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

Part 12: IG-01 extinguishant

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

Partie 12: Agent extincteur IG-01

Reference number
ISO 14520-12:2000(E)

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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 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 14520-12 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 12:
IG-01 extinguishant

1 Scope

1.1 This part of ISO 14520 contains specific requirements for gaseous fire-extinguishing systems, with respect to the IG-01 extinguishant. It includes details of physical properties, specification, usage and safety aspects.

1.2 This part of ISO 14520 covers systems operating at nominal pressures of 160 bar at 15 °C and 200 bar at 15 °C. This does not preclude the use of other systems, although design data for other pressures are not available at this time.

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 IG-01 shall comply with the specification shown in Table 1.

IG-01 is a colourless, odourless, electrically non-conductive gas at ambient (20 °C) temperatures, with a density approximately 1,4 times that of air.

The physical properties are shown in Table 2.

IG-01 extinguishes fires mainly by a reduction of oxygen.

Table 1 — Specification for IG-01

Property	Requirement
Purity	99,9 % by volume, min.
Moisture	50×10^{-6} by mass, max.
Suspended matter or sediment	None visible

Table 2 — Physical properties of IG-01

Property	Units	Value
Molecular mass	—	39,9
Boiling point at 1,013 bar (absolute)	°C	–185,9
Freezing point	°C	–189,4
Critical temperature	°C	–122,3
Critical pressure	bar abs	49,0
Critical volume	cm^3/mol	—
Critical density	kg/m^3	536
Vapour pressure 20 °C	bar abs	—
Liquid density 20 °C	kg/m^3	—
Saturated vapour density 20 °C	kg/m^3	—
Specific volume of superheated vapour at 1,013 bar and 20 °C	m^3/kg	0,602
Chemical formula	Ar	
Chemical name	Argon	

4.2 Use of IG-01 systems

IG-01 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.

Table 3 — IG-01 total flooding quantity

Temperature	Specific vapour volume	IG-01 volume requirements per unit volume of protected space, V/V (m^3/m^3)							
		Design concentration (by volume)							
T	S								
°C	m^3/kg	34 %	38 %	42 %	46 %	50 %	54 %	58 %	62 %
–40	0,4790	0,522	0,601	0,685	0,775	0,872	0,976	1,091	1,217
–35	0,4893	0,511	0,588	0,671	0,758	0,853	0,956	1,068	1,191
–30	0,4996	0,501	0,576	0,657	0,743	0,836	0,936	1,046	1,167
–25	0,5098	0,491	0,565	0,644	0,728	0,819	0,917	1,025	1,143
–20	0,5201	0,481	0,554	0,631	0,714	0,803	0,899	1,005	1,120
–15	0,5304	0,472	0,543	0,619	0,700	0,787	0,882	0,985	1,099
–10	0,5406	0,463	0,533	0,607	0,686	0,772	0,865	0,966	1,078
–5	0,5509	0,454	0,523	0,596	0,674	0,758	0,849	0,948	1,058
0	0,5612	0,446	0,513	0,585	0,661	0,744	0,833	0,931	1,038
5	0,5715	0,438	0,504	0,574	0,649	0,731	0,818	0,914	1,020
10	0,5817	0,430	0,495	0,564	0,638	0,718	0,804	0,898	1,002
15	0,5920	0,423	0,486	0,554	0,627	0,705	0,790	0,883	0,984
20	0,6023	0,416	0,478	0,545	0,616	0,693	0,777	0,868	0,968
25	0,6126	0,409	0,470	0,536	0,606	0,682	0,764	0,853	0,951
30	0,6228	0,402	0,462	0,527	0,596	0,670	0,751	0,839	0,936
35	0,6331	0,395	0,455	0,518	0,586	0,659	0,739	0,825	0,920
40	0,6434	0,389	0,448	0,510	0,577	0,649	0,727	0,812	0,906
45	0,6536	0,383	0,440	0,502	0,568	0,639	0,716	0,799	0,892
50	0,6639	0,377	0,434	0,494	0,559	0,629	0,704	0,787	0,878
55	0,6742	0,371	0,427	0,487	0,550	0,619	0,694	0,775	0,864
60	0,6845	0,366	0,421	0,479	0,542	0,610	0,683	0,763	0,851
65	0,6947	0,360	0,414	0,472	0,534	0,601	0,673	0,752	0,839
70	0,7050	0,355	0,408	0,465	0,526	0,592	0,663	0,741	0,827
75	0,7153	0,350	0,403	0,459	0,519	0,584	0,654	0,730	0,815
80	0,7256	0,345	0,397	0,452	0,511	0,575	0,645	0,720	0,803
85	0,7358	0,340	0,391	0,446	0,504	0,567	0,636	0,710	0,792
90	0,7461	0,335	0,386	0,440	0,497	0,560	0,627	0,700	0,781
95	0,7564	0,331	0,381	0,434	0,491	0,552	0,618	0,691	0,770
100	0,7666	0,326	0,376	0,428	0,484	0,545	0,610	0,682	0,760

