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ISO TC 21/SC 6

Secretariat: SAC

Fire extinguishing media — Foam concentrates —

Part 2:
Specification for medium- and high-expansion foam concentrates for top application to water-immiscible liquids

Agents extincteurs — Émulseurs —

Partie 2: Spécifications pour les émulseurs moyen et haut foisonnements destinés à une application par le haut sur les liquides non miscibles à l'eau

DIS stage

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 6, *Foam and powder media and firefighting systems using foam and powder*.

This third edition cancels and replaces the second edition (ISO 7203-2:2011), which has been technically revised.

The main changes compared to the previous edition are:

- addition of Clause 4 containing specifications for Class A foam concentrates;
- extension of Clause 2;
- modification of Clause 12 to run two tests instead of one and take the average of both values instead having just one datum;
- correction of several figures;
- the extension of Annex H by a scheme of a decision tree and the modification of the acceptable temperature range for testing fire performance;
- removal of Annex “Typical anticipated performance for various types of foam concentrate”.

A list of all parts in the ISO 7203 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Firefighting foams are widely used to control and extinguish fires of Class B (flammable liquids) and/or Class A fuels (solid materials, usually of an organic nature) and for inhibiting reignition.

Foams can be used in combination with other extinguishing media, in particular halons, carbon dioxide and powders, which are the subject of other International Standards, including, ISO 6183, ISO 7201-1, ISO 7201-2 and ISO 7202. A specification for foam systems can be found in ISO 7076.

Attention is drawn to Annex K, which deals with the compatibility of foam concentrates, and the compatibility of foams and powders.

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Fire extinguishing media — Foam concentrates — Part 2: Specification for medium- and high-expansion foam concentrates for top application to water-immiscible liquids

1 Scope

This document specifies the essential properties and performance of liquid foam concentrates used to make medium- or high-expansion foams or both for the control, the extinction and the inhibition of reignition of fires of water-immiscible liquids. Minimum performance on certain test fires is specified.

These foams are suitable for top application to fires of water-immiscible liquid. Those foams that comply with ISO 7203-1 are also suitable for top application to fires of water-immiscible liquids.

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.

ISO 304, *Surface active agents — Determination of surface tension by drawing up liquid films*

ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 3219, *Plastics — Polymers/resins in the liquid state or as emulsions or dispersions — Determination of viscosity using a rotational viscometer with defined shear rate*

ISO 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods*

ISO 3734, *Petroleum products — Determination of water and sediment in residual fuel oils — Centrifuge method*

ISO 7203-1, *Fire extinguishing media — Foam concentrates — Part 1: Specification for low-expansion foam concentrates for top application to water-immiscible liquids*

ISO 7203-3, *Fire extinguishing media — Foam concentrates — Part 3: Specification for low-expansion foam concentrates for top application to water-miscible liquids*

BS 5117-1.3:1985, *Testing corrosion inhibiting, engine coolant concentrate (“antifreeze”). Methods of test for determination of physical and chemical properties. Determination of freezing point*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1

characteristic value

value declared by the foam concentrate supplier for the chemical and physical properties and the performances of the foam, foam solution, and foam concentrate

3.2

25 % drainage time

time for 25 % of the liquid content of a foam to drain out

3.3

expansion

ratio of the volume of foam to the volume of the foam solution from which it was made

3.4

low-expansion

expansion (3.3) in the range 1 to 20, as applied to foam and to associated equipment, systems and concentrates

3.5

medium-expansion

expansion (3.3) in the range 21 to 200, as applied to foam and to associated equipment, systems and concentrates

3.6

high-expansion

expansion (3.3) greater than 200, as applied to foam and to associated equipment, systems and concentrates

3.7

foam

<firefighting> aggregate of air-filled bubbles formed from an aqueous solution of a suitable foam concentrate

3.8

concentrate

<foam> liquid that, when mixed with water in the appropriate concentration, gives a foam solution

3.9

protein foam concentrate

P

foam *concentrate* (3.8) derived from hydrolysed protein materials

3.10

fluoroprotein foam concentrate

FP

protein foam *concentrate* (3.8) with added fluorinated surface-active agents

3.11

synthetic foam concentrate

S

foam *concentrate* (3.8) based on a mixture of hydrocarbon surface-active agents and which can contain fluorocarbons with additional stabilizers

