INTERNATIONAL STANDARD

ISO 14520-2

Third edition
2016-10-01

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

Reference number
ISO 14520-2:2016(E)

Contents

Page

Foreword .... **iv**

1 Scope **1**

2 Normative reference **1**

3 Terms and definitions **1**

4 Characteristics and uses **1**

4.1 General 1

4.2 Use of CF_3I systems 2

5 Safety of personnel **4**

6 System design **5**

6.1 Fill density 5

6.2 Superpressurization 5

6.3 Extinguishant quantity 5

7 Environmental properties **6**

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 8, *Gaseous media and firefighting systems using gas*.

This third edition cancels and replaces the second edition (ISO 14520-2:2006), which has been technically revised with the following changes:

— added Clause 7.

A list of all parts in the ISO 14520 series can be found on the ISO website.

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

Part 2: CF_3I extinguishant

1 Scope

This document 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.

This document covers systems operating at a nominal pressure of 25 bar. This does not preclude the use of other systems.

2 Normative reference

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 document, the terms and definitions given in ISO 14520-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

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 also by some physical means.

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	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	

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 14520-1:2015, Clause 4.

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 ISO 14520-1:2015, 7.6.

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.

Table 3 — CF_3I total flooding quantity

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

Table 3 *(continued)*

Tempera-ture	**Specific volume**	**CF_3I mass requirements per unit volume of protected space**, m/V (kg/m^3)							
T	S	**Design concentration** (by volume)							
°C	m^3/kg	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %
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

$$S = k_1 + k_2T$$

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 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	See Note 3
PMMA	—	
PP	—	
ABS	—	
Higher Hazard Class A	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 ISO 14520-1:2015, Annexes B and C.

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 four extinguishment values, the minimum design concentration for Surface Class A is that of Higher Hazard Class A.

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

NOTE 5 See ISO 14520-1:2015, 7.5.1.3 for guidance on Class A fuels.

In Table 4, 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 — CF_3I inerting 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 14520-1:2015, 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) the 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 14520-1:2015, Clause 5.

Table 6 — Toxicological information for CF_3I

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

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	35,5
Superpressurization at 20 °C	bar	25
NOTE Reference should be made to Figure 1 for further data on pressure/temperature relationships.		

6.2 Superpressurization

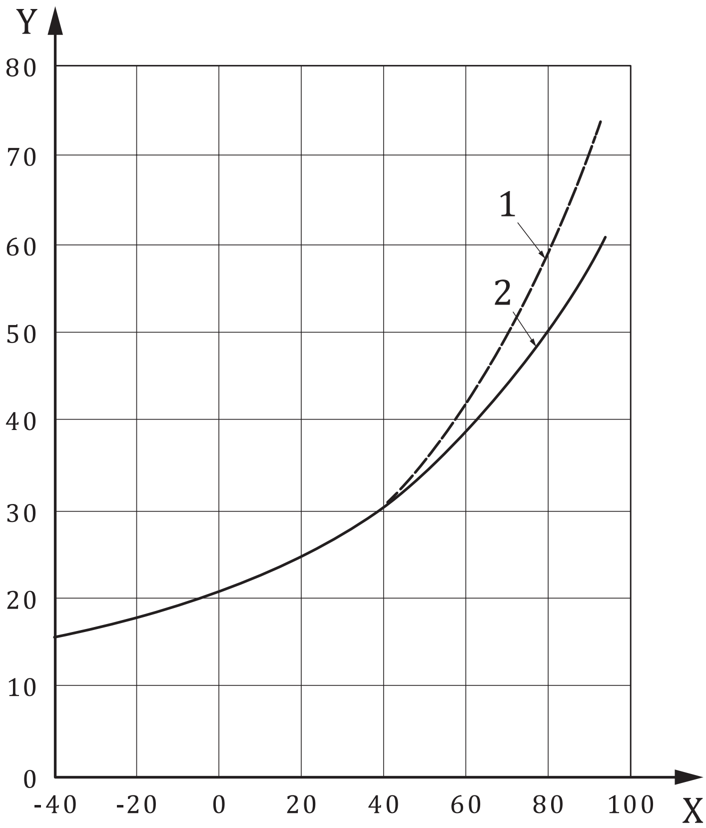
Containers shall be superpressurized with nitrogen with a moisture content of not more than 60×10^{-6} parts per million by mass to an equilibrium pressure of 25 bar $^{+5}_{0}$ % at a temperature of 20 °C (see Clause 1).

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 ISO 14520-1:2015, 7.6.

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.

Consideration should be given to increasing this for particular hazards and seeking advice from the relevant authority.



Key

1 CF_3I 1 680 kg/m^3

2 CF_3I 1 470 kg/m^3

X temperature, °C

Y pressure, bar

Figure 1 — Temperature/pressure graph for CF_3I pressurized to 25 bar with nitrogen at 20 °C

7 Environmental properties

For information purposes, environmental properties of CF_3I extinguishant are provided:

GWP (100 years ITH)	0,4
ODP	0[1)]

NOTE 1 See ISO 14520-1:2015, 4.2.1 for a discussion of GWP values and their relation to the impact of a gas on climate change/global warming.

NOTE 2 Environmental properties were derived from the following:

— 2005 IPCC/TEAP Special Report Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons;

— 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change;

— U.S. EPA.

1) CF_3I released at low altitudes has an ODP of zero because it has a very short atmospheric lifetime (1 to 3,7 days, see http://fire.nist.gov/bfrlpubs/fire05/PDF/f05070.pdf) with the effect that iodine, the primary kinetically active species for ozone depletion, is returned to ground level by natural processes and is, thereby, not available to stratospheric ozone.

ICS 13.220.10
Price based on 6 pages