SLOVENSKI STANDARD
oSIST prEN 15004-2:2019

01-september-2019

Vgrajeni gasilni sistemi - Sistemi za gašenje s plinom - 2. del: Fizikalne lastnosti in načrtovanje sistema za gašenje s plinom za gasilo FK-5-1-12 (ISO 14520-5:2016, spremenjen)

Fixed firefighting systems - Gas extinguishing systems - Part 2: Physical properties and system design of gas extinguishing systems for FK-5-1-12 extinguishant (ISO 14520-5:2016, modified)

Ortsfeste Brandbekämpfungsanlagen - Löschanlagen mit gasförmigen Löschmitteln - Teil 2: Physikalische Eigenschaften und Anlagenauslegung für Feuerlöschmittel FK-5-1-12 (ISO 14520-5:2016, modifiziert)

Installations fixes de lutte contre l'incendie - Installations d'extinction à gaz - Partie 2 : Propriétés physiques et conception des systèmes des installations d'extinction à gaz pour agent extincteur FK-5-1-12 (ISO 14520-5:2016, modifiée)

Ta slovenski standard je istoveten z: **prEN 15004-2**

ICS:

13.220.10	Gašenje požara	Fire-fighting

oSIST prEN 15004-2:2019 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 15004-2

June 2019

ICS 13.220.20

Will supersede EN 15004-2:2008

English Version

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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.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 15004-2:2019) 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 15004-2:2008.

The text of the International Standard ISO 14520-5:2016 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 CF_3I and HFC 236fa extinguishants, respectively, have not been implemented by CEN, as CF_3I 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.

1 Scope

This document specifies requirements for gaseous fire-extinguishing systems, with respect to FK-5-1-12 extinguishant. It includes details of physical properties, specification, usage and safety aspects.

This document covers only systems operating at nominal pressures of 25 bar, 34,5 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, *Fixed firefighting systems — Gas extinguishing systems — Part 1: Design, installation and maintenance (ISO 14520-1)*

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 FK-5-1-12 shall comply with the specification shown in Table 1.

FK-5-1-12 is a clear, colourless, almost odourless, electrically non-conductive gas with a density approximately 11 times that of air.

The physical properties are shown in Table 2.

FK-5-1-12 extinguishes fires mainly by physical means, but also by some chemical means.

Table 1 — Specification for FK-5–1-12

Property	Requirement
Purity	99,0 % mol/mol min.
Acidity	3×10^{-6} by mass, max.
Water content	0,001 % by mass, max.
Non-volatile residue	0,03 % by mass, max.
Suspended matter or sediment	None visible

Table 2 — Physical properties of FK-5–1-12

Property	Units	Value
Molecular mass	n/a	316,04
Boiling point at 1,013 bar (absolute)	°C	49,2
Freezing point	°C	–108,0
Critical temperature	°C	168,66
Critical pressure	bar	18,646
Critical volume	cm^3/mol	494,5
Critical density	kg/m^3	639,1
Vapour pressure 20 °C	bar abs	0,3260
Liquid density 20 °C	g/ml	1,616
Saturated vapour density 20 °C	kg/m^3	4,3305
Specific volume of superheated vapour at 1,013 bar and 20 °C	m^3/kg	0,0719
Heat of vapourization at boiling point	KJ/kg	88,0
Chemical formula	$CF_3CF_2C(O)CF(CF_3)_2$	
Chemical name	Dodecafluoro-2-methylpentan-3-one	

4.2 Use of FK-5-1-12 systems

FK-5-1-12 total flooding systems may 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 heptane and Surface Class A hazards are shown in Table 4. Concentrations for other fuels are shown in Table 5 and inerting concentrations in Table 6.

Table 3 — FK-5–1-12 total flooding quantity

Temperature	Specific volume	FK-5–1-12 mass requirements per unit volume of protected space, m/V (kg/m^3)							
		Design concentration (by volume)							
T	S								
°C	m^3/kg	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %
–20	0,060 9	0,507 7	0,684 0	0,864 0	1,040 7	1,235 7	1,427 5	1,623 6	1,824 1
–15	0,062 3	0,496 5	0,669 0	0,845 0	1,024 8	1,208 4	1,396 1	1,587 9	1,783 9
–10	0,063 7	0,485 9	0,654 5	0,826 8	1,002 7	1,182 4	1,366 0	1,553 7	1,745 5
–5	0,065 0	0,475 6	0,640 7	0,809 4	0,981 6	1,157 5	1,337 2	1,520 9	1,708 7
0	0,066 4	0,465 8	0,627 5	0,792 6	0,961 3	1,133 6	1,309 6	1,489 5	1,673 4
5	0,067 8	0,456 4	0,614 8	0,776 6	0,941 8	1,110 6	1,283 1	1,459 3	1,639 5