3.12

alcohol-resistant foam concentrate

AR

foam *concentrate* (3.8) resistant to breakdown when applied to the surface of alcohol or other water-miscible solvents

3.13

aqueous film-forming foam concentrate

AFFF

foam *concentrate* (3.8) based on a mixture of hydrocarbon and fluorinated surface-active agents with the ability to form an aqueous film on the surface of some hydrocarbons

3.14

film-forming fluoroprotein foam concentrate

FFFP

fluoroprotein foam *concentrate* (3.8) that has the ability to form an aqueous film on the surface of some hydrocarbons

3.15

foam solution

solution of foam *concentrate* (3.8) and water

3.16

forceful application

application of foam such that it falls directly onto the surface of a liquid fuel

3.17

gentle application

application of foam indirectly to the surface of a liquid fuel via a backboard, tank wall or other surface

3.18

sediment

insoluble particles in the foam concentrate

3.19

spreading coefficient

value calculated from the measured surface and interfacial tensions to indicate the ability of one liquid to spontaneously spread across the surface of another

3.20

temperature for use

maximum and minimum temperatures claimed by the manufacturer between which the foam concentrate is ready for use

3.21

fluorine free foam concentrate

F3

foam *concentrate* (3.8) which does not form an aqueous film on hydrocarbon fuels, but which is targeting Class B performance at forceful application and which does not contain any fluorochemicals

3.22

Class A foam concentrate

foam *concentrate* (3.8) for use on Class A fires

3.23

Class A fire

fire involving solid materials, usually of an organic nature, in which combustion normally takes place with the formation of glowing embers

Note 1 to entry: Adapted from ISO 3941:2007, Clause 2.

Note 2 to entry: Class A fires involve solid materials, usually of an organic nature (such as vegetation, wood, cloth and paper), rubber, and some plastics, in which combustion can occur at or below the surface of the material with or without the formation of glowing embers.

4 Classification and uses of foam concentrates

4.1 Classification

The foam concentrate shall be classified as medium- or high- expansion or both and shall comply with the appropriate requirements.

4.2 Use with sea water

If a foam concentrate is marked as suitable for use with sea water, the recommended concentrations for use with fresh water and sea water shall be identical.

5 Tolerance of the foam concentrate to freezing and thawing

Before and after temperature conditioning in accordance with A.2, the foam concentrate, if claimed by the supplier not to be adversely affected by freezing and thawing, shall show no visual sign of stratification and non-homogeneity, when tested in accordance with Annex B.

Foam concentrates complying with this clause shall be tested for compliance with the appropriate requirements given in other clauses of this document after freezing and thawing in accordance with A.2.1.

6 Sediment in the foam concentrate

6.1 Sediment before ageing

Any sediment in the concentrate sampled in accordance with A.1 shall be dispersible through a 180 µm sieve, and the volume percentage of sediment shall be not more than 0,25 % when tested in accordance with Annex C.

6.2 Sediment after ageing

Any sediment in the concentrate aged in accordance with C.1 shall be dispersible through a 180 µm sieve, and the volume percentage of sediment shall be not more than 1,0 % when tested in accordance with Annex C.

7 Determination of viscosity

7.1 Newtonian foam concentrates

The viscosity of the foam concentrate at the lowest temperature for use claimed by the manufacturer shall be determined in accordance with ISO 3104. If the viscosity is greater than $200 \text{ mm}^2\text{s}^{-1}$, the container shall be marked "This concentrate can require special proportioning equipment".

7.2 Pseudo-plastic foam concentrates

The viscosity of the foam concentrate shall be determined in accordance with Annex D. If the viscosity at the lowest temperature for use is greater than or equal to $120 \text{ mPa}\cdot\text{s}$ at 375/s, the container shall be marked "This concentrate can require special proportioning equipment".

NOTE Pseudo-plastic foam concentrates are a particular class of non-Newtonian foam concentrates and have a viscosity that decreases with increasing shear rate at constant temperature.

