INTERNATIONAL STANDARD

ISO 14520-3

First edition
2000-08-01

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

Part 3: FC-2-1-8 extinguishant

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

Partie 3: Agent extincteur FC-2-1-8

Reference number
ISO 14520-3:2000(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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 3.

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 part of ISO 14520 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14520-3 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 8, *Gaseous media fire extinguishing systems*.

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: FC-2-1-8 extinguishant*

— *Part 4: FC-3-1-10 extinguishant*

— *Part 6: HCFC Blend A extinguishant*

— *Part 7: HCFC 124 extinguishant*

— *Part 8: HCFC 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 3:
FC-2-1-8 extinguishant

1 Scope

1.1 This part of ISO 14520 contains specific requirements for gaseous fire-extinguishing systems, with respect to the FC-2-1-8 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, 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 14520-1:2000, *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 FC-2-1-8 shall comply with the specification shown in Table 1.

FC-2-1-8 is a colourless, odourless, electrically non-conductive gas with a density approximately 6,5 times that of air.

The physical properties are shown in Table 2.

FC-2-1-8 extinguishes fires mainly by physical means but by some chemical means.

Table 1 — Specification for FC-2-1-8

Property	Requirement
Purity	99,0 % by mass, min.
Acidity	3×10^{-6} by mass, max.
Water content	10×10^{-6} by mass, max.
Non-volatile residue	100×10^{-6} by mass, max.
Suspended matter or sediment	None visible

Table 2 — Physical properties of FC-2-1-8

Property	Units	Value
Molecular mass	—	188
Boiling point at 1,013 bar (absolute)	°C	–36,7
Freezing point	°C	–183,0
Critical temperature	°C	71,9
Critical pressure	bar abs	26,8
Critical volume	cm^3/mol	298,92
Critical density	kg/m^3	629
Vapour pressure 20 °C	bar abs	7,92
Liquid density 20 °C	kg/m^3	1,32
Saturated vapour density 20 °C	kg/m^3	73,3
Specific volume of superheated vapour at 1,013 bar and 20 °C	m^3/kg	0,114
Chemical formula	$CF_3CF_2CF_3$	
Chemical name	Perfluoropropane	

4.2 Use of FC-2-1-8 systems

FC-2-1-8 total flooding systems may be used for extinguishing fires of all classes within the limits specified in clause 4 of ISO 14520-1:2000.

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 14520-1:2000.

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, and inerting concentrations are shown in Table 6.

Table 3 — FC-2-1-8 total flooding quantity

Temperature T °C	**Specific volume** S m³/kg	**FC-2-1-8 mass requirements per unit volume of protected space,** m/V (kg/m³) **Design concentration** (by volume) 5 %	6 %	7 %	8 %	9 %	10 %	11 %	12 %
–35	0,1008	0,5223	0,6335	0,7470	0,8630	0,9815	1,1027	1,2266	1,3533
–30	0,1031	0,5105	0,6191	0,7301	0,8434	0,9593	1,0777	1,1988	1,3226
–25	0,1054	0,4992	0,6054	0,7139	0,8247	0,9380	1,0538	1,1722	1,2933
–20	0,1078	0,4883	0,5923	0,6984	0,8068	0,9177	1,0310	1,1468	1,2653
–15	0,1101	0,4780	0,5797	0,6836	0,7897	0,8982	1,0091	1,1225	1,2384
–10	0,1124	0,4680	0,5676	0,6694	0,7733	0,8795	0,9881	1,0991	1,2127
–5	01148	0,4585	0,5561	0,6557	0,7576	0,8616	0,9680	1,0767	1,1880
0	0,1171	0,4494	0,5450	0,6426	0,7424	0,8444	0,9487	1,0553	1,1643
5	0,1195	0,4406	0,5343	0,6301	0,7279	0,8279	0,9301	1,0346	1,1415
10	0,1218	0,4321	0,5241	0,6180	0,7139	0,8120	0,9123	1,0148	1,1196
15	0,1241	0,4240	0,5142	0,6063	0,7005	0,7967	0,8951	0,9957	1,0985
20	0,1265	0,4162	0,5047	0,5951	0,6876	0,7820	0,8785	0,9773	1,0782
25	0,1288	0,4086	0,4955	0,5843	0,6751	0,7678	0,8626	0,9595	1,0587
30	0,1311	0,4013	0,4867	0,5739	0,6631	0,7541	0,8472	0,9424	1,0398
35	0,1335	0,3943	0,4782	0,5639	0,6514	0,7409	0,8324	0,9259	1,0216
40	0,1358	0,3875	0,4700	0,5542	0,6402	0,7282	0,8181	0,9100	1,0040
45	0,1382	0,3810	0,4620	0,5448	0,6294	0,7159	0,8042	0,8946	0,9870
50	0,1405	0,3746	0,4543	0,5357	0,6189	0,7039	0,7909	0,8797	0,9706
55	0,1428	0,3685	0,4469	0,5270	0,6088	0,6924	0,7779	0,8653	0,9547
60	0,1452	0,3626	0,4397	0,5185	0,5990	0,6813	0,7654	0,8514	0,9393
65	0,1475	0,3568	0,4327	0,5103	0,5895	0,6705	0,7533	0,8379	0,9245
70	0,1498	0,3512	0,4260	0,5023	0,5803	0,6600	0,7415	0,8248	0,9100
75	0,1522	0,3458	0,4194	0,4946	0,5714	0,6499	0,7301	0,8122	0,8961
80	0,1545	0,3406	0,4131	0,4871	0,5628	0,6401	0,7191	0,7999	0,8825
85	0,1569	0,3355	0,4069	0,4799	0,5544	0,6305	0,7084	0,7880	0,8694
90	0,1592	0,3306	0,4010	0,4728	0,5462	0,6213	0,6980	0,7764	0,8566
95	0,1615	0,3258	0,3952	0,4660	0,5383	0,6123	0,6879	0,7652	0,8442
100	0,1639	0,3212	0,3895	0,4593	0,5307	0,6035	0,6781	0,7542	0,8322

