



SLOVENSKI STANDARD
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Vgrajeni gasilni sistemi - Sistemi za gašenje s plinom - 5. del: Fizikalne lastnosti in načrtovanje sistema za gašenje s plinom za gasilo HFC 227ea (ISO 14520-9:2016, spremenjen)

Fixed firefighting systems - Gas extinguishing systems - Part 5: Physical properties and system design of gas extinguishing systems for HFC 227ea extinguishant (ISO 14520-9:2016, modified)

Ortsfeste Brandbekämpfungsanlagen - Löschanlagen mit gasförmigen Löschmitteln - Teil 5: Physikalische Eigenschaften und Anlagenauslegung für Feuerlöschmittel HFC 227a (ISO 14520-9:2016, modifiziert)

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Installations fixes de lutte contre l'incendie - Installations d'extinction à gaz - Partie 5 : Propriétés physiques et conception des systèmes pour agent extincteur HFC 227ea (ISO 14520-9:2016, modifiée)

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**Fixed firefighting systems - Gas extinguishing systems -
Part 5: Physical properties and system design of gas
extinguishing systems for HFC 227ea extinguishant (ISO
15420-9:2016, modified)**

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Eigenschaften und Anlagenauslegung für
Feuerlöschmittel HFC 227a (ISO 15420-9:2016,
modifiziert)

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 191.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (prEN 15004-5:2019) has been prepared by Technical Committee CEN/TC 191 “Fixed firefighting systems”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 15004-5:2008.

The text of the International Standard ISO 14520-12:2015 from Technical Committee ISO/TC 21 “Equipment for fire protection and firefighting” of the International Organization for Standardization (ISO) has been taken over as a European Standard by Technical Committee CEN/TC 191 “Fixed firefighting systems”, the secretariat of which is held by BSI, with common modifications which are indicated by a straight line in the margin of the text.

This document will consist of the following parts, under the general title *Fixed firefighting systems – Gas extinguishing systems*:

- Part 1: *Design, installation and maintenance*;
- Part 2: *Physical properties and system design of gas extinguishing systems for FK-5-1-12 extinguishant*;
- Part 3: *Physical properties and system design of gas extinguishing systems for HCFC Blend A extinguishant*;
- Part 4: *Physical properties and system design of gas extinguishing systems for HFC 125 extinguishant*;
- Part 5: *Physical properties and system design of gas extinguishing systems for HFC 227ea extinguishant*;
- Part 6: *Physical properties and system design of gas extinguishing systems for HFC 23 extinguishant*;
- Part 7: *Physical properties and system design of gas extinguishing systems for IG-01 extinguishant*;
- Part 8: *Physical properties and system design of gas extinguishing systems for IG-100 extinguishant*;
- Part 9: *Physical properties and system design of gas extinguishing systems for IG-55 extinguishant*;
- Part 10: *Physical properties and system design of gas extinguishing systems for IG-541 extinguishant*.

The International Standards ISO 14520-2 and ISO 14520-11, which dealt with CF₃I and HFC 236fa extinguishants, respectively, have not been implemented by CEN, as CF₃I is only valid for local application and HFC 236fa extinguishant is only applicable for portable fire extinguishers and local application, respectively, which is not covered by the scope.

prEN 15004-5:2019 (E)

1 Scope

This document contains specific requirements for gaseous fire-extinguishing systems, with respect to the HFC 227ea extinguishant. It includes details of physical properties, specification, usage and safety aspects.

This document covers systems operating at nominal pressures of 25 bar, 42 bar and 50 bar with nitrogen propellant. This does not preclude the use of other systems.

2 Normative references

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.

EN 15004-1:2019, *Ortsfeste Brandbekämpfungsanlagen — Löschanlagen mit gasförmigen Löschmitteln — Teil 1: Planung, Installation und Instandhaltung*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15004-1 apply.

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

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Characteristics and uses

4.1 General

Extinguishant HFC 227ea shall comply with the specification shown in Table 1.

HFC 227ea is a colourless, almost odourless, electrically non-conductive gas, with a density approximately six times that of air.

The physical properties are shown in Table 2.

