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Fire extinguishing media - Foam concentrates - Part 4:
Specification for low expansion foam concentrates for
surface application to water-miscible liquids

Agents extincteurs - Émulseurs - Partie 4 :
Spécifications pour les émulseurs bas foisonnement
destinés à une application à la surface de liquides ayant
une affinité pour l'eau

Feuerlöschmittel - Schaummittel - Teil 4:
Anforderungen an Schaummittel zur Erzeugung von
Schwerschaum zum Aufgeben auf mit Wasser
mischbare Flüssigkeiten

This European Standard was approved by CEN on 18 September 2017.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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European foreword

This document (EN 1568-4:2018) has been prepared by Technical Committee CEN/TC 191 "Fixed firefighting systems", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2018, and conflicting national standards shall be withdrawn at the latest by November 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1568-4:2008.

In comparison with the previous edition, the following significant changes have been made:

- the interfacial tension and spreading coefficient test was removed;
- the freezing point test was introduced;
- the stability/separation test of foam concentrate was introduced;
- the occupational health and ecotoxicological testing was introduced;
- an example of technical data sheet was included; and
- setting-up procedures of foam nozzle for the determination of expansion and drainage times have been modified in the light of ISO 7203.

This document is Part 4 of EN 1568 which has the general title *Fire extinguishing media — Foam concentrates*. The other parts are:

- *Part 1: Specification for medium expansion foam concentrates for surface application to water-immiscible liquids;*
- *Part 2: Specification for high expansion foam concentrates for surface application to water-immiscible liquids;*
- *Part 3: Specification for low expansion foam concentrates for surface application to water-immiscible liquids.*

This European Standard is one of a series of standards specifying requirements for fire extinguishing media in common use. This series includes the following standards:

- EN ISO 5923, *Equipment for fire protection and fire fighting — Fire extinguishing media — Carbon dioxide (ISO 5923);*
- EN 27201-1, *Fire protection — Fire extinguishing media — Halogenated hydrocarbons — Part 1: Specifications for halon 1211 and halon 1301 (ISO 7201-1:1989);*
- EN 27201-2, *Fire protection — Fire extinguishing media — Halogenated hydrocarbons — Part 2: Code of practice for safe handling and transfer procedures (ISO 7201-2:1991);*



EN 12018, Fire protection — Fire extinguishing media — Specifications for powders (other than class 1 powders).

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

As fire-fighting foams are chemical agents or chemical preparations, Commission Directive 2006/60/CE [1] and Regulations (EC) No 1272/2008 (CLP) [2] and No 1907/2006 (REACH) [3] apply and need to be taken into account.

Fire are classified in EN 2 [4] as follows:

- Class A: fires involving solid materials, usually of an organic nature, in which combustion normally takes place with the formation of glowing embers;
- Class B: fires involving liquids or liquefiable solids;
- Class C: fires involving gases;
- Class D: fires involving metals;
- Class F: fires involving cooking media (vegetable or animal oils and fats) in cooking appliances.

Fire-fighting foams are widely used to control and extinguish Class B fires and to inhibit re-ignition. These foams can also be used for prevention of ignition of flammable liquids and, in certain conditions, to extinguish Class A fires.

Foams can be used in combination with other extinguishing media, particularly gaseous media and powders, which are the subject of other European Standards (see the European foreword).

These specifications have been designed to ensure that fire extinguishing media have the minimum useful fire fighting capability. The user should ensure that the foam concentrates are used accurately at the concentration recommended by the manufacturer. Fire performances indicated by this standard cannot replicate practical fire situations.

Foam concentrates of different types and manufacture should not be mixed.

Some combinations of extinguishing powder and foam can lead to unacceptable loss of efficiency, caused by unfavourable interaction of the chosen media when applied simultaneously or successively to the fire.

It is extremely important that the foam concentrate after dilution with water to the recommended concentration does not in normal usage present a significant toxic hazard to life in relation to the environment. Commission Directive 2006/60/CE [1] and Regulations (EC) No 1272/2008 (CLP) [2] and No 1907/2006 (REACH) [3] apply when considering the testing of ecotoxicological properties and safety in the work environment.

Special quality characteristic is the type test conducted by an independent testing laboratory accredited to EN ISO/IEC 17025 [5].



This European Standard specifies requirements for chemical and physical properties, and minimum performance requirements of low expansion foams suitable for surface application to water-miscible liquids. Requirements are also specified for marking.

IMPORTANT — The fire performance is tested using acetone and isopropanol as the fuel, which also forms the basis for the performance classification. However, there are a large number of water-miscible liquids which have more or less different properties to acetone and isopropanol. It has been shown by tests using other fuels that the performance of various foams can differ considerably. Examples of such fuel is Methyl Ethyl Ketone (MEK). It is therefore essential that the user checks for any unfavourable or unacceptable loss of efficiency when the foam is used against fires in any other water-miscible fuels than acetone and isopropanol respectively. The fire test conditions and procedure given in H.2 can be used in order to achieve results comparative with acetone and isopropanol respectively and related requirements.

It is also essential for the user to note that other fuel depths and methods of application than those specified in H.2 can cause considerable loss of efficiency and these matters should be carefully considered by the user when assessing the suitability for particular applications.

WARNING — Any type approval according to this standard is invalidated by any change in composition of the approved product.

NOTE Some concentrates conforming to this part of the EN 1568 series can also conform to other parts and therefore can also be suitable for application as medium and/or high expansion foams.

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

EN ISO 3219:1994, *Plastics — Polymers/resins in the liquid state or as emulsions or dispersions — Determination of viscosity using a rotational viscometer with defined shear rate (ISO 3219:1993)*

EN ISO 3696, *Water for analytical laboratory use — Specification and test methods (ISO 3696)*

EN ISO 11348-2, *Water quality — Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) — Part 2: Method using liquid-dried bacteria (ISO 11348-2)*

EN ISO 23753-1, *Soil Quality — Determination of dehydrogenase activity in soil — Part 1: Method using triphenyltetrazolium chloride (TTC) (ISO 23753-1)*

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

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

OECD 201, *Test No. 201: Freshwater Alga and Cyanobacteria, Growth Inhibition Test*

OECD 202, *Test No. 202: Daphnia sp. Acute Immobilisation Test*

OECD 203, *Test No. 203: Fish, Acute Toxicity Test*



OECD 301, Test No. 301: Ready Biodegradability

OECD 404, Test No. 404: Acute Dermal Irritation/Corrosion

OECD 405, Test No. 405: Acute Eye Irritation/Corrosion

OECD 420, Test No. 420: Acute Oral Toxicity – Fixed Dose Procedure

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:

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

3.1

25 %/50 % drainage time

time taken for 25 %/50 % of the volume of the original foam solution to drain out of the generated foam

3.2

Expansion (E)

expansion value

expansion ratio

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

3.3

low expansion foam

foam which has an expansion ratio less than 20

3.4

medium expansion foam

foam which has an expansion ratio greater than or equal to 20 but less than 200

3.5

high expansion foam

foam which has an expansion ratio greater than or equal to 200

3.6

fire-fighting foam

aggregate of air-filled bubbles formed from a foam solution used for fire fighting

3.7

foam concentrate

liquid which is diluted with water to produce foam solution

Note 1 to entry: Annex A gives information on grades of foam concentrate.

