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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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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).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 8, *Gaseous media and firefighting systems using gas*.

This third edition cancels and replaces the second edition (ISO 14520-1:2006), which has been technically revised. It also incorporates ISO 14520-1:2006/Cor 1:2007 and ISO/TS 20885:2003.

This corrected version of ISO 14520-1:2015 incorporates the following corrections.

Foreword: the details of documents that ISO 14520-1:2015 cancels and replaces have been amended.

7.6.3: the numerator within brackets in Formula 4 has been corrected (from *C* to 100).

C.4.1: the numerator within brackets in Formula C.2 has been corrected (from *C* to 100).

The most important changes in the third edition are as follows.

Methods are given to calculate the effects of atmospheric pressure on the inert gases.

The discharge time for inert gas agents has been increased from a maximum of 60 seconds to a maximum of 120 seconds for the protection of Class A hazards.

The height at which agent concentrations are to be held following a discharge, and during the hold time, has been revised to reflect the height of the protected hazard replacing the previous requirement of 10%, 50% and 90% of the enclosure height.

Annexes B, C and E have been modified to reflect experience gained in the areas covered by these Annexes, since the last edition.

Annex H has been amended to reflect the content of what was previously ISO/TS 13075.

Certain environmental data has been added in the specific agents parts of ISO 14520 and an explanation and advice on where additional information can be found has been added as Clause 4.2.1.

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: CF3I 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*

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.

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).

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, plants 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, plants 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. CO_2 is not included as it is covered by other International Standards.

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_3I	Trifluoroiodomethane	CF_3I	2314-97-8	ISO 14520-2
FK-5-1-12	Dodecafluoro-2-methylpentan-3-one	$CF_3CF_2C(O)CF(CF_3)_2$	756-13-8	ISO 14520-5
HCFC Blend A				
HCFC-123	Dichlorotrifluoroethane	$CHCl_2CF_3$	306-83-2	
HCFC-22	Chlorodifluoromethane	$CHClF_2$	75-45-6	ISO 14520-6
HCFC-124	Chlorotetrafluoroethane	$CFClFCF_3$	2837-89-0	
	Isopropenyl-1-methylcyclohexene	$C_{10}H_{16}$	5989-27-5	
HFC 125	Pentafluoroethane	CHF_2CF_3	354-33-6	ISO 14520-8
HFC 227ea	Heptafluoropropane	CF_3CHFCF_3	2252-84-8	ISO 14520-9
HFC 23	Trifluoromethane	CHF_3	75-46-7	ISO 14520-10
HFC 236fa	Hexafluoropropane	$CF_3CH_2CF_3$	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	
IG-55	Argon (50 %)	Ar	74040-37-1	ISO 14520-14

Table 1 *(continued)*

Extinguishant	Chemical	Formula	CAS No.	International Standard
IG-541	Nitrogen (52 %)	N_2	7727-37-9	ISO 14520-15
	Argon (40 %)	Ar	74040-37-1	
	Carbon dioxide (8 %)	CO2	124-38-9	

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

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

Note 1 to entry: See 3.2.

Note 2 to entry: In determining the acceptability of installations or procedures, equipment, or materials, the authority can base acceptance on compliance with the appropriate International 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 1 to entry: 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 extinguishing agent that, upon evaporation, does not leave a residue

Note 1 to entry: See Table 1.

Note 2 to entry: The terms "extinguishant" and "agent" are used interchangeably throughout in this part of ISO 14520.

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

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 1 to entry: 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 to entry: The actuation of this device provides an indication of system isolation.

Note 2 to entry: 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 to entry: For liquefied gases, this is at the maximum fill density and can include superpressurization.

Note 2 to entry: 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 1 to entry: No deviation is permitted from the limits specified by the manufacturer or authority.

3.23
regulated system
non-liquefied gas system where the pressure downstream of a pressure regulation device is limited to some maximum pressure under both flow and no flow conditions

3.24
safety factor
multiplier of the agent extinguishing concentration to determine the agent minimum design concentration

3.25
sea level equivalent of agent
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

3.26
sea level equivalent of oxygen
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

3.27
selector valve
valve installed in the discharge piping downstream of the agent containers, to direct the agent to the appropriate hazard enclosure

Note 1 to entry: It is used where one or more agent containers are arranged in order to selectively discharge agent to any of several separate hazard enclosures.

3.28
superpressurization
addition of a gas to the extinguishant container, where necessary, to achieve the required pressure for proper system operation

3.29
total flooding system
system arranged to discharge extinguishant into an enclosed space to achieve the appropriate design concentration

3.30
unoccupiable area
area that 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.

