INTERNATIONAL STANDARD

ISO 14520-13

First edition
2000-08-01

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

Part 13: IG-100 extinguishant

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

Partie 13: Agent extincteur IG-100

Reference number
ISO 14520-13:2000(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 14520-13 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 13:
IG-100 extinguishant

1 Scope

1.1 This part of ISO 14520 contains specific requirements for gaseous fire-extinguishing systems, with respect to the IG-100 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 135 bar at 15 °C and 162 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-100 shall comply with the specification shown in Table 1.

IG-100 is a colourless, odourless, electrically non-conductive gas with a density approximately the same as that of air.

The physical properties are shown in Table 2.

IG-100 extinguishes fires mainly by a reduction of oxygen.

Table 1 — Specification for IG-100

Property	Requirement
Purity	99,6 % by volume, min.
Moisture	50×10^{-6} by mass, max.
Oxygen	0,1 % by volume, max.
NOTE Only principal contaminants are shown. Other measurements may include hydrocarbons, CO, NO, NO_2, CO_2, etc. Most are $<20 \times 10^{-6}$.	

Table 2 — Physical properties of IG-100

Property	Units	Value
Molecular mass	—	28,02
Boiling point at 1,013 bar (absolute)	°C	–195,8
Freezing point	°C	–210,0
Critical temperature	°C	—
Critical pressure	bar abs	—
Critical volume	cm^3/mol	—
Critical density	kg/m^3	—
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	0,858
Chemical formula	N_2	
Chemical name	Nitrogen	

4.2 Use of IG-100 systems

IG-100 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.

Table 3 — IG-100 total flooding quantity

Temperature T	Specific vapour volume S	IG-100 volume requirements per unit volume of protected space, V/V (m³/m³)							
		Design concentration (by volume)							
°C	m³/kg	34 %	38 %	42 %	46 %	50 %	54 %	58 %	62 %
–40	0,6825	0,523	0,601	0,685	0,775	0,872	0,977	1,091	1,217
–35	0,6971	0,512	0,589	0,671	0,759	0,853	0,956	1,068	1,191
–30	0,7118	0,501	0,576	0,657	0,743	0,836	0,936	1,046	1,167
–25	0,7264	0,491	0,565	0,644	0,728	0,819	0,917	1,025	1,143
–20	0,7411	0,481	0,554	0,631	0,714	0,803	0,899	1,005	1,121
–15	0,7557	0,472	0,543	0,619	0,700	0,787	0,882	0,985	1,099
–10	0,7704	0,463	0,533	0,607	0,686	0,772	0,865	0,966	1,078
–5	0,7850	0,454	0,523	0,596	0,674	0,758	0,849	0,948	1,058
0	0,7997	0,446	0,513	0,585	0,661	0,744	0,833	0,931	1,038
5	0,8143	0,438	0,504	0,574	0,649	0,731	0,818	0,914	1,020
10	0,8290	0,430	0,495	0,564	0,638	0,718	0,804	0,898	1,002
15	0,8436	0,423	0,486	0,554	0,627	0,705	0,790	0,883	0,984
20	0,8583	0,416	0,478	0,545	0,616	0,693	0,777	0,868	0,968
25	0,8729	0,409	0,470	0,536	0,606	0,682	0,763	0,853	0,951
30	0,8876	0,402	0,462	0,527	0,596	0,670	0,751	0,839	0,936
35	0,9022	0,395	0,455	0,518	0,586	0,659	0,739	0,825	0,920
40	0,9169	0,389	0,447	0,510	0,577	0,649	0,727	0,812	0,906
45	0,9315	0,383	0,440	0,502	0,568	0,639	0,715	0,799	0,891
50	0,9462	0,377	0,434	0,494	0,559	0,629	0,704	0,787	0,878
55	0,9608	0,371	0,427	0,487	0,550	0,619	0,694	0,775	0,864
60	0,9755	0,366	0,421	0,479	0,542	0,610	0,683	0,763	0,851
65	0,9901	0,360	0,414	0,472	0,534	0,601	0,673	0,752	0,839
70	1,0048	0,355	0,408	0,465	0,526	0,592	0,663	0,741	0,827
75	1,0194	0,350	0,402	0,459	0,519	0,584	0,654	0,730	0,815
80	1,0341	0,345	0,397	0,452	0,511	0,575	0,645	0,720	0,803
85	1,0487	0,340	0,391	0,446	0,504	0,567	0,636	0,710	0,792
90	1,0634	0,335	0,386	0,440	0,497	0,559	0,627	0,700	0,781
95	1,0780	0,331	0,381	0,434	0,491	0,552	0,618	0,691	0,770
100	1,0927	0,326	0,375	0,428	0,484	0,544	0,610	0,681	0,760

NOTE This information was supplied by the manufacturer, Koatsu Co., Japan. It refers only to the product IG-100, and may not represent any other products containing nitrogen.

Symbols:

V/V is the agent volume requirements (m³/m³); i.e. the quantity Q (m³) 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 (m³); i.e. the enclosed volume minus the fixed structures impervious to extinguishant;

S_R is the specific reference volume (m³/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 (m³/kg); the specific volume of superheated IG-100 vapour at a pressure of 1,013 bar may be approximated by the formula:

$$S = k_1 + k_2 T$$

where

k_1 = 0,799 68

k_2 = 0,002 93

c is the concentration (%); i.e. the volumetric concentration of IG-100 in air at the temperature indicated, and a pressure of 1,013 bar absolute.

Table 4 — IG-100 reference extinguishing and design concentrations

Fuel	Extinguishment %	Minimum design %
Heptane	33,6	43,7
Surface class A hazards [a]	Not available at this time	Not available at this time
NOTE Values were derived in accordance with the requirements of ISO 14520-1:2000, annex B.		
[a] See 7.5.1.3 of ISO 14520-1:2000.		

5 Safety of personnel

Any hazard to personnel created by the discharge of IG-100 shall be considered in the design of the system.

Potential hazards can arise from the following:

a) the extinguishant itself, by reduction in oxygen; and

b) the combustion products of the fire.

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

Physiological information for IG-100 is shown in Table 5.

Table 5 — Physiological information for IG-100

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 6 and 7 for systems operating at 135 bar at 15°C and 162 bar at 15°C respectively.

Other pressures may be used and the minimum design pressure specified accordingly.

The relationships between pressure and temperature are shown in Figure 1.

Table 6 — 135 bar storage container characteristics for IG-100

Property	Unit	Value
Filling pressure at 15 °C	bar	135
Maximum container working pressure at 50 °C	bar	157
NOTE Reference should be made to Figure 1 for further data on pressure/temperature relationships.		

Table 7 — 162 bar storage container characteristics for IG-100

Property	Unit	Value
Filling pressure at 15 °C	bar	162
Maximum container working pressure at 50 °C	bar	188
NOTE Reference should be made to Figure 1 for further data on pressure/temperature relationships.		

6.2 Superpressurization

Containers for IG-100 are not superpressurized.

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 14520-1:2000.

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.