NOTE This information was supplied by the manufacturer, 3M Company, USA. It refers only to the product CEA-308, and may not represent any other products containing perfluoropropane.

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 FC-2-1-8 vapour at a pressure of 1,013 bar may be approximated by the formula:

$$S = k_1 + k_2 T$$

where

k_1 = 0,117 123 19

k_2 = 0,004 674 3

c is the concentration (%); i.e. the volumetric concentration of FC-2-1-8 in air at the temperature indicated, and a pressure of 1,013 bar absolute.

Table 4 — FC-2-1-8 reference extinguishing and design concentrations

Fuel	Extinguishment %	Minimum design %
Heptane	7,3	9,5
Surface class A hazards [a]	Not available at this time	Not available at this time
NOTE Extinguishing values were derived by the manufacturer using the ICI cup burner method.		
[a] See 7.5.1.3 of ISO 14520-1:2000.		

Table 5 — FC-2-1-8 extinguishing and design concentrations for other fuels

Fuel	Extinguishment %	Minimum design %
Acetone	6,9	9,0
Acetonitrile	4,5	5,9
Diesel No. 2	6,8	8,8
Heptane	7,3	9,5
Isopropanol	7,2	9,4
JP-4	7,0	9,1
Methanol	10,2	13,3
Methylethyl ketone	7,5	9,8
Methyl *t*-butyl ether	6,7	8,7
n-Butanol	8,0	10,4
Toluene	5,3	6,9
NOTE Extinguishing values were derived by the manufacturer using the ICI cup burner method.		

Table 6 — FC-2-1-8 inerting and design concentrations

Fuel	Inertion %	Minimum design %
Methane	8,9	9,8
Propane	11,2	12,4
NOTE Inerting concentrations were determined in accordance with the requirements of ISO 14520-1:2000, 7.5.2 and annex D.		

5 Safety of personnel

Any hazard to personnel created by the discharge of FC-2-1-8 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 14520-1:2000, clause 5.

Toxicological information for FC-2-1-8 is shown in Table 7.

Table 7 — Toxicological information for FC-2-1-8

Property	Value %
4-h LC_{50}	> 81 in 19 % O_2
No observed adverse effect level (NOAEL)	30
Lowest observed adverse effect level (LOAEL)	> 30
NOTE 4-h LC_{50} is the approximate concentration lethal to 50 % of a rat population during a 4-h exposure.	

6 System design

6.1 Fill density

The fill density of the container shall not result in pressures exceeding container specifications at the maximum design temperature. For an example, see Table 8.

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 8 — Storage container characteristics for FC-2-1-8

Property	Unit	Value
Maximum fill density	kg/m^3	1 124
Maximum container working pressure at 50 °C	bar	30
Superpressurization at 20 °C	bar	25
NOTE Reference should be made to Figure 1 for further data on pressure/temperature relationships.		