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

Part 2:
CF3I extinguishant

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

Partie 2: Agent extincteur CF3I

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Foreword

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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.

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ISO 14520-2 was prepared by Technical Committee ISO/TC 21, Equipment for fire protection and fire fighting, Subcommittee SC 8, Gaseous media fixed fire extinguishing 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 media 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— *Part 3: Withdrawn*

— *Part 4: Withdrawn*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— *Part 7: Withdrawn*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 media fire extinguishing systems — Physical properties and system design — Part 2: CF3I Extinguishant

1 Scope

1.1 This part of ISO 14520 contains 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.

1.2 This part of ISO 14520 covers systems operating at a nominal pressure of 25 bar. 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 CF_3I shall comply with the specification shown in 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 shown in Table 2.

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

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 1 — Specification for CF_3I

Property	Units	Value
Molecular mass	—	195,9
Boiling point at 1,013 bar (absolute)	°C	–22,5
Freezing point	°C	–110
Critical temperature	°C	122
Critical pressure	bar abs	40,4
Critical volume	cm^3/mol	225,0
Critical density	kg/m^3	871
Vapour pressure 20 °C	bar abs	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	0,112
Chemical formula	CF_3I	
Chemical name	Trifluoroiodomethane	

Table 2 — Physical properties of CF_3I

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 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. Inerting concentrations are shown in Table 5.

Temperature T °C	Specific volume S m^3/kg	CF_3I mass requirements per unit volume of protected space m/V (kg/m^3)							
		Design concentration (by volume)							
		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

NOTE This information refers only to the product CF_3I., and does not represent any other product containing Trifluoroiodomethane as a component.

Symbols:

m/V is the agent mass requirements (kg/m^3); 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 (m^3); 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 (m^3/kg); the specific volume of superheated CF_3I vapour at a pressure of 1,013 bar may be approximated by the formula:

$S = k_1 + k_2 T$

where

k_1 = 0,113 8

k_2 = 0,000 5

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

Table 3 — CF_3I total flooding quantity

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

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 4 — CF_3I reference extinguishing and design concentrations

Fuel	Inertion % by volume	Minimum design % by volume
Propane	6,5	7,2

NOTE Inerting concentrations were determined in accordance with the requirements of ISO 14520-1, section 7.5.2 and annex D.

Table 5 — CF_3I inerting and design concentrations

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; and

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

Toxicological information for CF_3I is shown 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. For minimum safety requirements see ISO 14520-1, section 5.

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
NOTE LC50 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.	

Table 6 — Toxicological information for CF_3I

6 System design

6.1 Fill density

The fill density of the container shall not exceed the values shown in Table 7.

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.

Property	Unit	Value
Maximum fill density.	kg/m^3	1 680
Maximum container working pressure at 50 °C	bar	35,5
Superpressurization at 20 °C	bar	25
NOTE Reference should be made to Figure 1 for further data on pressure/temperature relationships.		

Table 7 — Storage container characteristics for CF_3I

6.2 Superpressurization

Containers shall be superpressurized with nitrogen with a moisture content of not more than 60×10^{-6} by mass to an equilibrium pressure of 25 bar $^{+5}_{0}$% at a temperature of 20 °C (see 1.2).

6.3 Extinguishant quantity

The quantity of extinguishant shall be the minimum required to achieve the design concentration within the hazard volume at the minimum expected temperature, determined using Table 3 and the method specified in 7.6 of ISO 14520-1.

The design concentrations shall be that specified for relevant hazards shown in Table 4. This includes a 1,3 safety factor on the extinguishing concentration.