3.8

foam solution

solution of foam concentrate in water

3.9 **gentle application**

application (of foam from the test nozzle) indirectly to the surface of the fuel from a backboard

Note 1 to entry: This definition of gentle application relates to the fire test procedures used in EN 1568-3 and EN 1568-4. In practice fire-fighting systems foam can also be applied gently by fixed foam pourers or by indirect application via a tank wall or other surface.

3.10 **sediment**

insoluble particles in the foam concentrate

3.11 **Newtonian foam concentrates**

foam concentrates which have a viscosity which is independent of the shear rate

3.12 **pseudo-plastic foam concentrates**

foam concentrates which have a viscosity which decreases with increasing shear rate

3.13 **surface tension**

tension within the interface between a liquid and air

3.14 **freezing point**

temperature at which the first ingredient of a mixture starts to solidify or freeze out

3.15 **designation** **identifying name**

name that corresponds to a chemical formulation and a specific production process

Note 1 to entry: The designation guarantees consistency of the characteristics, performance and conditions of use of the foam concentrate.

3.16 **demineralized water**

water conforming to EN ISO 3696 (Grade 3), the water having a surface tension greater than 70 mN m^{-1} when tested in accordance with F.2 and a conductivity of $< 5 \text{ }\mu\text{S cm}^{-1}$

4 Sediment in the foam concentrate

4.1 Sediment before ageing

Any sediment in the foam concentrate sampled in accordance with Annex B, but not aged in accordance with C.1, shall be dispersible through a $180 \text{ }\mu\text{m}$ sieve, and the percentage volume of sediment shall be not more than 0,25 % when tested in accordance with Annex C.

4.2 Sediment after ageing

Any sediment in the foam concentrate sampled in accordance with Annex B, and aged in accordance with C.1, shall be dispersible through a $180 \text{ }\mu\text{m}$ sieve and the percentage volume of sediment shall be not more than 1,0 % when tested in accordance with Annex C.

Freezing point

The freezing point of the foam concentrate sampled in accordance with Annex B shall be determined in accordance with Annex K.

6 Viscosity of the foam concentrate

6.1 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 EN ISO 3104. If the viscosity is $> 200 \text{ mm}^2 \text{ s}^{-1}$, the container shall be marked in accordance with Clause 14, item j).

6.2 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^{-1} , the container shall be marked in accordance with Clause 14, item k).

7 pH of the foam concentrate

The pH of the foam concentrate sampled in accordance with Annex B shall be not less than 6,0 and not more than 9,5 at $(20 \pm 1) ^\circ\text{C}$.

8 Surface tension of the foam solution

The surface tension (determined in accordance with F.2) of the foam solutions prepared using top and bottom half-samples (see E.4) of the foam concentrate sampled in accordance with Annex B and conditioned in accordance with Annex E shall be not less than 0,95 times and not more than 1,05 times the surface tension of the foam solution prepared using the sampled foam concentrate.

9 Stability/separation test of foam concentrate

The foam concentrate shall not separate, stratify or precipitate as indicated by two or more distinct layers or the presence of solid deposits at the bottom of the container when tested in accordance with Annex L.

10 Determination of expansion and drainage time

10.1 Before temperature conditioning

The foam produced from the foam solution prepared from the foam concentrate sampled in accordance with Annex B, at the supplier's recommended concentration with simulated fresh water in accordance with G.4.1, shall be tested in accordance with Annex G. If appropriate, a further sample of the same concentration made with the simulated sea water in accordance with G.4.2 shall also be tested.

10.2 After temperature conditioning

The foams produced from the solutions prepared with simulated fresh water by using top and bottom half-samples (see E.4) of foam concentrate sampled in accordance with Annex B at the supplier's recommended concentration, when tested in accordance with Annex G, shall have the following:

- a) expansions which do not differ from each other or from the value obtained in 10.1 using simulated fresh water (i.e. before temperature conditioning) by more than 20 % of the value obtained in 10.1 using simulated fresh water; and

drainage times which do not differ from each other or from the value obtained in 10.1 using simulated fresh water (i.e. before temperature conditioning) by more than 20 % of the value obtained in 10.1 using simulated fresh water.

If appropriate, the tests shall be repeated using top and bottom half-samples (see E.4) of foam concentrate, sampled in accordance with Annex B at the supplier's recommended concentration, using foam solutions prepared with the simulated sea water in accordance with G.4.2. These foam solutions shall have the following:

- c) expansions which do not differ from each other or from the value obtained in 10.1 using the simulated sea water (i.e. before temperature conditioning) by more than 20 % of the value obtained in 10.1 using the simulated sea water in accordance with G.4.2; and
- d) 25 % drainage times which do not differ from each other or from the value obtained in 10.1 using the simulated sea water (i.e. before temperature conditioning) by more than 20 % of the value obtained in 10.1 using the simulated sea water in accordance with G.4.2.

NOTE Expansion is dependent on the foam concentrate and the equipment used to make the foam.

11 Test fire performance

The foam produced from the foam solutions prepared using the foam concentrate sampled in accordance with Annex B at the supplier's recommended concentration with simulated fresh water in accordance with G.4.1, and if appropriate at the same concentration with the simulated sea water in accordance with G.4.2, shall have an extinguishing performance class and burn-back resistance level as specified in Table 1 when tested in accordance with H.2 and H.3.

NOTE 1 The values obtained with sea water can differ from those obtained with simulated fresh water.

NOTE 2 Annex I describes a small-scale fire test which can be suitable for quality control purposes.

Table 1 — Extinguishing performance classes and burn-back resistance levels

| Extinguishing performance class | 25 % Burn-back resistance level | Extinction time not more than (min) | 25 % Burn-back time not less than (min) |
|---------------------------------|---------------------------------|-------------------------------------|---|
| I | A | 3 | 15 |
| | B | 3 | 10 |
| | C | 3 | 5 |
| II | A | 5 | 15 |
| | B | 5 | 10 |
| | C | 5 | 5 |

12 Occupation health

The manufacturer shall provide information as specified in Annex M.

13 Technical data sheet

The manufacturer should provide information for the foam concentrate. An example of the type of information provided in a manufacturer's technical data sheet is given in Annex N.

14 Container marking

Markings on shipping containers should be permanent and legible. The following information shall be marked on the packaging or transport container:

- a) the designation (identifying name) of the concentrate;
- b) the words "low expansion fire-fighting foam concentrate" and the number and date of this European Standard (i.e. EN 1568-4:2018);

NOTE 1 For low expansion concentrates which also conform to other parts of the EN 1568 series additional markings can be used as specified in those parts.

