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

Part 11:
HFC 236fa extinguishant

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

Partie 11: Agent extincteur HFC 236fa

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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

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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 14520-11 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*.

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This second edition cancels and replaces the first edition (ISO 14520-11:2000), which has been technically revised.

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

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Parts 3, 4 and 7, which dealt with FC-2-1-8, FC-3-1-10 and HCFC 124 extinguishants, respectively, have been withdrawn, as these types are no longer manufactured.

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

Part 11: **HFC 236fa extinguishant**

1 Scope

This part of ISO 14520 gives specific requirements for gaseous fire-extinguishing systems, with respect to the HFC 236fa extinguishant. It includes details of physical properties, specification, usage and safety aspects and is applicable to systems operating at nominal pressures of 25 bar and 42 bar superpressurized with nitrogen. This does not preclude the use of other systems.

2 Normative references

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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.

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ISO 14520-1:—[1)], *Gaseous fire-extinguishing systems — Physical properties and system design — Part 1: General requirements*

3 Terms and definitions

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

4 Characteristics and uses

4.1 General

Extinguishant HFC 236fa shall comply with the specification according to Table 1.

HFC 236fa is a colourless, almost odourless, electrically non-conductive gas with a density approximately five times that of air.

The physical properties are given in Table 2.

HFC 236fa extinguishes fires mainly by physical means, but also by some chemical means.

1) To be published. (Revision of ISO 14520-1:2000)

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Table 1 — Specification for HFC 236fa

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 236fa

Property	Unit	Value
Molecular mass	—	152
Boiling point at 1,013 bar (absolute) [a]	°C	–1,4
Freezing point	°C	–103
Critical temperature	°C	124,9
Critical pressure	bar abs [a]	32,00
Critical volume	cm^3/mol	274,0
Critical density	kg/m^3	551,3
Vapour pressure 20 °C	bar abs [a]	2,296
Liquid density 20 °C	kg/m^3	1 377
Saturated vapour density 20 °C	kg/m^3	15,58
Specific volume of superheated vapour at 1,013 bar and 20 °C	m^3/kg	0,1529
Chemical formula	$CHF_3CH_2CF_3$	
Chemical name	Hexafluoropropane	
[a] 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.		

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4.2 Use of HFC 236fa systems

HFC 236fa total flooding systems may be used for extinguishing fires of all classes within the limits specified in ISO 14520-1:— [2)], Clause 4.

The extinguishant requirements per volume of protected space are given in Table 3 for various levels of concentration. These are based on methods given in ISO 14520-1— [2)], 7.6.

The extinguishing concentrations and design concentrations for various types of hazard are given in Table 4, and concentrations for other fuels in Table 5.

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Table 3 — HFC 236fa total flooding quantity

Temperature T °C	Specific vapour volume S m^3/kg	**HFC 236fa mass requirements per unit volume of protected space**, m/V (kg/m^3) This information refers only to HFC 236fa, and may not represent any other products containing 1,1,1,3,3,3-hexafluoropropane as a component. **Design concentration** (by volume) 5 %	6 %	7 %	8 %	9 %	10 %	11 %	12 %	13 %	14 %	15 %
0	0,1413	0,3725	0,4517	0,5327	0,6154	0,6999	0,7863	0,8747	0,9651	1,0575	1,1521	1,2489
5	0,1442	0,3650	0,4427	0,5220	0,6031	0,6860	0,7706	0,8572	0,9458	1,0364	1,1291	1,2240
10	0,1471	0,3579	0,4340	0,5118	0,5913	0,6725	0,7555	0,8404	0,9273	1,0161	1,1070	1,2000
15	0,1499	0,3510	0,4257	0,5020	0,5799	0,6596	0,7410	0,8243	0,9095	0,9966	1,0857	1,1769
20	0,1528	0,3444	0,4177	0,4925	0,5690	0,6472	0,7271	0,8088	0,8923	0,9778	1,0652	1,1548
25	0,1557	0,3380	0,4100	0,4834	0,5585	0,6352	0,7136	0,7938	0,8758	0,9597	1,0455	1,1334
30	0,1586	0,3319	0,4025	0,4746	0,5483	0,6237	0,7007	0,7794	0,8599	0,9423	1,0266	1,1128
35	0,1615	0,3260	0,3953	0,4662	0,5386	0,6125	0,6882	0,7655	0,8446	0,9255	1,0082	1,0930
40	0,1643	0,3203	0,3884	0,4580	0,5291	0,6018	0,6761	0,7521	0,8298	0,9092	0,9906	1,0738
45	0,1672	0,3147	0,3817	0,4501	0,5200	0,5914	0,6645	0,7391	0,8155	0,8936	0,9735	1,0553
50	0,1701	0,3094	0,3752	0,4425	0,5112	0,5814	0,6532	0,7266	0,8017	0,8785	0,9570	1,0375
55	0,1730	0,3043	0,3690	0,4351	0,5027	0,5717	0,6423	0,7145	0,7883	0,8638	0,9411	1,0202
60	0,1759	0,2993	0,3630	0,4280	0,4945	0,5624	0,6318	0,7028	0,7754	0,8497	0,9257	1,0035
65	0,1787	0,2945	0,3571	0,4211	0,4865	0,5533	0,6216	0,6915	0,7629	0,8360	0,9108	0,9873
70	0,1816	0,2898	0,3514	0,4144	0,4788	0,5445	0,6118	0,6805	0,7508	0,8227	0,8963	0,9716
75	0,1845	0,2853	0,3460	0,4080	0,4713	0,5360	0,6022	0,6699	0,7391	0,8099	0,8823	0,9565
80	0,1874	0,2809	0,3406	0,4017	0,4641	0,5278	0,5930	0,6596	0,7277	0,7974	0,8688	0,9418
85	0,1903	0,2766	0,3355	0,3956	0,4570	0,5198	0,5840	0,6496	0,7167	0,7854	0,8556	0,9275
90	0,1931	0,2725	0,3305	0,3897	0,4502	0,5121	0,5753	0,6399	0,7060	0,7737	0,8429	0,9137
95	0,1960	0,2685	0,3256	0,3840	0,4436	0,5045	0,5668	0,6305	0,6957	0,7623	0,8305	0,9003

