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

Part 8: HFC 125 extinguishant

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

Partie 8: Agent extincteur HCFC 125

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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 14520-8 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 8, *Gaseous media fire fighting system 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 system 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— *Part 3: Withdrawn*

— *Part 4: Withdrawn*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— *Part 7: Withdrawn*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 system design — Part 8: HFC 125 extinguishant

1 Scope

1.1 This part of ISO 14520 contains specific requirements for gaseous fire-extinguishing systems, with respect to the HFC 125 extinguishant. It includes details of physical properties, specification, usage and safety aspects.

1.2 This part of ISO 14520 covers systems operating at nominal pressures of 25 bars and 42 bar, superpressurized with nitrogen. This does not preclude the use of other systems.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 14520. For dated references, subsequent amendments to, or revisions of, this publication do not apply. However, parties to agreements based on this part of ISO 14520 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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 125 shall comply with the specification shown in Table 1.

HFC 125 is a colourless, almost odourless, electrically non-conductive gas, with a density approximately four times that of air.

The physical properties are shown in Table 2.

HFC 125 extinguishes fires mainly by physical means, but also by some chemical means.

Table 1 — Specification for HFC 125

Property	Requirement
Purity	99,6 % by mass, min.
Acidity	3×10^{-4} % by mass (3 ppm), max.
Water content	10×10^{-4} % by mass (10 ppm), max.
Non-volatile residue	0,01 % by mass, max.
Suspended matter or sediment	None visible

Table 2 — Physical properties of HFC 125

Property	Units	Value
Molecular mass	—	120,02
Boiling point at 1,013 bar (absolute)	°C	-48,09
Freezing point	°C	-101
Critical temperature	°C	66,02
Critical pressure	bar abs	36,18
Critical volume	cm^3/mol	210
Critical density	kg/m^3	573,6
Vapour pressure 20 °C	bar abs	12,05
Liquid density 20 °C	kg/m^3	1 218,0
Saturated vapour density 20 °C	kg/m^3	77,97
Specific volume of superheated vapour at 1,013 bar and 20 °C	m^3/kg	0,1972
Chemical formula	CF_3CHF_2	
Chemical name	Pentafluoroethane	

4.2 Use of HFC 125 systems

HFC 125 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 other fuels are shown in Table 5