- c) recommended usage concentration (mostly commonly 1 %, 3 % or 6 %);
- d) recommended maximum storage temperature, lowest temperature for use and freezing point;
- e) if the manufacturer advises that the foam concentrate is adversely affected by low temperature storage according to Annex E, the words "Do not freeze";
- f) the nominal quantity in the container;
- g) the supplier's name and address;
- h) the batch number and the date of manufacture;
- i) the words "Not suitable for use with sea water" or "Suitable for use with sea water" as appropriate;
- j) if the foam concentrate is Newtonian and the viscosity at the lowest temperature for use is greater than $200 \text{ mm}^2 \text{ s}^{-1}$ when measured in accordance with EN ISO 3104 the words "This concentrate can require special proportioning equipment";
- k) 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 s^{-1} the words "Pseudo-plastic foam concentrate. This concentrate can require special proportioning equipment";
- l) the lowest extinguishing performance class and the lowest burn-back resistance level obtained with all fuels in simulated fresh water and sea water.

NOTE 2 The marking of shipping containers shipped to laboratories for testing are exempt from this requirement.



Annex A

(informative)

Grades of foam concentrate

Foam concentrates are graded as follows:

- a) protein foam concentrates (P): these are liquids derived from hydrolysed protein materials;
- b) fluoroprotein foam concentrates (FP): these are protein concentrates with added fluorinated surface active agents;
- c) synthetic foam concentrates (S): these are based upon mixtures of hydrocarbon surface-active agents and do not contain fluoroorganic compounds;
- d) alcohol-resistant foam concentrates (AR): these can be suitable for use on hydrocarbon fuels, and additionally are resistant to breakdown when applied to the surface of water-miscible liquid fuels. Some alcohol-resistant foam concentrates can precipitate a polymeric membrane on the surface of alcohol;
- e) aqueous film-forming foam concentrates (AFFF): these are generally based on mixtures of hydrocarbon surfactants and fluorinated surface active agents and have the ability to form an aqueous film on the surface of some hydrocarbon fuels;
- f) film-forming fluoroprotein foam concentrates (FFFP): these are fluoroprotein foam concentrates which have the ability to form an aqueous film on the surface of some hydrocarbon fuels.
- g) fluorine free foam concentrates (F3): these foam concentrates are dedicated to meeting fire performance ratings and are targeting applications similar to AFFF and/or AR-foams without using fluoroorganic compounds. These foam concentrates are based upon mixtures of hydrocarbon surface-active agents and non-fluorine containing stabilizers.



Annex B (normative)

Sampling of foam concentrates

The samples for testing shall be delivered by the supplier in completely filled sealable containers. The samples for testing shall be taken and delivered by the supplier using a method which provides a representative sample of the foam concentrate to be tested.

NOTE Nominal 25-l containers are convenient.

Annex C (normative)

Determination of percentage sediment

NOTE See Clause 4.

C.1 Sampling

Use a sample prepared in accordance with Annex B. Place approximately 1 l of the sample in a suitable container of nominal capacity sufficient to provide an ullage of 5 % to 10 % of the container volume. Seal the container. Ensure that any sediment is dispersed by agitating the sample container.

Take two samples, testing one immediately at a temperature of $(20 \pm 5) ^\circ\text{C}$, and the other after ageing for (24 ± 2) h at $(60 \pm 2) ^\circ\text{C}$ in a completely filled container without access to air.

C.2 Apparatus

C.2.1 Graduated centrifuge tubes.

NOTE The centrifuge tubes described in ISO 3734 [7] are suitable.

C.2.2 Centrifuge, operating at $(6\,000 \pm 600) \text{ m s}^{-2}$.

NOTE The centrifuge described in ISO 3734 [7] is suitable.

C.2.3 180 μm sieve, conforming to ISO 3310-1.

C.2.4 Plastic wash bottle

C.3 Procedure

C.3.1 Centrifuge each sample of the concentrate for 10 min. Determine the volume of the sediment and report it as a percentage of the volume of the centrifuged sample.

C.3.2 Wash the contents of the centrifuge tube onto the sieve and check whether the sediment can be dispersed through the sieve by the jet from the plastic wash bottle.

Annex D (normative)

Determination of viscosity for pseudo-plastic foam concentrates

NOTE The procedure is described in EN ISO 3219:1994, Annex A or B.

D.1 Pseudo-plastic foam concentrates

Pseudo-plastic foam concentrates have a viscosity which decreases with increasing shear rate at constant temperature.

NOTE Pseudo-plastic foam concentrates are a particular class of non-Newtonian foam concentrate.

D.2 Viscosity determination

D.2.1 Apparatus

D.2.1.1 Rotational viscometer in accordance with EN ISO 3219 with the following parameters:

- maximum shear stress ≥ 75 Pa;
- maximum shear rate ≥ 600 s⁻¹.

The viscometer shall be fitted with a temperature control unit which can maintain the sample temperature within ± 1 °C of the required temperature.

D.2.2 Test temperatures

The viscosity of the foam concentrate shall be measured from 20 °C up to and including the lowest temperature for use claimed by the manufacturer in steps of 10 °C. Use a fresh sample for each temperature.

D.2.3 Viscosity measurement

If the sample contains suspended air bubbles, the sample shall be centrifuged for 10 min using the apparatus specified in C.2.1 and C.2.2 before the sample is applied in the apparatus.

The viscosity measurement shall be obtained according to the following test procedure:

- 1) adjustment of temperature control unit;
- 2) setting of the gap;
- 3) application of the sample;
- 4) minimum 10 min waiting period (no shear) to reach temperature equilibrium;
- 5) 1 min pre-shearing at 600 s⁻¹;
- 6) 1 min waiting period without shearing;
- 7) measure the shear stress for 10 s at each shear rate starting at the lowest shear rate (preferable at 75 s⁻¹).

the shear stress at least at 8 different shear rates up to 600 s^{-1} , e.g. 75 s^{-1} , 150 s^{-1} , 225 s^{-1} , 300 s^{-1} , 375 s^{-1} , 450 s^{-1} , 525 s^{-1} , 600 s^{-1} . Calculate the apparent viscosity from Formula (D.1):

$$\text{Apparent viscosity } (\text{mPa} \cdot \text{s}) = 1000 \times \frac{\text{Shearstress} (\text{Pa})}{\text{Shearrate} (\text{s}^{-1})} \quad (\text{D.1})$$

D.2.4 Results

Report the results as a table, including test temperature ($^{\circ}\text{C}$), shear rate (s^{-1}), shear stress (Pa), and apparent viscosity ($\text{mPa} \cdot \text{s}$).

Annex E (normative)

Temperature conditioning of foam concentrates

E.1 General

If the foam concentrate is claimed by the supplier not to be adversely affected by storage at $-30\text{ }^{\circ}\text{C}$, condition the sample in accordance with E.2 and then in accordance with E.3; otherwise, condition only in accordance with E.3.

E.2 Low temperature conditioning

E.2.1 Apparatus

E.2.1.1 Freezing chamber, capable of achieving a temperature of $(-30 \pm 3)\text{ }^{\circ}\text{C}$.

E.2.1.2 Sample containers, in accordance with Annex B.

NOTE More than one container can be needed to condition sufficient volume of foam concentrate for subsequent testing.

E.2.2 Procedure

Set the temperature of the freezing chamber to $(-30 \pm 3)\text{ }^{\circ}\text{C}$.

Do not agitate the content of the container(s) at any time until the sample of foam concentrate has been divided into top and bottom half-samples (see E.4).