HFC 227ea extinguishes fires mainly by physical means, but also by some chemical means.

Table 1 — Specification for HFC 227ea

Property	Requirement
Purity	99,6 % by mass, min.
Acidity	3×10^{-6} by mass, max.
Water content	10×10^{-6} by mass, max.
Non-volatile residue	0,01 % by mass, max.
Suspended matter or sediment	None visible

Table 2 — Physical properties of HFC 227ea

Property	Units	Value
Molecular mass	—	170
Boiling point at 1,013 bar (absolute)	°C	-16,4
Freezing point	°C	-127
Critical temperature	°C	101,7
Critical pressure	bar abs	29,26
Critical volume	cm ³ /mol	274
Critical density	kg/m ³	573
Vapour pressure 20 °C	bar abs	3,90
Liquid density 20 °C	kg/m ³	1 410
Saturated vapour density 20 °C	kg/m ³	31,035
Specific volume of superheated vapour at 1,013 bar and 20 °C	m ³ /kg	0,137 4
Chemical formula	CF ₃ CHFCF ₃	
Chemical name	Heptafluoropropane	

4.2 Use of HFC 227ea systems

HFC 227ea total flooding systems can be used for extinguishing fires of all classes within the limits specified in EN 15004-1:2019, 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 EN 15004-1:2019, 7.6.

The extinguishing concentrations and design concentrations for n-heptane and surface class A hazards are shown in Table 4.

Table 3 — HFC 227ea total flooding quantity

Temperature T °C	Specific vapour volume S m ³ /kg	HCF 227ea mass requirements per unit volume of protected space, m/V (kg/m ³)									
		Design concentration (by volume)									
		6 %	7 %	8 %	9 %	10 %	11 %	12 %	13 %	14 %	15 %
-10	0,121 5	0,525 4	0,619 6	0,715 8	0,814 2	0,914 7	1,017 4	1,122 5	1,230 1	1,340 1	1,452 7
-5	0,124 1	0,514 2	0,606 4	0,700 5	0,796 7	0,895 1	0,995 7	1,098 5	1,203 8	1,311 4	1,421 6
0	0,126 8	0,503 4	0,593 6	0,685 8	0,780 0	0,876 3	0,974 8	1,075 5	1,178 5	1,283 9	1,391 8
5	0,129 4	0,493 2	0,581 6	0,671 9	0,764 2	0,858 6	0,955 0	1,053 7	1,154 6	1,257 9	1,363 6
10	0,132 0	0,483 4	0,570 0	0,658 5	0,749 0	0,841 4	0,936 0	1,032 7	1,131 6	1,232 8	1,336 4
15	0,134 7	0,474 0	0,558 9	0,645 7	0,734 4	0,825 1	0,917 8	1,012 6	1,109 6	1,208 9	1,310 5
20	0,137 3	0,465 0	0,548 3	0,633 5	0,720 5	0,809 4	0,900 4	0,993 4	1,08 86	1,185 9	1,285 6
25	0,139 9	0,456 4	0,538 2	0,621 7	0,707 1	0,794 4	0,883 7	0,975 0	1,068 4	1,164 0	1,261 8
30	0,142 5	0,448 1	0,528 4	0,610 4	0,694 3	0,780 0	0,867 6	0,957 3	1,049 0	1,142 8	1,238 8
35	0,145 0	0,440 1	0,519 0	0,599 6	0,681 9	0,766 1	0,852 2	0,940 2	1,030 3	1,122 4	1,216 8
40	0,147 6	0,432 4	0,509 9	0,589 1	0,670 1	0,752 8	0,837 4	0,923 9	1,012 4	1,102 9	1,195 6
45	0,150 2	0,425 0	0,501 2	0,579 0	0,658 6	0,739 9	0,823 0	0,908 0	0,995 0	1,084 0	1,175 1
50	0,152 7	0,418 0	0,492 9	0,569 4	0,647 6	0,727 6	0,809 3	0,892 9	0,978 4	1,066 0	1,155 5
55	0,155 3	0,411 1	0,484 7	0,560 0	0,636 9	0,715 6	0,796 0	0,8782	0,962 3	1,048 4	1,136 5
60	0,157 8	0,404 5	0,477 0	0,551 0	0,626 7	0,704 1	0,783 2	0,864 1	0,946 9	1,031 6	1,118 3
65	0,160 4	0,398 0	0,469 4	0,542 3	0,616 7	0,6929	0,770 7	0,850 4	0,931 8	1,015 2	1,100 5
70	0,162 9	0,391 9	0,462 1	0,533 8	0,607 2	0,6821	0,758 8	0,837 1	0,917 3	0,999 4	1,083 4
75	0,165 4	0,385 9	0,455 0	0,525 7	0,597 9	0,6717	0,747 1	0,824 3	0,903 3	0,984 1	1,066 8
80	0,167 9	0,380 1	0,448 2	0,517 8	0,589 0	0,6617	0,736 0	0,812 0	0,889 8	0,969 4	1,050 9
85	0,170 4	0,374 5	0,441 6	0,510 2	0,580 3	0,6519	0,725 1	0,800 0	0,876 7	0,955 1	1,035 4
90	0,173 0	0,369 0	0,435 1	0,502 7	0,571 7	0,642 3	0,714 5	0,788 3	0,863 8	0,941 1	1,020 2
95	0,175 5	0,363 8	0,429 0	0,495 6	0,563 6	0,633 2	0,704 4	0,777 1	0,851 6	0,927 7	1,005 7
100	0,178 0	0,358 7	0,422 9	0,488 6	0,555 7	0,624 3	0,694 5	0,766 2	0,839 6	0,914 7	0,991 6