NOTE This information was supplied by the manufacturer, Minimax GmbH, Germany. It refers only to the product IG-01, and may not represent any other products containing argon.

Symbols:

V/V is the agent volume requirements (m^3/m^3); i.e. the quantity Q (m^3) of agent required at a temperature of 20 °C and a pressure of 1,013 bar per cubic metre of protected volume to produce the indicated concentration at the temperature specified:

$$Q = V \frac{S_R}{S} \ln\left(\frac{100}{100 - c}\right)$$

V is the nett volume of hazard (m^3); i.e. the enclosed volume minus the fixed structures impervious to extinguishant;

S_R is the specific reference volume (m^3/kg); i.e. the specific vapour volume at the filling reference temperature;

T is the temperature (°C); i.e. the design temperature of the protected area;

S is the specific volume (m^3/kg); the specific volume of superheated IG-01 vapour at a pressure of 1,013 bar may be approximated by the formula:

$$S = k_1 + k_2 T$$

where

k_1 = 0,561 19

k_2 = 0,002 054 5

c is the concentration (%); i.e. the volumetric concentration of IG-01 in air at the temperature indicated, and a pressure of 1,013 bar absolute.

Table 4 — IG-01 reference extinguishing and design concentrations

Fuel	Extinguishment %	Minimum design %
Heptane	37,5 [a]	48,8
Class A surface fires [a]	29,2	38,0
NOTE Value derived using the NMERI standard cup burner method.		
[a] See 7.5.1.3 of ISO 14520-1:2000.		

Table 5 — IG-01 extinguishing and design concentrations for other fuels

Fuel	Extinguishment %	Minimum design %
Acetone	32,9	42,8
Acetonitrile	32,9	42,8
Aviation gas	31,9	41,5
n-Butanol	35,9	46,7
Cyclohexane	36,4	47,3
Diesel No.2	27,1	35,2
Ethanol	40,5	52,6
Ethyl acetate	35,3	45,9
Ethylene glycol	31,0	40,3
Gasoline, unleaded	36,9	48,0
Hexane	36,9	48,0
Hydraulic oil No.1	25,7	33,4
Isopropanol (100 %)	35,1	45,7
JP-4	32,0	41,6
JP-5	31,5	41,0
Methane	34,8	45,2
Methanol	44,0	57,2
Morpholine	38,2	49,7
Nitromethane	34,6	45,0
Propane	40,1	52,1
Toluene	28,3	36,8
Xylene	25,6	33,3
NOTE Values were derived using the NMERI standard cup burner method.		

Table 6 — IG-01 inerting and design concentrations

Fuel	Inertion %	Minimum design %
Methane	55,8	61,4
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 IG-01 shall be considered in the design of the system.

Potential hazards can arise from the following:

a) oxygen reduction; and

b) the combustion products of the fire.

For minimum safety requirements, see ISO 14520-1:2000, clause 5.

Physiological information for IG-01 is shown in Table 7.

Table 7 — Physiological information for IG-01

Property	Value %
No observed adverse effect level (NOAEL)	43
Lowest observed adverse effect level (LOAEL)	52
NOTE These values are based on physiological effects in human subjects of hypoxic atmospheres. These values are the functional equivalents of NOAEL and LOAEL values, and correspond to 12 % minimum oxygen for the no-effect level and 10 % minimum oxygen for the low-effect level.	

6 System design

6.1 Fill pressure

The fill pressure of the container shall not exceed the values given in Tables 8 and 9.

The relationships between pressure and temperature are shown in Figure 1 for various levels of pressurization.

Table 8 — 160 bar storage container characteristics for IG-01

Property	Unit	Value
Filling pressure at 15 °C	bar	160
Maximum container working pressure at 50 °C	bar	180
NOTE Reference should be made to Figure 1 for further data on pressure/temperature relationships.		