Place the sample container(s) in the freezing chamber and maintain at the required temperature for $(24 \pm 1)\text{ h}$. At the end of this period store the container(s) for not less than 48 h and not more than 96 h in an ambient temperature of $(20 \pm 5)\text{ }^{\circ}\text{C}$.

Repeat 3 times so that there are four cycles of freezing and thawing before testing.

E.3 High-temperature conditioning

E.3.1 Apparatus

E.3.1.1 Oven, capable of achieving a temperature of $(60 \pm 3)\text{ }^{\circ}\text{C}$.

E.3.2 Procedure

Set the temperature of the oven to $(60 \pm 3)\text{ }^{\circ}\text{C}$.

If the foam concentrate sample has not been conditioned in accordance with E.2 use foam concentrate sampled in accordance with Annex B; otherwise use containers conditioned in accordance with E.2. Do not agitate the content of the container(s) at any time until the sample of foam concentrate has been divided into top and bottom half-samples (see E.4).

Place the container(s) in the oven and maintain at required temperature for 7 d. At the end of this period store the container(s) for not less than 48 h and not more 96 h in an ambient temperature of $(20 \pm 5)\text{ }^{\circ}\text{C}$.

E.4 Division into top and bottom half-samples

E.4.1 Apparatus

E.4.1.1 Top half-sample container(s).

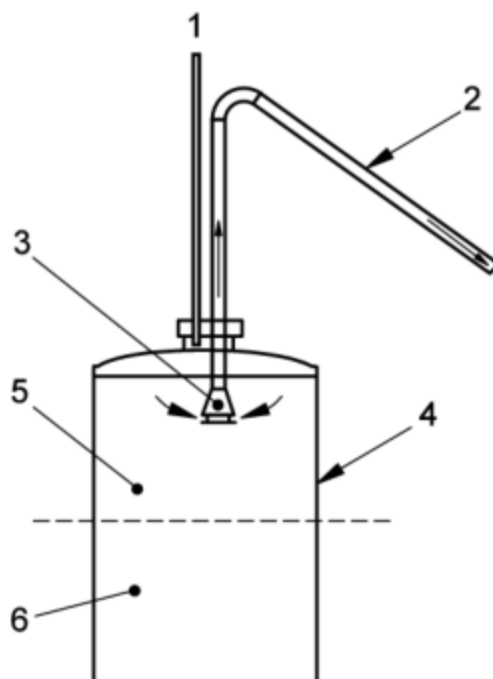
Sealable empty container(s), suitable for the foam concentrate to be tested, of minimum half the volume of the sample container(s) as described in Annex B.

E.4.1.2 Divider device.

After conditioning, the top sample from the sample container shall be divided from the bottom sample by pressurizing the sample container and force the top sample through a delivery pipe into the top sample container described in E.4.1.1. A principle sketch of the divider and sample container is shown in Figure E.1.

The delivery pipe and the pressure inlet can be fitted to the lid of the original sample container. In practice it might be necessary to use different fittings depending on the design of the lid and sample container. Be sure that the fitting between divider and the lid is air tight to keep the pressure needed to force the foam concentrate through the delivery pipe.

In order to ensure that there is no mixture between the top sample and the bottom sample during the division process, the delivery pipe shall be adjustable in vertical direction. The inlet of the delivery pipe shall be conical and equipped with a plate in order to provide a horizontal flow into the pipe as shown in Figure E.1. In order to make it possible to mount the delivery pipe either the cone and plate shall be detachable or the delivery pipe shall be designed in a way that it can be mounted through the lid. Other suitable design of the divider device is permitted provided that the function is the same.



Key

- 1 air pressure pipe
- 2 delivery pipe diameter (8 to 15) mm
- 3 detachable cone and plate, diameter (25 to 35) mm, height (40 to 50) mm, distance between cone and plate (10 to 12) mm
- 4 sample container approximately 25 l
- 5 top sample
- 6 bottom sample

Figure E.1 — Example of a suitable equipment to divide the conditioned foam concentrate into top and bottom half-samples

E.4.2 Procedure

Mount the divider device to the sample container. Adjust the delivery pipe in vertical direction so that the inlet of the delivery pipe is positioned below the surface, on a vertical distance of approximately $\frac{1}{3}$ into the top half-sample. Pressurize the sample container carefully and start collecting the top half-sample foam concentrate into the empty top half-sample container. Interrupt the pressurizing just before the foam liquid surface reaches the inlet of the delivery pipe. Lower the delivery pipe another $\frac{1}{3}$ into the top half-sample and repeat the procedure twice. At the end of the dividing process, the top half-sample shall have been collected from three levels.

The bottom half-sample should preferably be kept in the original sample container.

Before subsequent testing starts of the top and bottom half-samples for Clauses 8 and 10, the top half-container and the bottom half-sample container shall be agitated in order to provide a homogenous foam sample.

Annex F (normative)

Determination of surface tension

F.1 Solution of foam concentrate

NOTE See Clause 8.

Solution of foam concentrate, at the recommended usage concentration in demineralized water conforming to EN ISO 3696 (Grade 3), the water having a surface tension greater than 70 mN m^{-1} when tested in accordance with F.2 and a conductivity of $< 5 \mu\text{S cm}^{-1}$.

F.2 Procedure — Surface tension

Determine the surface tension of the solution at a temperature of $(20 \pm 3) ^\circ\text{C}$ using the ring or plate method of ISO 304.

In the test report state which method (ring or plate) was used.

Annex G (normative)

Determination of expansion and drainage time

G.1 Apparatus

NOTE See Clause 10.

G.1.1 Collecting vessel (see Figure G.1), of nominal volume 1,6 l, known to ± 1 % and equipped with a drain at the base.

G.1.2 Foam collector, as shown in Figure G.2.

G.1.3 Foam-making equipment, with nozzle as shown in Figures G.3 and G.4 which, when tested with water, has a flow rate of 11,4 l/min at a nozzle pressure of $(6,3 \pm 0,3)$ bar.

G.1.4 Stop clock, or other timing device.

G.2 Temperature conditions

Carry out the tests under the following temperature conditions:

- air temperature (20 ± 5) °C;
- foam solution temperature $(17,5 \pm 2,5)$ °C.

G.3 Procedure

G.3.1 Prepare two samples of foam concentrate in accordance with Annex B. Condition one other sample in accordance with Annex E, to give a total of three samples (non-conditioned, bottom-conditioned, and top-conditioned).

G.3.2 Carry out the remainder of the procedure for each sample on the same day. Prepare a foam solution of each sample following the supplier's recommendations for concentration, maximum premix time, compatibility with the test equipment, avoiding contamination by other types of foam, etc.

Use simulated fresh water to make up the foam solutions and, if the supplier claims the concentrate to be suitable for sea water, also make foam solutions at the same concentration using simulated sea water prepared in accordance with G.4.2.

The concentration used in simulated sea water shall be the same as the concentration used in simulated fresh water.

If the foam concentrate is intended to be used at two different concentrations (i.e. AFFF-AR 3X6), the tests shall be performed at both concentrations.