Temperature	Specific volume	FK-5–1-12 mass requirements per unit volume of protected space, m/V (kg/m^3)							
		Design concentration (by volume)							
T	S								
°C	m^3/kg	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %
10	0,069 1	0,447 3	0,602 6	0,761 2	0,923 2	1,088 6	1,257 6	1,430 4	1,607 0
15	0,070 5	0,438 6	0,590 9	0,746 4	0,905 2	1,067 4	1,233 2	1,402 6	1,575 7
20	0,071 9	0,430 2	0,579 6	0,732 2	0,887 9	1,047 1	1,209 6	1,375 8	1,545 7
25	0,073 3	0,422 2	0,568 8	0,718 4	0,871 3	1,027 5	1,187 0	1,350 0	1,516 7
30	0,074 6	0,414 4	0,558 3	0,705 2	0,855 3	1,008 6	1,165 2	1,325 2	1,488 8
35	0,076 0	0,406 9	0,548 2	0,692 5	0,839 9	0,990 4	1,144 2	1,301 3	1,462 0
40	0,077 4	0,399 7	0,538 5	0,680 2	0,825 0	0,972 8	1,123 9	1,278 3	1,436 1
45	0,078 7	0,392 8	0,529 1	0,668 4	0,810 6	0,955 9	1,104 3	1,256 0	1,411 1
50	0,080 1	0,386 0	0,520 1	0,657 0	0,796 7	0,939 5	1,085 4	1,234 5	1,386 9
55	0,081 5	0,379 5	0,511 3	0,645 9	0,783 3	0,923 7	1,067 1	1,213 7	1,363 6
60	0,082 9	0,373 3	0,502 9	0,635 2	0,770 4	0,908 4	1,049 5	1,193 6	1,341 0
65	0,084 2	0,367 2	0,494 7	0,624 7	0,757 8	0,893 6	1,032 4	1,174 2	1,319 1
70	0,085 6	0,361 3	0,486 8	0,614 8	0,745 7	0,879 3	1,015 8	1,155 4	1,298 0
75	0,087 0	0,355 6	0,479 1	0,605 2	0,733 9	0,865 4	0,999 8	1,137 2	1,277 5
80	0,088 3	0,350 1	0,471 6	0,595 8	0,722 5	0,852 0	0,984 3	1,119 5	1,257 7
85	0,089 7	0,344 7	0,464 4	0,586 6	0,711 5	0,839 0	0,969 2	1,102 4	1,238 5
90	0,091 1	0,339 5	0,457 4	0,577 8	0,700 8	0,826 3	0,954 7	1,085 8	1,219 8
95	0,092 5	0,334 5	0,450 7	0,569 2	0,690 4	0,814 1	0,940 5	1,069 7	1,201 4
100	0,093 8	0,329 6	0,444 1	0,560 9	0,680 3	0,802 2	0,926 7	1,054 0	1,184 2

NOTE This information refers only to FK-5–1-12 and does not represent any other product containing dodecafluoromethylpentan-3-one 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 FK-5–1-12 vapour at a pressure of 1,013 bar may be approximated by the formula

$S = k_1 + k_2 T$

where

$k_1 = 0{,}066\ 4$

$k_2 = 0{,}000\ 274$

c is the concentration (%), i.e. the volumetric concentration of FK-5–1-12 in air at the temperature indicated and a pressure of 1,013 bar absolute.

Table 4 — FK-5–1-12 reference extinguishing and design concentrations

Fuel	Extinguishment % by volume	Minimum design % by volume
Class B		
Heptane (cup burner)	4,5	5,9
Heptane (room test)	4,4	
Surface Class A		
Wood crib	3,4	
PMMA	4,1	5,3
PP	4,0	
ABS	4,0	
Higher Hazard Class A	See Note 4	5,6

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.

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 Higher-Hazard Class A hazards are those having the characteristics described in the CAUTION statement of EN 15004 -1:2019, 7.5.1.3. 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 EN 15004-1:2019, 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 and 6 from ISO 14520-12:2014 has been removed because no data was available to verify the given values.

5 Safety of personnel

Any hazard to personnel created by the discharge of FK-5-1-12 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.

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

Toxicological information for FK-5-1-12 is shown in Table 5.

Table 5 — Toxicological information for FK-5–1-12

Property	Value %
4 h LC_{50}	> 10 %
No observed adverse effect level (NOAEL)	10 %
Lowest observed adverse effect level (LOAEL)	> 10 %
NOTE LC_{50} is the concentration lethal to 50 % of the 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 6 to 9 for 25 bar, 34,5 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 for various levels of fill density.

Table 6 — 25 bar storage container characteristics for FK-5–1-12

Property	Unit	Value
Maximum fill density	kg/m^3	1 480
Maximum container working pressure at 50 °C	bar	29
Superpressurization at 20 °C	bar	25
NOTE Reference Figure 1 for further data on pressure/temperature relationships.		

Table 7 — 34,5 bar storage container characteristics for FK-5–1-12

Property	Unit	Value
Maximum fill density	kg/m^3	1 200
Maximum container pressure at 50 °C	bar	38
Superpressurization at 20 °C	bar	34,5
NOTE Reference Figure 2 for further data on pressure/temperature relationships.		