m/V is the agent mass requirement (in kilograms per cubic metre); 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 (in cubic metres); 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 (in degrees Celsius); i.e. the design temperature in the hazard area;

S is the specific volume (in cubic metres per kilogram); the specific volume of superheated HFC 236fa vapour at a pressure of 1,013 bar may be approximated by

$$S = k_1 + k_2 T$$

where k_1 = 0,141 3; k_2 = 0,000 6

c is the concentration (in percent); i.e. the volumetric concentration of HFC 236fa in air at the temperature indicated, and a pressure of 1,013 bar absolute.

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Table 4 — HFC 236fa reference extinguishing and design concentrations

Fuel	Extinguishment % by volume	Minimum design % by volume
Class B		
Heptane (cup burner) Heptane (room test)	6,5 12,3	9,8
Surface Class A		
Wood crib PMMA PP ABS	5,0 6,8 6,8 6,8	8,8
Higher Hazard Class A	[a]	9,3

The extinguishment values for the Class B and the Surface Class A fuels are determined by testing in accordance with ISO 14520-1:— [3], Annexes B and C.

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.

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.

See ISO 14520-1:— [3], 7.5.1.3, for guidance on Class A fuels.

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.

[a] 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.

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Table 5 — HFC 236fa extinguishing and design concentrations for other fuels

Fuel	Extinguishment % by volume	Minimum design % by volume
Acetone	6,7	9,8
Ethanol	7,8	10,1
Ethyl acetate Kerosene	6,8 6,5	9,8 9,8
Methanol Propane	8,4 7,2	10,9 9,8
Toluene	6,5	9,8

Extinguishing concentrations for all Class B fuels listed were derived in accordance with ISO 14520-1:— [3], Annex B.

Minimum design values have been increased to the minimum design concentration established for heptane in accordance with ISO 14520-1:— [3], 7.5.1.

3) To be published. (Revision of ISO 14520-1:2000)

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5 Safety of personnel

Any hazard to personnel created by the discharge of HFC 236fa 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;

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

For minimum safety requirements, see ISO 14250-1:—[4)], Clause 5.

Toxicological information for HFC 236fa is given in Table 6.

Table 6 — Toxicological information for HFC 236fa

Property	Value % by volume
ALC [a]	> 47,5
No observed adverse effect level (NOAEL)	10
Lowest observed adverse effect level (LOAEL)	15
[a] ALC is the approximate lethal concentration for a rat population during a 4 h exposure.	

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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 examples, see Tables 7 and 8.

Table 7 — Storage container characteristics for HFC 236fa — 25 bar

Property	Unit	Value
Maximum fill density	kg/m^3	1 200
Maximum container working pressure at 50 °C	bar a	34
Superpressurization at 22 °C	bar a	25
Reference should be made to Figure 1 for further data on pressure/temperature relationships.		
[a] 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.		

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