G.3.3 Set up the nozzle horizontally, directly in front of the foam collector, with the front of the nozzle $(3 \pm 0,3)$ m from the top edge of the collector. Set up the foam equipment and adjust the nozzle pressure within the range $(6,3 \pm 0,3)$ bar to give a flow rate of 11,4 l/min. Discharge foam and adjust the height of the nozzle so that the discharge strikes the collector centrally. Keep the nozzle horizontal. Wet the vessel internally and weigh it. Record the mass (M_1). Allow the discharge to stabilize. With the drain at the base closed, collect foam, taking care that voids are not formed in the vessel, starting the timing

When the vessel is half full, as soon as the vessel is full, stop collecting foam and strike the surface level with the rim. Clean the vessel of foam running outside after the strike of the foam.

Weigh the vessel and record the mass (M_2).

Calculate the expansion E from Formula (G.1):

$$E = \frac{V}{M_2 - M_1} \quad (\text{G.1})$$

where

V is the vessel volume in litres;

M_1 is the mass of the empty vessel in kilograms;

M_2 is the mass of the full vessel in kilograms.

Assume that the density of the foam solution is 1,0 kg/l.

Open the drainage facility and measure the 25 % and 50 % drainage time. Determine the drainage either by having the vessel on a scale and recording the mass loss or by collecting the drained foam solution in a measuring cylinder. Adjust the drainage facility such that the drained foam solution can flow out while preventing the passage of foam. For each foam carry out the test three times.

NOTE This can be achieved by controlling the level of the liquid/foam interface in the plastic tube at the outlet.

G.3.4 For each sample calculate the mean values of the three tests for the expansion and 25 % and 50 % drainage time.

G.4 Simulated fresh and sea water

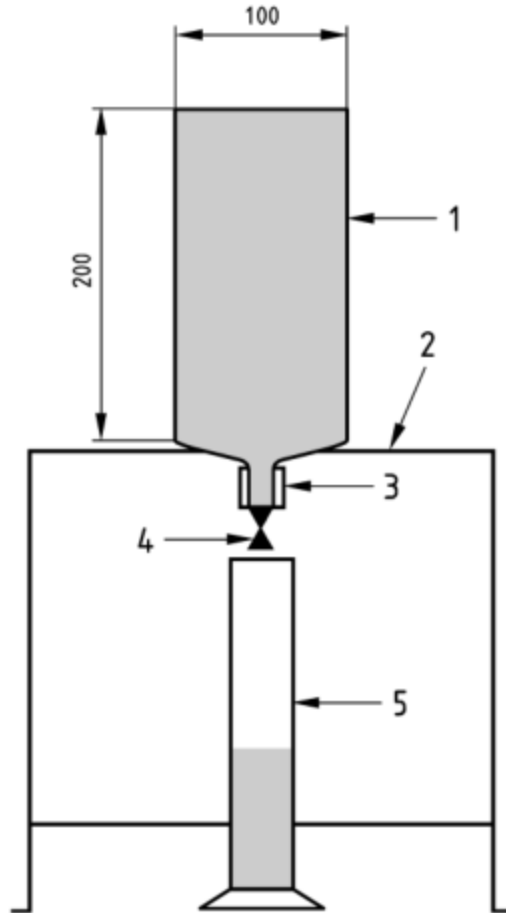
G.4.1 Prepare the simulated fresh water by mixing the following components:

| g/litre | Component | |
|--------------------------|---------------------|---|
| 0,035 | Magnesium chloride | ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$) |
| 0,080 | Calcium chloride | ($\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$) |
| 999,885 (Make up to 1 l) | Demineralized water | |

G.4.2 Prepare the simulated sea water by mixing the following components:

| % by weight | Component | |
|-------------|-----------------------|---|
| 2,50 | Sodium chloride | (NaCl) |
| 1,10 | Magnesium chloride | ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$) |
| 0,16 | Calcium chloride | ($\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$) |
| 0,40 | Sodium sulfate | (Na_2SO_4) |
| 95,84 | Simulated fresh water | |

Dimensions are nominal and in mm

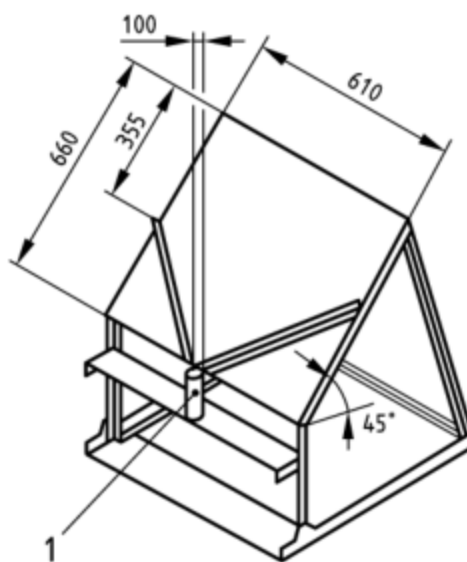


Key

- 1 drainage pot (angle of slope of base nominally 11°)
- 2 stand
- 3 transparent tube, 6 mm to 8 mm bore, 30 mm to 50 mm long
- 4 discharge outlet closure
- 5 measuring cylinder

Figure G.1 — Collecting vessel for determination of expansion and drainage time

Dimensions are nominal and in millimetres



Key

1 drainage pot

NOTE Suitable materials for the collection surface are stainless steel, aluminium, brass or plastics.

Figure G.2 — Foam collector for expansion and drainage measurement

Dimensions in millimetres

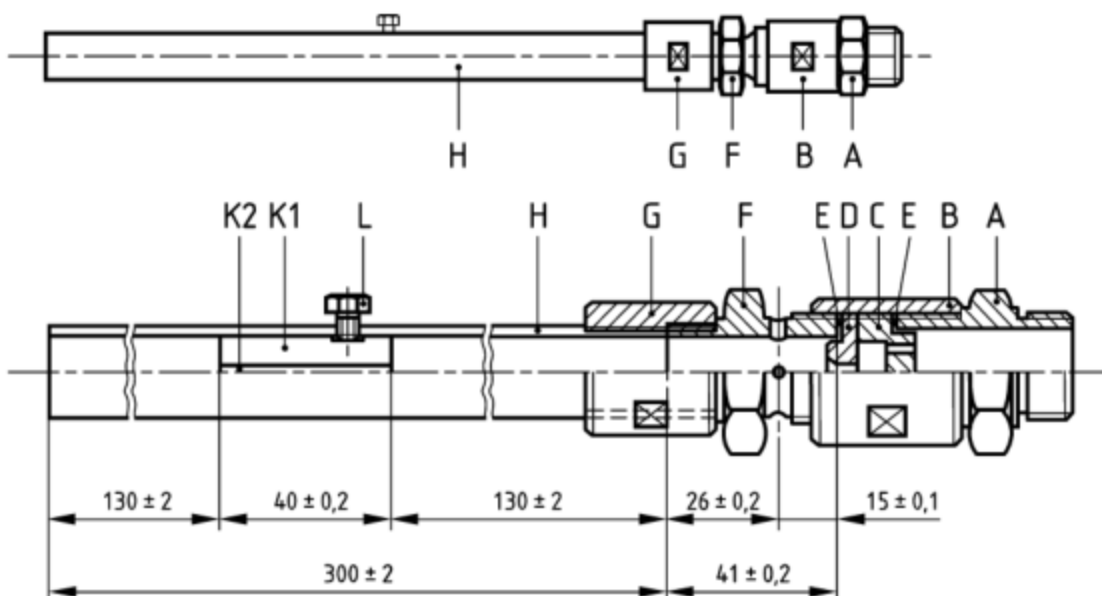


Figure G.3 — Foam-making nozzle: General arrangement¹⁾

1) Examples of a suitable apparatus, available commercially, are supplied by:

— Swedish National Testing and Research Institute, Department of Fire Technology, Box 857, SE-501 15 BORAS, Sweden.

