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

Part 10:
HFC 23 extinguishant

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

Partie 10: Agent extincteur HFC 23

ICS: 13.220.10

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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.

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 14520-10 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 8, *Gaseous media fire fighting systems using gas*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

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

— *Part 1: General requirements*

— *Part 2: CF_3I extinguishant*

— *Part 3: Withdrawn*

— *Part 4: Withdrawn*

— *Part 5: FK-5-1-12 extinguishant*

— *Part 6: HCFC Blend A extinguishant*

— *Part 7: Withdrawn*

— *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*

Gaseous fire-extinguishing systems — Physical properties and systems design — Part 10: HFC 23 extinguishant

1 Scope

This part of ISO 14520 contains specific requirements for gaseous fire-extinguishing systems, with respect to the HFC 23 extinguishant. It includes details of physical properties, specification, usage and safety aspects and is applicable to systems operating at a nominal pressure of 41 bar without nitrogen superpressurization and 70 bar superpressurized with nitrogen.

2 Normative reference

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

3 Terms and definitions

For the purposes of this part of ISO 14520, the terms and definitions given in ISO 14520-1 apply.

4 Characteristics and uses

4.1 General

Extinguishant HFC 23 shall comply with the specification shown in Table 1.

HFC 23 is a colourless, almost odourless, electrically non-conductive gas with a density approximately 2,4 times that of air.

The physical properties are shown in Table 2.

HFC 23 extinguishes fires mainly by physical means, but by some chemical means.

Table 1 — Specification for HFC 23

Property	Requirement
Purity	99,6 % (mol/mol), min.
Acidity	3×10^{-6} by mass, max.
Water content	10×10^{-6} by mass, max.
Non-volatile residue	0,01 % by mass, max.
Suspended matter or sediment	None visible

Table 2 — Physical properties of HFC 23

Property	Units	Value
Molecular mass	—	70
Boiling point at 1,013 bar (absolute)	°C	–82,0
Freezing point	°C	–155,2
Critical temperature	°C	25,9
Critical pressure	bar abs	48,36
Critical volume	cm^3/mol	133
Critical density	kg/m^3	525
Vapour pressure 20 °C	bar abs	41,80
Liquid density 20 °C	kg/m^3	806,6
Saturated vapour density 20 °C	kg/m^3	263,0
Specific volume of superheated vapour at 1,013 bar and 20 °C	m^3/kg	0,3409
Chemical formula	CHF_3	
Chemical name	Trifluoromethane	

4.2 Use of HFC 23 systems

HFC 23 total flooding systems may be used for extinguishing fires of all classes within the limits specified in clause 4 of ISO 14520-1.

The extinguishant requirements per volume of protected space are shown in Table 3 for various levels of concentration. These are based on methods shown in 7.6 of ISO 14520-1.

The extinguishing concentrations and design concentrations for *n*-heptane and surface class A hazards are shown in Table 4. Concentrations for acetone heptane, methanol and toluene are shown in Table 5, and inerting concentrations are shown in Table 6.