Table 3 — HFC 125 total flooding quantity

Temperature T	Specific vapour volume S	HCFC 125 mass requirements per unit volume of protected space, m/V (kg/m³)									
		Design concentration (by volume)									
°C	m³/kg	7 %	8 %	9 %	10 %	11 %	12 %	13 %	14 %	15 %	16 %
–45	0,1497	0,5028	0,5809	0,6607	0,7422	0,8256	0,9109	0,9982	1,0874	1,1788	1,2724
–40	0,1534	0,4907	0,5669	0,6447	0,7243	0,8057	0,8889	0,9741	1,0612	1,1504	1,2417
–35	0,1572	0,4788	0,5532	0,6291	0,7068	0,7862	0,8675	0,9505	1,0356	1,1226	1,2117
–30	0,1608	0,4681	0,5408	0,6151	0,6910	0,7686	0,8480	0,9293	1,0124	1,0975	1,1846
–25	0,1645	0,4576	0,5286	0,6012	0,6754	0,7513	0,8290	0,9084	0,9896	1,0728	1,1579
–20	0,1682	0,4475	0,5170	0,5880	0,6606	0,7348	0,8107	0,8884	0,9678	1,0492	1,1324
–15	0,1719	0,4379	0,5059	0,5753	0,6464	0,7190	0,7933	0,8693	0,9470	1,0266	1,1081
–10	0,1755	0,4289	0,4955	0,5635	0,6331	0,7042	0,7770	0,8514	0,9276	1,0055	1,0853
–5	0,1791	0,4203	0,4855	0,5522	0,6204	0,6901	0,7614	0,8343	0,9089	0,9853	1,0635
0	0,1828	0,4118	0,4757	0,5410	0,6078	0,6761	0,7460	0,8174	0,8905	0,9654	1,0420
5	0,1864	0,4038	0,4665	0,5306	0,5961	0,6631	0,7316	0,8016	0,8733	0,9467	1,0219
10	0,1900	0,3962	0,4577	0,5205	0,5848	0,6505	0,7177	0,7864	0,8568	0,9288	1,0025
15	0,1935	0,3890	0,4494	0,5111	0,5742	0,6387	0,7047	0,7722	0,8413	0,9120	0,9844
20	0,1971	0,3819	0,4412	0,5018	0,5637	0,6271	0,6919	0,7581	0,8259	0,8953	0,9664
25	0,2007	0,3750	0,4333	0,4928	0,5536	0,6158	0,6794	0,7445	0,8111	0,8793	0,9491
30	0,2042	0,3686	0,4258	0,4843	0,5441	0,6053	0,6678	0,7318	0,7972	0,8642	0,9328
35	0,2078	0,3622	0,4185	0,4759	0,5347	0,5948	0,6562	0,7191	0,7834	0,8492	0,9166
40	0,2113	0,3562	0,4115	0,4681	0,5258	0,5849	0,6454	0,7072	0,7704	0,8352	0,9014
45	0,2149	0,3503	0,4046	0,4602	0,5170	0,5751	0,6345	0,6953	0,7575	0,8212	0,8863
50	0,2184	0,3446	0,3982	0,4528	0,5088	0,5659	0,6244	0,6842	0,7454	0,8080	0,8721
55	0,2219	0,3392	0,3919	0,4457	0,5007	0,5570	0,6145	0,6734	0,7336	0,7953	0,8584
60	0,2254	0,3339	0,3858	0,4388	0,4930	0,5483	0,6050	0,6629	0,7222	0,7829	0,8451
65	0,2289	0,3288	0,3799	0,4321	0,4854	0,5400	0,5957	0,6528	0,7112	0,7710	0,8321
70	0,2324	0,3239	0,3742	0,4256	0,4781	0,5318	0,5868	0,6430	0,7005	0,7593	0,8196
75	0,2358	0,3192	0,3688	0,4194	0,4712	0,5242	0,5783	0,6337	0,6904	0,7484	0,8078
80	0,2393	0,3145	0,3634	0,4133	0,4643	0,5165	0,5698	0,6244	0,6803	0,7374	0,7960
85	0,2428	0,3100	0,3581	0,4073	0,4576	0,5090	0,5616	0,6154	0,6705	0,7268	0,7845
90	0,2463	0,3056	0,3531	0,4015	0,4511	0,5018	0,5536	0,6067	0,6609	0,7165	0,7734
95	0,2498	0,3013	0,3481	0,3959	0,4448	0,4948	0,5459	0,5982	0,6517	0,7064	0,7625

NOTE This information refers only to the product HFC-125, and does not represent any other products containing pentafluoroethane 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 HCFC 125 vapour at a pressure of 1,013 bar may be approximated by the formula:

$$S = k_1 + k_2 T$$

where

k_1 = 0,182 5

k_2 = 0,000 7

c is the concentration (%); i.e. the volumetric concentration of HCFC 125 in air at the temperature indicated, and a pressure of 1,013 bar.

Table 4 — HFC 125 reference extinguishing and design concentrations

Fuel	Extinguishment % by volume	Minimum design % by volume
Class B		
Heptane (cup burner) Heptane (room test)	9,3 9,3	12,1
Surface Class A		
Wood Crib PMMA PP ABS	6,7 8,6 8,6 8,6	11,2
Higher Hazard Class A	See Note 4	11,5

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 125 extinguishing and design concentrations for other fuels

Fuel	Extinguishment % by volume	Minimum design % by volume
Acetone	9,3	12,1
Ethanol	11,3	14,7
Ethyl acetate	9,3	12,1
Methanol Kerosene Propane	12,3 9,3 9,7	15,9 12,1 12,6
Toluene	9,3	12,1

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.

5 Safety of personnel

Any hazard to personnel created by the discharge of HFC 125 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 14520-1, clause 5.

Toxicological information for HFC 125 is shown in Table 6.

Table 6 — Toxicological information for HFC 125

Property	Value % by volume
ALC	> 70
No observed adverse effect level (NOAEL)	7,5
Lowest observed adverse effect level (LOAEL)	10
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 exceed the values shown in Table 7 for 25 bar system and Table for 42 bar system.

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.

Table 7 — 25 bar storage container characteristics for HFC 125

Property	Unit	Value
Maximum fill density	kg/m^3	929
Maximum container working pressure at 50 °C	bar	40
Superpressurization at 22 °C	bar	25
NOTE Reference should be made to Figure 1 for further data on pressure/temperature relationships.		