8 pH of the foam concentrate

8.1 pH limits

The pH of the foam concentrate, before and after temperature conditioning in accordance with A.2, shall be not less than 6,0 and not more than 8,5 at (20 ± 2) °C.

8.2 Sensitivity to temperature

The difference in pH between before and after temperature conditioning shall not be greater than 1,0 pH units.

9 Surface tension of the foam solution

9.1 Before temperature conditioning

The surface tension of the foam solution prepared from the concentrate, before temperature conditioning in accordance with A.2, at the supplier's recommended concentration, shall be within ± 10 % of the characteristic value when determined in accordance with E.2.

9.2 Temperature sensitivity

The surface tension of the foam solution prepared from the concentrate, after temperature conditioning in accordance with A.2, at the supplier's recommended concentration, shall be determined in accordance with E.2.

The value obtained after temperature conditioning shall not be less than 0,95 times, or more than 1,05 times, the value obtained before temperature conditioning.

10 Interfacial tension between the foam solution and cyclohexane

10.1 General

Interfacial tension shall only be tested on foam agents which are declared by the manufacturer to be aqueous film forming.

10.2 Before temperature conditioning

Before temperature conditioning in accordance with A.2, the difference between (a) the interfacial tension between the foam solution prepared from the foam concentrate and cyclohexane (when determined in accordance with E.3) and (b) the characteristic value for interfacial tension shall not exceed 1,0 mN/m or 10 % of the characteristic value, whichever is greater.

10.3 Temperature sensitivity

After temperature conditioning in accordance with A.2, the interfacial tension between the foam solution prepared from the foam concentrate and cyclohexane shall be determined in accordance with E.3.

The two values obtained before and after temperature conditioning shall not differ by more than 0,5 mN/m.

11 Spreading coefficient of the foam solution on cyclohexane

The spreading coefficient shall only be tested on foam agents which are declared by the manufacturer to be aqueous film forming.

Before and after temperature conditioning in accordance with A.2, the spreading coefficient of the foam solution prepared from a concentrate claimed by the supplier to be "film-forming" shall be positive when calculated in accordance with E.4.

NOTE Foam concentrates conforming with this clause are more likely to be of type AFFF or FFFP than of type FP, P, F3 or S.

12 Expansion

12.1 Medium-expansion foam concentrates — Limits

The foam produced from the foam concentrate, before and after temperature conditioning in accordance with A.2, with potable water and, if appropriate, with the synthetic sea water of H.2.4, shall have an expansion of not less than 21 when tested in accordance with Annex F.

12.2 High-expansion foam concentrate — Limits

The foam produced from the foam concentrate, before and after temperature conditioning in accordance with A.2, with potable water and, if appropriate, with the synthetic sea water of I.2.4, shall have an expansion of not less than 201 when tested in accordance with Annex G.

13 Test fire performance

The foam produced from the foam concentrate with potable water, and if appropriate, with the synthetic sea water according to H.2.4 and/or I.2.4, shall have an extinguishing performance class and burn-back resistance level as specified in Table 1 when tested in accordance with Annex H or Annex I, or both, as appropriate.

Table 1 — Test fire performance

Types of expansion foam	Medium-expansion foam	High-expansion foam
Extinguishment time, seconds	Not more than 120	Not more than 150
1 % burn-back time, seconds	Not less than 30	Not applicable

14 Marking, packaging and specification sheet

14.1 Marking

14.1.1 The following information shall be marked on the shipping container:

- a) designation (identifying name) of the concentrate and, as appropriate, the words “medium” or “high”, or “medium and high” and “expansion foam concentrate”;
- b) if the concentrate complies with Clause 11, the words “aqueous film-forming”;
- c) recommended concentration for use (most commonly 1 %, 3 % or 6 %);
- d) any tendency of the foam concentrate to cause harmful physical effects, the methods required to avoid them and the first aid treatment if they should occur;
- e) recommended storage temperature and temperature of use;
- f) if the concentrate complies with Clause 5, the words “Not affected by freezing and thawing” or, if the foam concentrate does not comply with Clause 5, the words “Do not freeze”;
- g) nominal quantity in the container;
- h) supplier's name and address;
- i) batch number;

j) words “Not suitable for use with sea water” or “Suitable for use with sea water”, as appropriate.