The apparatus by Swedish National Testing and Research Institute, Department of Fire Technology is an example of suitable products available commercially. This information is given for the convenience of users of this standard and does not constitute an endorsement by CEN of these products.

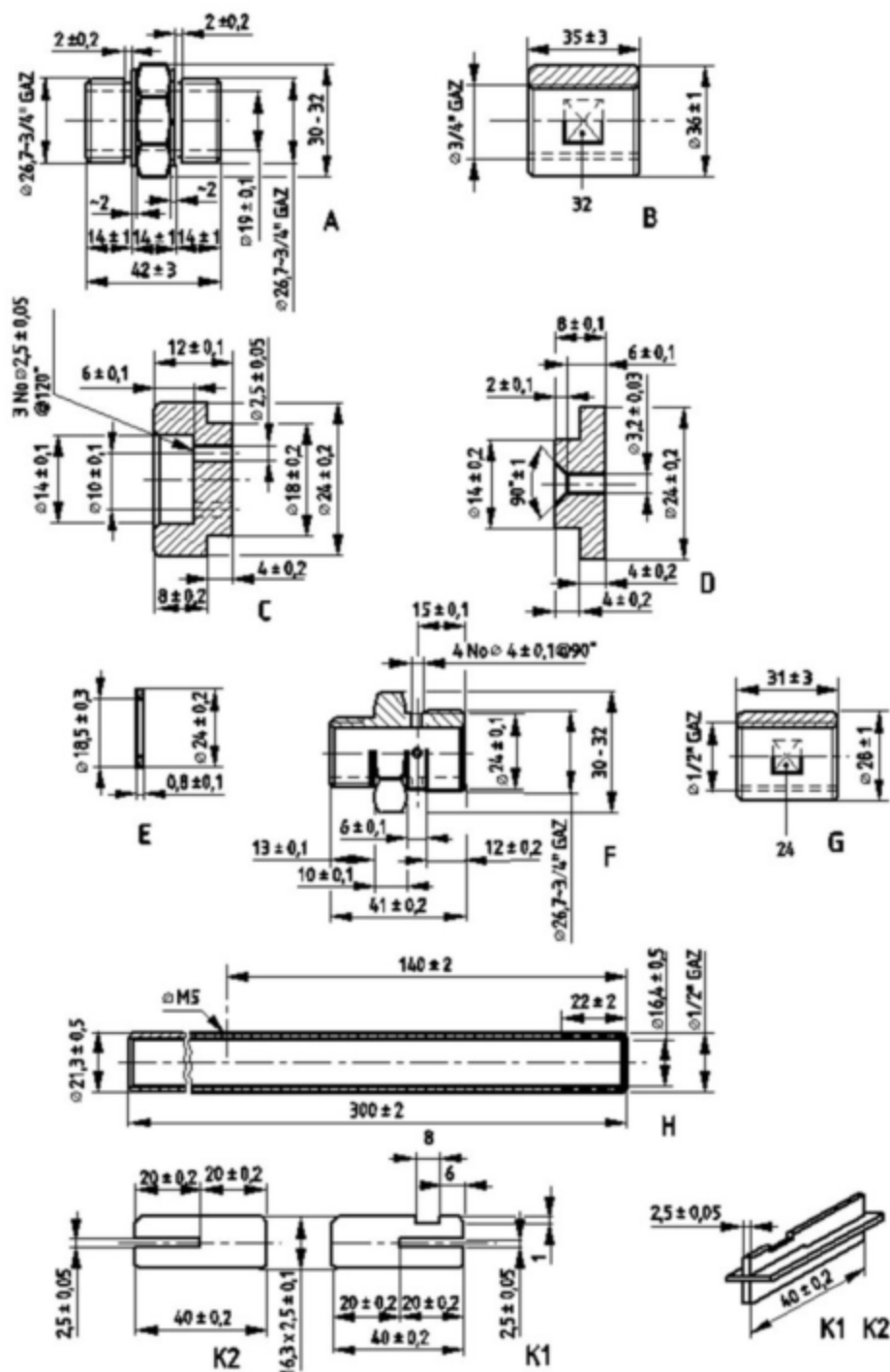


Figure G.4 — Foam-making nozzle (details of Figure G.3)



Annex H (normative)

Determination of test fire performance

H.1 General

NOTE See Clause 11.

The tests described in this annex are more expensive and time consuming than the other tests described in the standard. It is recommended that they are carried out at the end of the test programme, so as to avoid the expense of unnecessary testing.

H.2 General conditions

H.2.1 Test series and criteria for success

H.2.1.1 Foam concentrates not compatible with sea water

Carry out one test with simulated fresh water (see G.4.1) on propan-2-one (acetone) and one test with simulated fresh water on propan-2-ol (isopropanol, isopropyl alcohol, IPA). If both tests are successful, or if both tests are unsuccessful, terminate the test series. If one test is unsuccessful, repeat that test. The concentrate conforms to Clause 11 if the first two tests are successful, or if one of the first two tests is successful, and the repeat test is successful.

H.2.1.2 Foam concentrates compatible with sea water

Carry out one test with simulated fresh water (see G.4.1) on propan-2-one (acetone), and one test with simulated fresh water on propan-2-ol (isopropanol, isopropyl alcohol, IPA). If both tests are successful, carry out one test with simulated sea water (see G.4.2) on propan-2-one (acetone), and one test with the simulated sea water of G.4.2 on propan-2-ol (isopropanol, isopropyl alcohol, IPA). If all tests are successful, terminate the test series. If one of the simulated fresh water tests is not successful, repeat that test. If one of the simulated sea water tests is not successful, repeat that test. The concentrate conforms to Clause 11 if all four tests have been successful, or in the case of one or two unsuccessful results, the repeat or repeats has or have been successful.

H.2.2 Temperature and wind speed

Carry out the tests under the following conditions:

- | | |
|---|-----------------------------------|
| a) air temperature | $(15 \pm 5) ^\circ\text{C}$; |
| b) fuel temperature | $(17,5 \pm 2,5) ^\circ\text{C}$; |
| c) foam solution temperature | $(17,5 \pm 2,5) ^\circ\text{C}$; |
| d) maximum wind speed in the proximity of the fire tray | 3 m/s. |

NOTE If necessary some form of windscreen can be used.

H.2.3 Records

During the fire test record the following:

- a) location; indoors or outdoors;
- b) air temperature;

- c) ... temperature;
- d) foam solution temperature;
- e) wind speed;
- f) 90 % control time;
- g) 99 % control time;
- h) extinction time; and
- i) 25 % and 100 % burn-back time.

