	CFCIFCF ₃	2837-89-0	
	Isopropenyl-1-methylcyclohexene	C ₁₀ H ₁₆	5989-27-5	
HFC 125	Pentafluoroethane	CHF ₂ CF ₃	354-33-6	ISO 14520-8
HFC 227ea	Heptafluoropropane	CF ₃ CHFCF ₃	2252-84-8	ISO 14520-9
HFC 23	Trifluoromethane	CHF ₃	75-46-7	ISO 14520-10
HFC 236fa	Hexafluoropropane	CF ₃ CH ₂ CF ₃	27070-61-7	ISO 14520-11
IG-01	Argon	Ar	74040-37-1	ISO 14520-12
IG-100	Nitrogen	N ₂	7727-37-9	ISO 14520-13
	Nitrogen (50 %)	N ₂	7727-37-9	ISO 14520-14
IG-55	Argon (50 %)	Ar	74040-37-1	
	Nitrogen (52 %)	N ₂		
IG-541	Argon (40 %)	Ar	74040-37-1	ISO 14520-15
	Carbon dioxide (8 %)	CO ₂	124-38-9	

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.

ISO 3941, *Classification of fires*

ISO 5660-1, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 1: Heat release rate (cone calorimeter method)*

ISO 14520-2, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 2: CF₃I extinguishant*

ISO 14520-5, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 5: FK-5-1-12 extinguishant*

ISO 14520-6, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 6: HCFC Blend A extinguishant*

ISO 14520-8, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 8: HFC 125 extinguishant*

ISO 14520-9, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 9: HFC 227ea extinguishant*

ISO 14520-10, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 10: HFC 23 extinguishant*

ISO 14520-11, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 11: HFC 236fa extinguishant*

ISO 14520-12, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 12: IG-01 extinguishant*

ISO 14520-13, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 13: IG-100 extinguishant*

ISO 14520-14, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 14: IG-55 extinguishant*

ISO 14520-15, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 15: IG-541 extinguishant*

ASTM E1354-04a, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*

3 Terms and definitions

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

NOTE For the purposes of this document, the term “bar” shall be taken as “gauge”, unless otherwise indicated. Concentrations or quantities expressed in percentages (%) shall be taken as by volume, unless otherwise indicated.

3.1

approved

acceptable to a relevant authority (see 3.2)

NOTE In determining the acceptability of installations or procedures, equipment or materials, the authority can base acceptance on compliance with the appropriate standards.

3.2**authority**

organization, office or individual responsible for approving equipment, installations or procedures

3.3**automatic/manual switch**

means of converting the system from automatic to manual actuation

NOTE This can be in the form of a manual switch on the control panel or other units, or a personnel door interlock. In all cases, this changes the actuation mode of the system from automatic and manual to manual only or vice versa.

3.4**extinguishant**

electrically non-conducting gaseous fire extinguishant that, upon evaporation, does not leave a residue (see Table 1)

3.5**clearance**

air gap between equipment, including piping and nozzles and unenclosed or uninsulated live electrical components at other than ground potential

3.6 Concentration**3.6.1****design concentration**

concentration of extinguishant, including a safety factor, required for system design purposes

3.6.2**maximum concentration**

concentration achieved from the actual extinguishant quantity at the maximum ambient temperature in the protected area

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3.6.3**extinguishing concentration**

minimum concentration of extinguishant required to extinguish a fire involving a particular fuel under defined experimental conditions excluding any safety factor

3.7**engineered system**

system in which the supply of extinguishant stored centrally is discharged through a system of pipes and nozzles in which the size of each section of pipe and nozzle orifice has been calculated in accordance with relevant parts of ISO 14520

3.8**fill density**

mass of extinguishant per unit volume of container

3.9**flooding quantity**

mass or volume of extinguishant required to achieve the design concentration within the protected volume

3.10**nett volume**

volume enclosed by the building elements around the protected enclosure, minus the volume of any permanent impermeable building elements within the enclosure

3.11**hold time**

period of time during which a concentration of extinguishant greater than the fire extinguishing concentration surrounds the hazard

3.12

inspection

visual check to give reasonable assurance that the extinguishing system is fully charged and operable

NOTE This is done by seeing that the system is in place, that it has not been activated or tampered with, and that there is no obvious physical damage or condition to prevent operation.

3.13

liquefied gas

gas or gas mixture (normally a halocarbon) which is liquid at the container pressurization level at room temperature (20 °C)

3.14

lock-off device

manual shut-off valve installed in the discharge piping downstream of the agent containers or another type of device that mechanically prevents agent container actuation

NOTE 1 The actuation of this device provides an indication of system isolation.

NOTE 2 The intent is to prevent the discharge of agent into the hazard area when the lock-off device is activated.

3.15

lowest observed adverse effect level

LOAEL

lowest concentration at which an adverse toxicological or physiological effect has been observed

3.16

maintenance

thorough check, comprising a thorough examination and any necessary repair or replacement of system component, to give maximum assurance that the extinguishing system will operate as intended

3.17

maximum working pressure

equilibrium pressure within a container at the maximum working temperature

NOTE 1 For liquefied gases this is at the maximum fill density and can include superpressurization.

NOTE 2 The equilibrium pressure for a container in transit can differ from that in storage within a building.

3.18

no observed adverse effect level

NOAEL

highest concentration at which no adverse toxicological or physiological effect has been observed

3.19

non-liquefied gas

gas or gas mixture (normally an inert gas) which, under service pressure and permissible service temperature conditions, is always present in the gaseous form

3.20

normally occupied area

area intended for occupancy

3.21

normally unoccupied area

area not normally occupied by people but which may be entered occasionally for brief periods

3.22**pre-engineered systems**

system consisting of a supply of extinguishant of specified capacity coupled to pipework with a balanced nozzle arrangement up to a maximum permitted design

NOTE No deviation is permitted from the limits specified by the manufacturer or authority.

3.23**safety factor**

multiplier of the agent extinguishing concentration to determine the agent minimum design concentration

3.24**sea level equivalent of agent**

the agent concentration (volume percent) at sea level for which the partial pressure of agent matches the ambient partial pressure of agent at a given altitude

3.25**sea level equivalent of oxygen**

the oxygen concentration (volume percent) at sea level for which the partial pressure of oxygen matches the ambient partial pressure of oxygen at a given altitude

3.26**selector valve**

valve installed in the discharge piping downstream of the agent containers, to direct the agent to the appropriate hazard enclosure

NOTE It is used where one or more agent containers are arranged in order to selectively discharge agent to any of several separate hazard enclosures.

3.27**superpressurization**

addition of a gas to the extinguishant container, where necessary, to achieve the required pressure for proper system operation

3.28**total flooding system**

system arranged to discharge extinguishant into an enclosed space to achieve the appropriate design concentration

3.29**unoccupiable area**

area which cannot be occupied due to dimensional or other physical constraints

EXAMPLE Shallow voids and cabinets.

4 Use and limitations**4.1 General**

Throughout this part of ISO 14520 the word "shall" indicates a mandatory requirement; the word "should" indicates a recommendation or that which is advised but not required.

The design, installation, service and maintenance of gaseous fire-extinguishing systems shall be performed by those competent in fire extinguishing system technology. Maintenance and installation shall only be done by qualified personnel and companies.

The hazards against which these systems offer protection, and any limitations on their use, shall be contained in the system supplier's design manual.