SLOVENSKI STANDARD
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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

Fixed firefighting systems - Gas extinguishing systems - Part 2: Physical properties and system design of gas extinguishing systems for FK-5-1-12

Ortsfeste Brandbekämpfungsanlagen - Löschanlagen mit gasförmigen Löschmitteln - Teil 2: Physikalische Eigenschaften und Anlagenauslegung für Feuerlöschmittel FK-5-1-12

Installations fixes de lutte contre l'incendie - Installations d'extinction à gaz - Partie 2: Propriétés physiques et conception des systèmes pour agent extincteur FK-5-1-12

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (prEN 15004-2:2014) 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.

EN 15004 consists 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 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”*

1 Scope

1.1 This part of EN 15004 contains specific 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.

1.2 This part of EN 15004 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, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Gaseous fire-extinguishing systems — Physical properties and system design — Part 1: General requirements.*

3 Terms and definitions

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

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 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 clause 4 of EN 15004-1.

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 EN 15004-1.

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 T °C	Specific volume S m³/kg	FK-5-1-12 mass requirements per unit volume of protected space, m/V (kg/m³)							
		Design concentration (by volume)							
		3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %
–20	0,0609	0,5077	0,6840	0,8640	1,0407	1,2357	1,4275	1,6236	1,8241
–15	0,0623	0,4965	0,6690	0,8450	1,0248	1,2084	1,3961	1,5879	1,7839
–10	0,0637	0,4859	0,6545	0,8268	1,0027	1,1824	1,3660	1,5537	1,7455
–5	0,0650	0,4756	0,6407	0,8094	0,9816	1,1575	1,3372	1,5209	1,7087
0	0,0664	0,4658	0,6275	0,7926	0,9613	1,1336	1,3096	1,4895	1,6734
5	0,0678	0,4564	0,6148	0,7766	0,9418	1,1106	1,2831	1,4593	1,6395
10	0,0691	0,4473	0,6026	0,7612	0,9232	1,0886	1,2576	1,4304	1,6070
15	0,0705	0,4386	0,5909	0,7464	0,9052	1,0674	1,2332	1,4026	1,5757
20	0,0719	0,4302	0,5796	0,7322	0,8879	1,0471	1,2096	1,3758	1,5457
25	0,0733	0,4222	0,5688	0,7184	0,8713	1,0275	1,1870	1,3500	1,5167
30	0,0746	0,4144	0,5583	0,7052	0,8553	1,0086	1,1652	1,3252	1,4888
35	0,0760	0,4069	0,5482	0,6925	0,8399	0,9904	1,1442	1,3013	1,4620
40	0,0774	0,3997	0,5385	0,6802	0,8250	0,9728	1,1239	1,2783	1,4361
45	0,0787	0,3928	0,5291	0,6684	0,8106	0,9559	1,1043	1,2560	1,4111
50	0,0801	0,3860	0,5201	0,6570	0,7967	0,9395	1,0854	1,2345	1,3869
55	0,0815	0,3795	0,5113	0,6459	0,7833	0,9237	1,0671	1,2137	1,3636
60	0,0829	0,3733	0,5029	0,6352	0,7704	0,9084	1,0495	1,1936	1,3410
65	0,0842	0,3672	0,4947	0,6247	0,7578	0,8936	1,0324	1,1742	1,3191
70	0,0856	0,3613	0,4868	0,6148	0,7457	0,8793	1,0158	1,1554	1,2980
75	0,0870	0,3556	0,4791	0,6052	0,7339	0,8654	0,9998	1,1372	1,2775
80	0,0883	0,3501	0,4716	0,5958	0,7225	0,8520	0,9843	1,1195	1,2577
85	0,0897	0,3447	0,4644	0,5866	0,7115	0,8390	0,9692	1,1024	1,2385
90	0,0911	0,3395	0,4574	0,5778	0,7008	0,8263	0,9547	1,0858	1,2198
95	0,0925	0,3345	0,4507	0,5692	0,6904	0,8141	0,9405	1,0697	1,2014
100	0,0938	0,3296	0,4441	0,5609	0,6803	0,8022	0,9267	1,0540	1,1842

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/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 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) Heptane (room test)	 4.5 4,4	 5,9
Surface Class A Wood Crib PMMA PP ABS	 3,4 4,1 4,0 4,0	5,3
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 Annexes B and C of ISO 14520-1.

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 4 extinguishment values, the minimum design concentration for Surface Class A shall be that of Higher Hazard Class A.

NOTE 4 The minimum design concentration for Higher Hazard Class A fuels shall be the higher of the Surface Class A or 95% of the Class B minimum design concentration.

NOTE 5 See 7.5.1.3 of EN 15004-1 for guidance on Class A fuels.

NOTE 6 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 — FK-5-1-12 concentrations for other fuels

Fuel	Extinguishment % by volume	Minimum design % by volume
Acetone	4,5	5,9
Ethyl alcohol	5,5	7,2
Marine diesel	4,5	5,9
Methyl alcohol	6,5	8,5
Methyl ethyl ketone	4,5	5,9
n-heptane	4,5	5,9
Technical heptane	4,5	5,9

NOTE Extinguishing concentrations for all Class B fuels listed were derived in accordance with EN 15004-1, Annex B.

Minimum design values have been increased to the minimum design concentration established for heptane in accordance with EN 15004-1, section 7.5.1.

Table 6 — FK-5-1-12 inerting and design concentrations

Fuel	Inertion %	Minimum design %
Methane	8,8	9,7
Propane	8,1	8,9
NOTE Determined in accordance with EN 15004-1.		

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; and

c) the breakdown products of the extinguishant resulting from exposure to fire. For minimum safety requirements, see EN 15004-1, clause 5.

Toxicological information for FK-5-1-12 is shown in Table 7.

Table 7 — 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-hour exposure.	

6 System Design

6.1 Fill density

The fill density of the container shall not exceed the values shown in table 8 through 11 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.