NOTE 90 % control time and burn-back time can be determined either visually by an experienced person or from thermal radiation measurements. Annex J gives details of a method suitable for low expansion foams.

H.2.4 Foam solution

Prepare a foam solution following the recommendations of the supplier for concentration, maximum premix time, compatibility with the test equipment, avoiding contamination by other types of foam, etc.

Use simulated fresh water to prepare the foam solution and, if the supplier claims that the concentrate is suitable for use in sea water, make a second foam solution at the same concentration using the simulated sea water in accordance with G.4.2.

H.2.5 Fuel

Use propan-2-one (acetone) of not less than 99 % purity.

Use Propan-2-ol (isopropanol, isopropyl alcohol, IPA) of not less than 99 % purity.

H.3 Fire test

H.3.1 Apparatus

H.3.1.1 Circular fire tray, of stainless steel grade EN: X5CrNi18-10 with:

a) dimensions as follows:

- 1) internal diameter at rim (1 480 ± 15) mm;
- 2) depth (150 ± 10) mm;
- 3) nominal thickness of steel wall 2,5 mm; and

b) a vertical stainless steel backboard (1 ± 0,05) m high and (1 ± 0,05) m long fitted as closely as possible along the curved top of the curved wall.

The backboard shall be removed before the burn-back test is started.

NOTE The tray has an area of approximately 1,73 m².

H.3.1.2 Foam-making equipment, as described in G.1.3.

H.3.1.3 Stainless steel burn-back pot, of nominal thickness 2,5 mm, diameter (300 ± 5) mm and height (250 ± 5) mm.



H.2 Test procedure

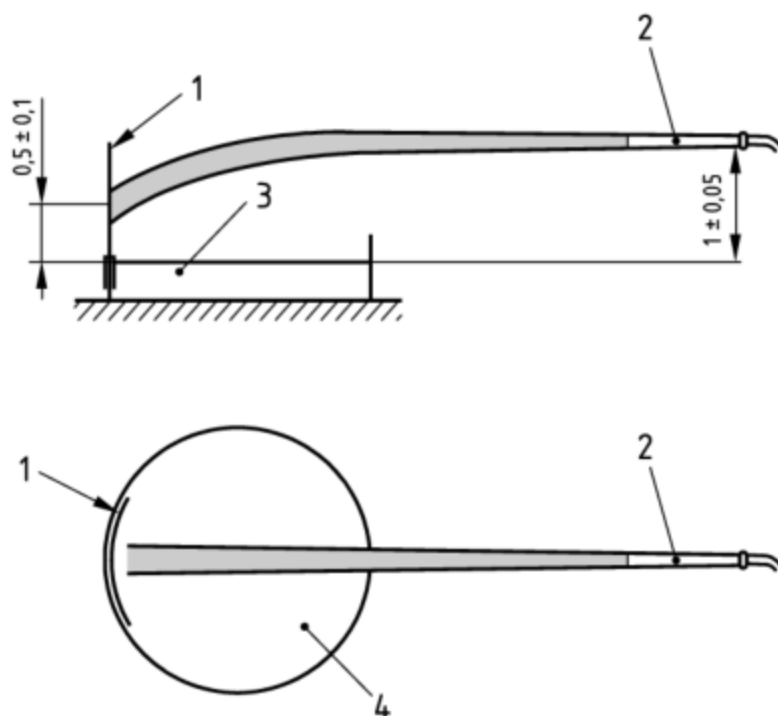
Place the fire tray directly on the ground and ensure that it is level. Set up the foam nozzle horizontally ($1 \pm 0,05$) m above the fuel level in a position where the central part of the foam discharge will strike the centre axis of the backboard ($0,5 \pm 0,1$) m above the fuel level (see Figure H.1). Clean the tray. Add (125 ± 5) l of fuel.

Ignite the fuel, not less than 3 min and not more than 5 min after adding it. Start foam application (120 ± 2) s after full involvement. Readjust the nozzle to ensure that the jet continues to hit the centre of the backboard. If the foam concentrate is claimed to be Class 1, apply foam for (180 ± 2) s. If the foam concentrate is claimed to be Class 2, apply foam for (300 ± 2) s. Record the extinction time as the period between the start of foam application and extinction of all flames within the fire tray. If a fire remains only on the outside of the tray after foam application, manually extinguish this fire before starting the burn-back test.

After a further (300 ± 10) s place a burn-back pot containing ($2 \pm 0,1$) l of the same test fuel in the centre of the tray, and ignite. Record the 25 % burn-back time. When 100 % of the tray is covered by sustained flames, record this as the 100 % burn-back time (for information only).

NOTE During foam application some foam may overflow from the fire tray, possibly carrying burning fuel. It is advisable to mount the test fire tray within a non-combustible bunded or dyked area to contain any foam overflow.

Dimensions in metres



Key

- 1 backboard
- 2 foam nozzle
- 3 fuel
- 4 fire tray

Figure H.1 — Test fire arrangement



Annex I (informative)

Small-scale fire test

NOTE Annex H describes large-scale fire tests for type approval. This annex describes a small-scale fire test which can be suitable for quality control purposes.

I.1 Apparatus

I.1.1 Circular fire tray of brass, as shown in Figure I.1 which:

- a) has dimensions as follows:
 - 1) internal diameter at rim (565 ± 5) mm;
 - 2) height of vertical wall (150 ± 5) mm;
 - 3) height of conical base (30 ± 5) mm;
 - 4) thickness of vertical wall (1,2 ± 0,2) mm;
- b) is fitted with a turned over rim, and a drain point with valve at the centre of the conical base;
- c) has a vertical backboard 2,5 mm thickness, 600 mm long and 300 mm high formed by an extension of the wall opposite to the nozzle; and
- d) is supported approximately 1 m above the ground on a steel frame with four legs.

NOTE 1 The tray is normally placed beneath a suitable fume extraction hood which will extract the smoke without interfering with the fire.

NOTE 2 The tray has an area of approximately 0,25 m².

I.1.2 Burn-back pot of brass:

- a) with dimensions as follows:
 - 1) internal diameter at rim (120 ± 2) mm;
 - 2) internal depth (80 ± 2) mm;
 - 3) thickness of wall (1,2 ± 0,2) mm; and
- b) with a turned over rim;
- c) fitted with four studs at the base to give an overall height of (96 ± 2) mm; and
- d) a chain fitted to the rim to allow the burn-back pot to be lifted using a metal rod.

I.1.3 Foam-making nozzle, as shown in Figure I.2, which:

- a) has a nominal flow rate of 5,0 l/min at 7 bar when tested with water;
- b) is fitted with an adjustable collar to allow foam to be ejected from the side of the nozzle and thus vary the foam flow rate through the outlet. The foam flow rate can also be controlled by adjusting the pressure applied to the foam solution.



Propan-2-one (acetone) or Propan-2-ol (isopropanol, isopropyl alcohol, IPA) of not less than 99 % purity.