WARNING — It is extremely important that the foam concentrate, after dilution with water to the recommended concentration, shall not, in normal usage, present a significant toxic hazard to life in relation to the environment.

NOTE Recommended storage temperature and temperature of use are the same if the product is marked “do not freeze”.

14.1.2 Markings on shipping containers shall be permanent and legible.

14.1.3 It is recommended that non-Newtonian concentrates be appropriately identified.

14.1.4 Foam concentrates complying with ISO 7203-1 shall also be marked “low-expansion”.

14.1.5 Foam concentrates in accordance with ISO 7203-3 shall also be marked “alcohol resistant”.

14.2 Packaging

The packaging of the foam concentrate shall ensure that the essential characteristics of the concentrate are preserved when stored and handled in accordance with the supplier's recommendations.

14.3 Specification sheet

14.3.1 If requested by the user, the supplier shall provide a list of the characteristic values.

14.3.2 If the foam concentrate is Newtonian and the viscosity at the lowest temperature for use is more than $200 \text{ mm}^2/\text{s}$ when measured in accordance with ISO 3104, it shall be marked with the words “This concentrate can require special proportioning equipment”.

14.3.3 If the foam concentrate is pseudo-plastic and the viscosity at the lowest temperature for use is greater than or equal to $120 \text{ mPa}\cdot\text{s}$ at $375/\text{s}$, it shall be marked “This concentrate can require special proportioning equipment”.

14.3.4 It is recommended that non-Newtonian concentrates be appropriately identified.

Annex A (normative)

Preliminary sampling and conditioning of the foam concentrate

A.1 Preliminary sampling

The sampling method shall ensure representative samples, whether taken from a bulk container or a number of individual packages.

Store samples in fully closed containers.

NOTE Containers with a capacity of 20 l are suitable.

A.2 Conditioning of foam concentrate

A.2.1 If the supplier claims that the concentrate is not adversely affected by freezing and thawing, condition the concentrate sample through four cycles of freezing and thawing, generally as described in B.2, before conditioning in accordance with A.2.2. If the foam concentrate is adversely affected by freezing and thawing, it shall be conditioned according to A.2.2 without prior freezing and thawing.

A.2.2 Condition the concentrate in the sealed container for 7 d at (60 ± 2) °C, followed by 1 d at (20 ± 5) °C.

A.3 Subsequent testing

Test samples prepared in accordance with A.1, or A.1 and A.2 as appropriate. Shake the sample container before sampling for further tests.

Annex B (normative)

Determination of tolerance to freezing and thawing

B.1 Apparatus

The usual laboratory apparatus and, in particular, the following.

B.1.1 Freezing chamber, capable of achieving the temperatures required in B.2.

B.1.2 Polyethylene tube, approximately 10 mm in diameter, approximately 400 mm long and sealed and weighted at one end, with suitable spacers attached.

Figure B.1 shows a typical form.

B.1.3 Measuring cylinder, glass, of 500 ml capacity, approximately 400 mm high and approximately 65 mm in diameter, with a stopper.

B.2 Procedure

Set the temperature of the freezing chamber (B.1.1) to at least 10 °C below the freezing point of the sample, measured in accordance with BS 5117-1.3, excluding 5.2.

To prevent the glass measuring cylinder (B.1.3) from breaking due to expansion of the foam concentrate on freezing, insert the tube (B.1.2) into the measuring cylinder with the sealed end downward, weighted if necessary to avoid flotation, the spacers ensuring it remains approximately on the central axis of the cylinder. Fill the cylinder and fit the stopper.

Place the cylinder in the freezing chamber, cool it and maintain at the required temperature for 24 h. At the end of this period, thaw the sample for not less than 24 h and not more than 96 h in an ambient temperature of (20 ± 5) °C.

Repeat three times to give four cycles of freezing and thawing before testing.

Examine the sample for stratification and non-homogeneity.

Nominal dimensions in millimetres