Table 3 — HFC 23 total flooding quantity

Temperature T °C	Specific vapour volume S	HCFC 23 mass requirements per unit volume of protected space, m/V (kg/m³)									
		Design concentration (by volume)									
	m³/kg	10 %	12 %	14 %	15 %	16 %	17 %	18 %	20 %	22 %	24 %
–60	0,2428	0,4576	0,5616	0,6705	0,7268	0,7845	0,8436	0,9041	1,0297	1,1617	1,3006
–55	0,2492	0,4459	0,5472	0,6533	0,7081	0,7644	0,8219	0,8809	1,0032	1,1318	1,2672
–50	0,2555	0,4349	0,5337	0,6371	0,6907	0,7455	0,8016	0,8591	0,9785	1,1039	1,2360
–45	0,2617	0,4246	0,5211	0,6221	0,6743	0,7278	0,7826	0,8388	0,9553	1,0778	1,2067
–40	0,2680	0,4146	0,5088	0,6074	0,6585	0,7107	0,7643	0,8191	0,9328	1,0524	1,1783
–35	0,2742	0,4052	0,4973	0,5937	0,6436	0,6947	0,7470	0,8006	0,9117	1,0286	1,1517
–30	0,2803	0,3964	0,4865	0,5808	0,6296	0,6795	0,7307	0,7831	0,8919	1,0062	1,1266
–25	0,2865	0,3878	0,4760	0,5682	0,6160	0,6648	0,7149	0,7662	0,8726	0,9845	1,1022
–20	0,2926	0,3797	0,4660	0,5564	0,6031	0,6510	0,7000	0,7502	0,8544	0,9639	1,0793
–15	0,2987	0,3720	0,4565	0,5450	0,5908	0,6377	0,6857	0,7349	0,8370	0,9443	1,0572
–10	0,3047	0,3647	0,4475	0,5343	0,5792	0,6251	0,6722	0,7204	0,8205	0,9257	1,0364
–5	0,3108	0,3575	0,4388	0,5238	0,5678	0,6129	0,6590	0,7063	0,8044	0,9075	1,0161
0	0,3168	0,3507	0,4304	0,5139	0,5570	0,6013	0,6465	0,6929	0,7891	0,8903	0,9968
5	0,3229	0,3441	0,4223	0,5042	0,5465	0,5899	0,6343	0,6798	0,7742	0,8735	0,9780
10	0,3289	0,3378	0,4146	0,4950	0,5365	0,5791	0,6227	0,6674	0,7601	0,8576	0,9601
15	0,3349	0,3318	0,4072	0,4861	0,5269	0,5688	0,6116	0,6555	0,7465	0,8422	0,9429
20	0,3409	0,3259	0,4000	0,4775	0,5177	0,5587	0,6008	0,6439	0,7334	0,8274	0,9263
25	0,3468	0,3204	0,3932	0,4694	0,5089	0,5492	0,5906	0,6330	0,7209	0,8133	0,9106
30	0,3528	0,3149	0,3865	0,4614	0,5002	0,5399	0,5806	0,6222	0,7086	0,7995	0,8951
35	0,3588	0,3097	0,3801	0,4537	0,4918	0,5309	0,5708	0,6118	0,6968	0,7861	0,8801
40	0,3647	0,3047	0,3739	0,4464	0,4839	0,5223	0,5616	0,6019	0,6855	0,7734	0,8659
45	0,3707	0,2997	0,3679	0,4391	0,4760	0,5138	0,5525	0,5922	0,6744	0,7609	0,8519
50	0,3766	0,2950	0,3621	0,4323	0,4686	0,5058	0,5439	0,5829	0,6638	0,7489	0,8385
55	0,3826	0,2904	0,3564	0,4255	0,4612	0,4978	0,5353	0,5737	0,6534	0,7372	0,8254
60	0,3885	0,2860	0,3510	0,4190	0,4542	0,4903	0,5272	0,5650	0,6435	0,7260	0,8128
65	0,3944	0,2817	0,3457	0,4128	0,4474	0,4830	0,5193	0,5566	0,6339	0,7151	0,8007
70	0,4004	0,2775	0,3406	0,4066	0,4407	0,4757	0,5115	0,5482	0,6244	0,7044	0,7887

NOTE This information refers only to HFC-23, and does not represent any other products containing trifluoromethane as a component.

Symbols:

m/V is the agent mass requirements (kg/m³); i.e. mass, m, in kilograms of agent required per cubic metre of protected volume V to produce the indicated concentration at the temperature specified;

V is the net volume of hazard (m³); i.e the enclosed volume minus the fixed structures impervious to extinguishant

$$m = \left(\frac{c}{100 - c}\right)\frac{V}{S}$$

T is the temperature (°C); i.e. the design temperature in the hazard area;

S is the specific volume (m³/kg); the specific volume of superheated HFC 23 vapour at a pressure of 1,013 bar may be approximated by the formula:

$$S = k_1 + k_2 T$$

where

k_1 = 0,316 4

k_2 = 0,001 2

c is the concentration (%); i.e. the volumetric concentration of HFC 23 in air at the temperature indicated, and a pressure of 1,013 bar absolute.