NOTE This information refers only to the product HFC-227ea and does not represent any other products containing 1,1,1,2,3,3,3-heptafluoropropane as a component.

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 HFC 227ea vapour at a pressure of 1,013 bar may be approximated by the formula

$$S = k_1 + k_2 T$$

where

$$k_1 = 0,126 9$$

$$k_2 = 0,000 513$$

c is the concentration (%); i.e. the volumetric concentration of HFC 227ea in air at the temperature indicated and a pressure of 1,013 bar absolute.

Table 4 — HFC 227ea reference extinguishing and design concentrations

Fuel	Extinguishment % by volume	Minimum design % by volume
Class B Heptane (cup burner) Heptane (room test)	6,7 6,9	9,0
Surface Class A Wood Crib PMMA PP ABS	4,9 6,1 6,1 6,1	7,9
Higher Hazard Class A	See Note 4	8,5
<p>NOTE 1 The extinguishment values for the Class B and the Surface Class A fuels are determined by testing in accordance with EN 15004-1:2019, Annexes B and C.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>NOTE 5 EN 15004-1:2019, 7.5.1.3 for guidance on Class A fuels.</p>		

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 and Table 6 from ISO/DIS 14520-9:2014 have been removed by CEN/TC 191/WG 6 because no data was available to verify the given values.

5 Safety of personnel

Any hazard to personnel created by the discharge of HFC 227ea 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) breakdown products of the extinguishant resulting from exposure to fire.

For minimum safety requirements, see EN 15004-1:2019, Clause 5.

Toxicological information for HFC 227ea is shown in Table 5.

Table 5 — Toxicological information for HFC 227ea

Property	Value % by volume
ALC	> 80 at 20 % O ₂
No observed adverse effect level (NOAEL)	9,0
Lowest observed adverse effect level (LOAEL)	10,5
NOTE 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 given in Table 8, Table 9, and Table 10 for 25 bar, 42 bar or 50 bar systems.

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 and Figure 2 for various levels of fill density.

Table 6 — 25 bar storage container characteristics for HFC 227ea

Property	Unit	Value
Maximum fill density	kg/m ³	1 150
Maximum container working pressure at 50 °C	bar	34
Superpressurization at 21 °C	bar	25
NOTE Reference Figure 1 for further data on pressure/temperature relationships.		

Table 7— 42 bar storage container characteristics for HFC 227ea

Property	Unit	Value
Maximum fill density	kg/m ³	1 150
Maximum container working pressure at 50 °C	bar	53
Superpressurization at 21 °C	bar	42
NOTE Reference Figure 2 for further data on pressure/temperature relationships.		