Total flooding fire-extinguishing systems are used primarily for protection against hazards that are in enclosures or equipment that, in itself, includes an enclosure to contain the extinguishant. The following are typical of such hazards, but the list is not exhaustive:

a) electrical and electronic hazards;

b) telecommunications facilities;

c) inflammable and combustible liquids and gases;

d) other high-value assets.

4.2 Extinguishants

Any agent that is to be recognized by this part of ISO 14520 or proposed for inclusion in this part of ISO 14520 shall first be evaluated in a manner equivalent to the process used by the U.S. Environmental Protection Agency’s (EPA) SNAP Programme or other internationally recognized extinguishing agent approval institutions.

The extinguishants referred to in this part of ISO 14520 are electrically non-conductive media.

The extinguishants and specialized system parameters are each covered individually in the parts of ISO 14520 for specific extinguishants. These parts shall be used in conjunction with this part of ISO 14520.

Unless relevant testing has been carried out to the satisfaction of the authority, the extinguishants referred to in the specific parts of ISO 14520 shall not be used on fires involving the following:

a) chemicals containing their own supply of oxygen, such as cellulose nitrate;

b) mixtures containing oxidizing materials, such as sodium chlorate or sodium nitrate;

c) chemicals capable of undergoing autothermal decomposition, such as some organic peroxides;

d) reactive metals (such as sodium, potassium, magnesium, titanium and zirconium), reactive hydrides, or metal amides, some of which may react violently with some gaseous extinguishants;

e) environments where significant surface areas exist at temperatures greater than the breakdown temperature of the extinguishing agent and are heated by means other than the fire.

4.2.1 Environmental properties

Global warming potential (GWP) and ozone depletion potential (ODP) values applicable to the gaseous extinguishing agents are detailed in ISO 14520-2 to ISO 14520-15.

NOTE GWP is a measure of how much a given mass of gas is estimated to contribute to global warming. The scale is a relative comparison on a mass basis where a clean agent is compared to carbon dioxide, which has a GWP equal to 1. ODP provides a relative comparison of the ability to react with ozone at altitudes within the stratosphere. ODP values are reported relative to the same mass of CFC-11, which has an ODP equal to 1. The intergovernmental panel on climate change (IPCC) and the Parties to the Montreal Protocol provide up to date environmental information on clean agent alternatives. Users of this part of ISO 14520 are encouraged to review the information provided by those organizations to understand the significance of the environmental properties of the agents in this part of ISO 14520.

The list of of compounds and their global warming potentials can be found at the IPCC site at: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html. The list of compounds and their ozone depletion potentials can be found at the Montreal Protocol site at: http://montreal-protocol.org/new_site/en/Treaties/treaties_decisions-hb.php?art_id=59,60,61,62,63.

4.3 Electrostatic discharge

Care shall be taken when discharging extinguishant into potentially explosive atmospheres. Electrostatic charging of conductors not bonded to earth may occur during the discharge of extinguishant. These conductors may discharge to other objects with sufficient energy to initiate an explosion. Where the system is used for inerting, pipework shall be adequately bonded and earthed.

4.4 Compatibility with other extinguishants

Mixing of extinguishants in the same container shall be permitted only if the system is approved for use with such a mixture.

Systems using the simultaneous discharge of different extinguishants to protect the same enclosed space shall not be permitted.

4.5 Temperature limitations

All devices shall be designed for the service they will encounter and shall not readily be rendered inoperative or susceptible to accidental operation. Devices normally shall be designed to function properly from -20 °C to +50 °C, or marked to indicate temperature limitations, or in accordance with manufacturers' specifications which shall be marked on the name-plate, or (where there is no name-plate) in the manufacturer's instruction manual.

5 Safety

5.1 Hazard to personnel

Any hazard to personnel created by the discharge of gaseous extinguishants shall be considered in the design of the system, in particular with reference to the hazards associated with particular extinguishants in the supplementary parts of ISO 14520. Unnecessary exposure to all gaseous extinguishants shall be avoided.

Adherence to ISO 14520 does not remove the user's statutory responsibility to comply with the appropriate safety regulations.

The decomposition products generated by the clean agent breaking down in the presence of very high degrees of heat can be hazardous. All of the present halocarbon agents contain fluorine. In the presence of available hydrogen (from water vapour, or the combustion process itself), the main decomposition product is hydrogen fluoride (HF).