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ISO 14520-2

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

Part 2: CF_3I extinguishant

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

Partie 2: Agent extincteur CF_3I

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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 14520-2 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 14520-2:2000), which has been technically revised. It incorporates ISO 14520-2:2000/Cor.1:2001.

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Parts 3, 4 and 7, which dealt with FC-2-1-8, FC-3-1-10 and HCFC 124 extinguishants, respectively, have been withdrawn, as these types are no longer manufactured.

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

Part 2:
CF_3I extinguishant

1 Scope

This part of ISO 14520 gives specific requirements for gaseous fire-extinguishing systems, with respect to the CF_3I extinguishant. It includes details of physical properties, specification, usage and safety aspects and is applicable to systems operating at a nominal pressure of 25 bar. This does not preclude the use of other systems.

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.

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ISO 14520-1:2006, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 1: General requirements*

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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 CF_3I shall comply with the specification according to Table 1.

CF_3I is a colourless, almost odourless, electrically non-conductive gas with a density approximately seven times that of air.

The physical properties are given in Table 2.

CF_3I extinguishes fires mainly by chemical means, but also by some physical means.

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Table 1 — Specification for CF_3I

Property	Requirement
Purity	99,9 % by mass, min.
Acidity	1×10^{-6} by mass, max.
Water content	6×10^{-6} by mass, max.
Non-volatile residue	100×10^{-6} by mass, max.
Suspended matter or sediment	None visible

Table 2 — Physical properties of CF_3I

Property	Unit	Value
Molecular mass	—	195,9
Boiling point at 1,013 bar (absolute) [a]	°C	−22,5
Freezing point	°C	−110
Critical temperature	°C	122
Critical pressure	bar abs [a]	40,4
Critical volume	cm^3/mol	225,0
Critical density	kg/m^3	871
Vapour pressure 20 °C	bar abs [a]	4,65
Liquid density 20 °C	kg/m^3	2 096
Saturated vapour density 20 °C	kg/m^3	8,051
Specific volume of superheated vapour at 1,013 bar and 20 °C	m^3/kg	0,124
Chemical formula	CF_3I	
Chemical name	Trifluoroiodomethane	

[a] 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

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4.2 Use of CF_3I systems

CF_3I total flooding systems may be used for extinguishing fires of all classes within the limits specified in ISO 14520-1:2006, 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 14520-1:2006, 7.6.

The extinguishing concentrations and design concentrations for *n*-heptane and Surface class A hazards are given in Table 4, and inerting concentrations in Table 5.

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Table 3 — CF_3I total flooding quantity