Table 4 — HFC 23 reference extinguishing and design concentrations

Fuel	Extinguishment % by volume	Minimum design % by volume
Class B		
Heptane (cup burner)	12,6	16,4
Heptane (room test)	12,3	
Surface Class A		
Wood Crib	10,5	16,3
PMMA	12,5	
PP	12,5	
ABS	12,4	
Higher Hazard Class A	See Note 4	16,3

NOTE 1 The extinguishment values for the Class B and the Surface Class A fuels are determined by testing in accordance with Annexes B and C of ISO 14520-1.

NOTE 2 The minimum design concentration for the Class B fuel is the higher value of the heptane cup burner or room test heptane extinguishment concentration multiplied by 1,3.

NOTE 3 The minimum design concentration for Surface Class A fuel is the highest value of the wood crib, PMMA, PP or ABS extinguishment concentrations multiplied by 1,3. In the absence of any of the 4 extinguishment values, the minimum design concentration for Surface Class A shall be that of Higher Hazard Class A.

NOTE 4 The minimum design concentration for Higher Hazard Class A fuels shall be the higher of the Surface Class A or 95% of the Class B minimum design concentration.

NOTE 5 See 7.5.1.3 of ISO 14520-1 for guidance on Class A fuels.

NOTE 6 The extinguishing and design concentrations for room-scale test fires are for informational purposes only. Lower and higher extinguishing concentrations than those shown for room-scale test fires may be achieved and allowed when validated by test reports from internationally recognized laboratories.

Table 5 — HFC 23 extinguishing and design concentrations for other fuels

Fuel	Extinguishment % by volume	Minimum design % by volume
Acetone	13,2	17,2
Ethanol	16,1	20,9
Ethyl acetate	13,4	17,4
Kerosene	13,2	17,2
Methanol	18,2	23,7
Propane	14,2	18,5
Toluene	12,6	16,4

NOTE Extinguishing concentrations for all Class B fuels listed were derived in accordance with ISO 14520-1, Annex B.

Minimum design values have been increased to the minimum design concentration established for heptane in accordance with ISO 14520-1, section 7.5.1.

Table 6 — HFC 23 inerting and design concentrations

Fuel	Inertion % by volume	Minimum design % by volume
Methane	20,2	22,2
Propane	20,2	22,2
NOTE Inerting concentrations were derived in accordance with the requirements of ISO/DIS 14520-1, annex D and 7.5.2.		

5 Safety of personnel

Any hazard to personnel created by the discharge of HFC 23 shall be considered in the design of the system.

Potential hazards can arise from the following:

a) the extinguishant itself;

b) the combustion products of the fire; and

c) breakdown products of the extinguishant resulting from exposure to fire.

For minimum safety requirements, see ISO/DIS 14250-1, clause 5.

Toxicological information for HFC 23 is shown in Table 7.

Table 7 — Toxicological information for HFC 23

Property	Value % by volume
ALC	>65
No observed adverse effect level (NOAEL)	30
Lowest observed adverse effect level (LOAEL)	>30
NOTE ALC is the approximate lethal concentration for a rat population during a 4-h exposure.	

6 System design

6.1 Fill density

The fill density of the container shall not result in pressures exceeding the container specifications at the maximum design temperature. For example, see Tables 8 and 9.

Exceeding the maximum fill density may result in the container becoming "liquid full", with the effect that an extremely high rise in pressure occurs with small increases in temperature, which could adversely affect the integrity of the container assembly.

The relationships between pressure and temperature are shown in Figure 1 for various levels of fill density.