Temperature T	Specific vapour volume S	CF_3I mass requirements per unit volume of protected space, m/V (kg/m³) This information refers only to CF_3I, and may not represent any other products containing Trifluoroiodomethane as a component							
		Design concentration (by volume)							
°C	m³/kg	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %
−25	0,1013	0,3053	0,4113	0,5196	0,6301	0,7430	0,8584	0,9763	1,0969
−20	0,1038	0,2980	0,4014	0,5070	0,6149	0,7251	0,8377	0,9528	1,0704
−15	0,1063	0,2909	0,3920	0,4851	0,6005	0,7081	0,8180	0,9304	1,0453
−10	0,1088	0,2843	0,3830	0,4837	0,5867	0,6918	0,7992	0,9090	1,0212
−5	0,1113	0,2779	0,3744	0,4729	0,5735	0,6763	0,7813	0,8886	0,9983
0	0,1138	0,2718	0,3661	0,4625	0,5609	0,6614	0,7641	0,8691	0,9764
5	0,1163	0,2659	0,3583	0,4526	0,5488	0,6472	0,7477	0,8504	0,9554
10	0,1188	0,2603	0,3507	0,4430	0,5373	0,6336	0,7320	0,8325	0,9353
15	0,1213	0,2550	0,3436	0,4339	0,5262	0,6205	0,7169	0,8153	0,9160
20	0,1238	0,2498	0,3366	0,4251	0,5156	0,6080	0,7024	0,7989	0,8975
25	0,1263	0,2449	0,3299	0,4167	0,5054	0,5960	0,6885	0,7831	0,8797
30	0,1288	0,2401	0,3235	0,4086	0,4956	0,5844	0,6751	0,7679	0,8627
35	0,1313	0,2356	0,3173	0,4008	0,4861	0,5733	0,6623	0,7532	0,8462
40	0,1338	0,2311	0,3114	0,3934	0,4771	0,5625	0,6499	0,7392	0,8304
45	0,1363	0,2269	0,3057	0,3861	0,4683	0,5522	0,6380	0,7256	0,8152
50	0,1388	0,2228	0,3002	0,3792	0,4599	0,5423	0,6265	0,7125	0,8005
55	0,1413	0,2189	0,2949	0,3725	0,4517	0,5327	0,6154	0,6999	0,7863
60	0,1438	0,2151	0,2898	0,3660	0,4439	0,5234	0,6047	0,6878	0,7727
65	0,1463	0,2114	0,2848	0,3598	0,4363	0,5145	0,5944	0,6760	0,7595
70	0,1488	0,2078	0,2800	0,3537	0,4290	0,5058	0,5844	0,6647	0,7467
75	0,1513	0,2044	0,2754	0,3479	0,4219	0,4975	0,5747	0,6537	0,7344
80	0,1538	0,2011	0,2709	0,3422	0,4150	0,4894	0,5654	0,6431	0,7224
85	0,1563	0,1979	0,2666	0,3367	0,4084	0,4816	0,5563	0,6328	0,7109
90	0,1588	0,1948	0,2624	0,3314	0,4020	0,4740	0,5476	0,6228	0,6997
95	0,1613	0,1917	0,2583	0,3263	0,3957	0,4666	0,5391	0,6132	0,6888
100	0,1638	0,1888	0,2544	0,3213	0,3897	0,4595	0,5309	0,6038	0,6783

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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 CF_3I vapour at a pressure of 1,013 bar may be approximated by

$$S = k_1 + k_2 T$$

where $k_1 = 0{,}113\,8$; $k_2 = 0{,}000\,5$

c is the concentration (in percent); i.e. the volumetric concentration of CF_3I in air at the temperature indicated, and a pressure of 1,013 bar absolute.

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Table 4 — CF_3I reference extinguishing and design concentrations

Fuel	Extinguishment % by volume	Minimum design % by volume
Class B		
Heptane (cup burner)	3,5	4,6
Heptane (room test)	3,5	
Surface Class A		
Wood crib	3,5	[a]
PMMA	—	
PP	—	
ABS	—	
Higher Hazard Class A	[b]	9,3

The extinguishment values for the Class B and the Surface Class A fuels are determined by testing in accordance with ISO 14520-1:2006, 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.

See ISO 14520-1:2006, 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 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.

[b] 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 — CF_3I inerting and design concentrations

Fuel	Extinguishment % by volume	Minimum design % by volume
Propane	6,5	7,2
Inerting concentrations determined in accordance with ISO 14520-1:2006, 7.5.2 and Annex D.		

5 Safety of personnel

Any hazard to personnel created by the discharge of CF_3I 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 14520-1:2006, Clause 5.

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Toxicological information for CF_3I is given in Table 6. Since the design concentrations exceed the LOAEL under normal design conditions, CF_3I shall only be used for total flooding in normally unoccupied areas.

Table 6 — Toxicological information for CF_3I

Property	Value % by volume
LC_{50}	27,4
ALC	$>$ 12,8
No observed adverse effect level (NOAEL)	0,2
Lowest observed adverse effect level (LOAEL)	0,4

LC_{50} is the concentration lethal to 50 % of a rat population during a 15 min exposure.
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 given in Table 7.

Table 7 — Storage container characteristics for CF_3I

Property	Unit	Value
Maximum fill density	kg/m^3	1 680
Maximum container working pressure at 50 °C	bar [a]	35,5
Superpressurization at 20 °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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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.

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