1.2 Test procedure

1.2.1 Test conditions

Carry out the tests under the following conditions:

- a) air temperature $(15 \pm 5) ^\circ\text{C}$;
- b) fuel temperature $(17,5 \pm 2,5) ^\circ\text{C}$;
- c) foam solution temperature $(17,5 \pm 2,5) ^\circ\text{C}$.

1.2.2 Set-up

Position the foam nozzle horizontally with the by-pass holes in the adjustable collar facing downwards at a height of (150 ± 5) mm above the rim of the fire tray (see Figure I.2).

Prepare the foam solution following the recommendations of the supplier for concentration, maximum premix time, compatibility with test equipment, avoiding contamination by other types of foam, etc.

Set the nozzle pressure to 7 bar and the foam flow rate to $(1,625 \pm 0,025)$ kg/min by adjusting the collar and, if necessary, reducing the nozzle pressure. It is convenient to collect the foam in a tared vessel for 6 s and to weigh it to calculate the flow rate.

Position the nozzle while keeping it horizontal so that the foam strikes the centre of the backboard. Shut off the foam discharge. Clean the tray and close the drain valve.

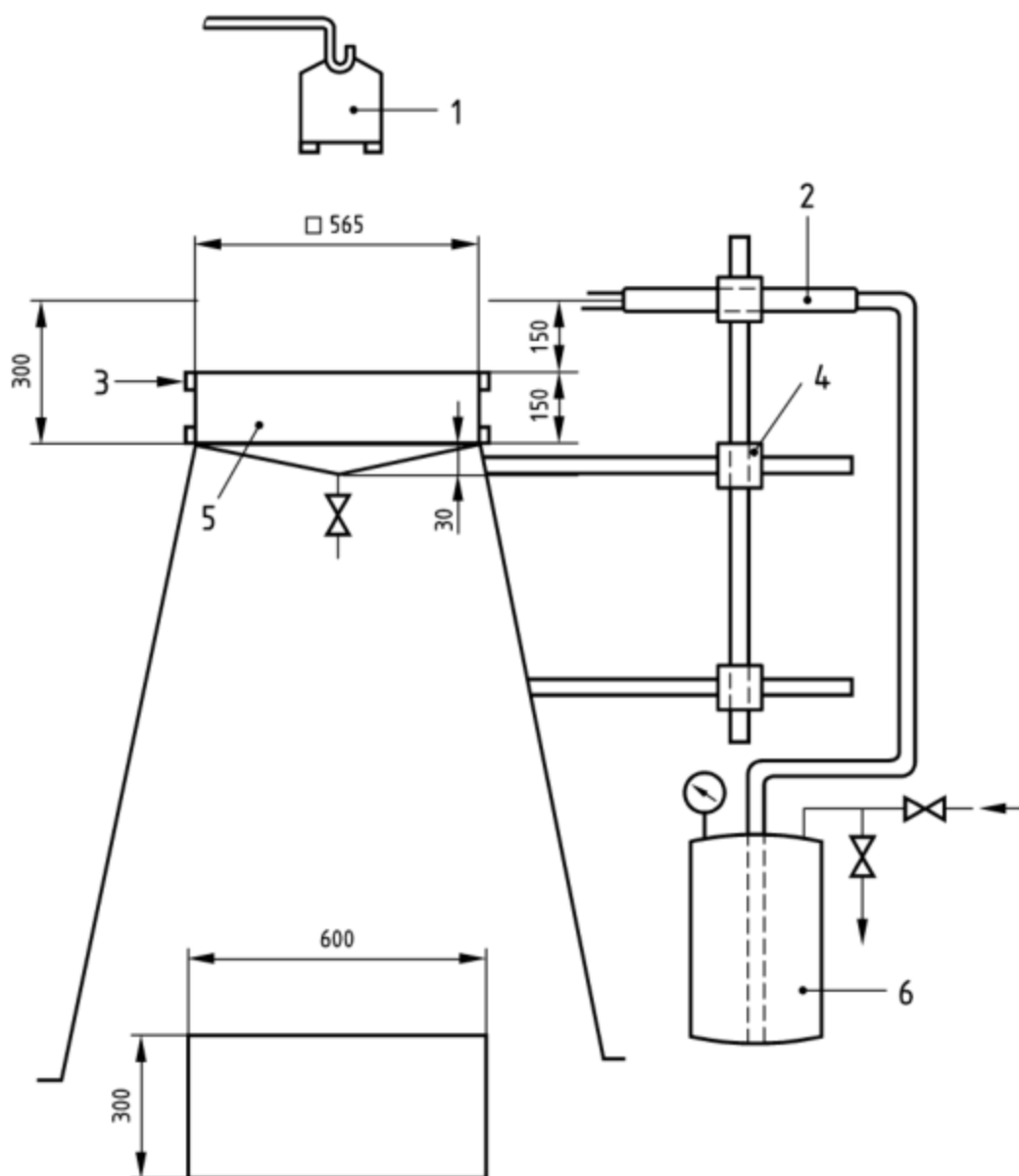
1.2.3 Fire test

Place $(9 \pm 0,1)$ l of fuel in the tray, and $(0,3 \pm 0,01)$ l of fuel in the burn-back pot.

(120 ± 2) s after fueling ignite the fuel and allow to burn for (120 ± 2) s before starting foam application. Apply foam for (120 ± 2) s to the centre of the backboard and record the times from the start of foam application to 90 % control, 99 % control, and complete extinction. If complete extinction is not obtained within (120 ± 2) s apply the foam for a further (120 ± 2) s.

At the end of foam application ignite the fuel in the burn-back pot, and (60 ± 2) s after the end of foam application lower the pot into the centre of the tray with a metal rod, taking care not to allow foam to enter the pot. Record the time taken from positioning of the burn-back pot to permanent full re-involvement of the fire tray surface in flames as the burn-back time.

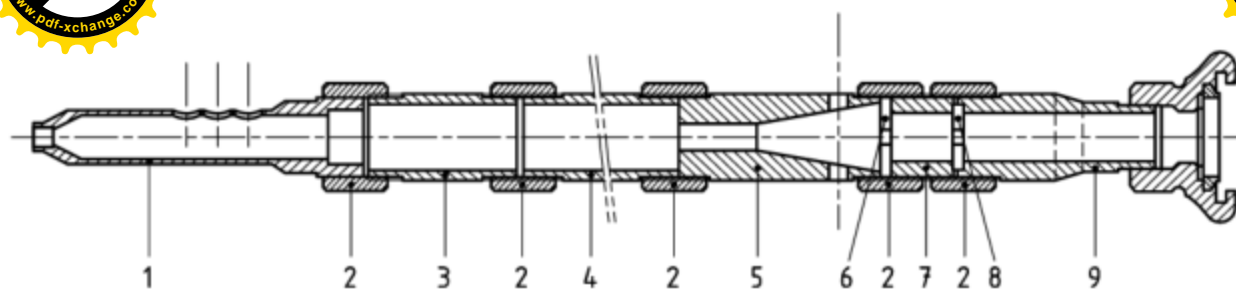
Dimensions in millimetres



Key

- 1 burnback pot
- 2 foam nozzle
- 3 backboard
- 4 adjustable boss
- 5 fire tray
- 6 foam solution

Figure I.1 — Small-scale fire test

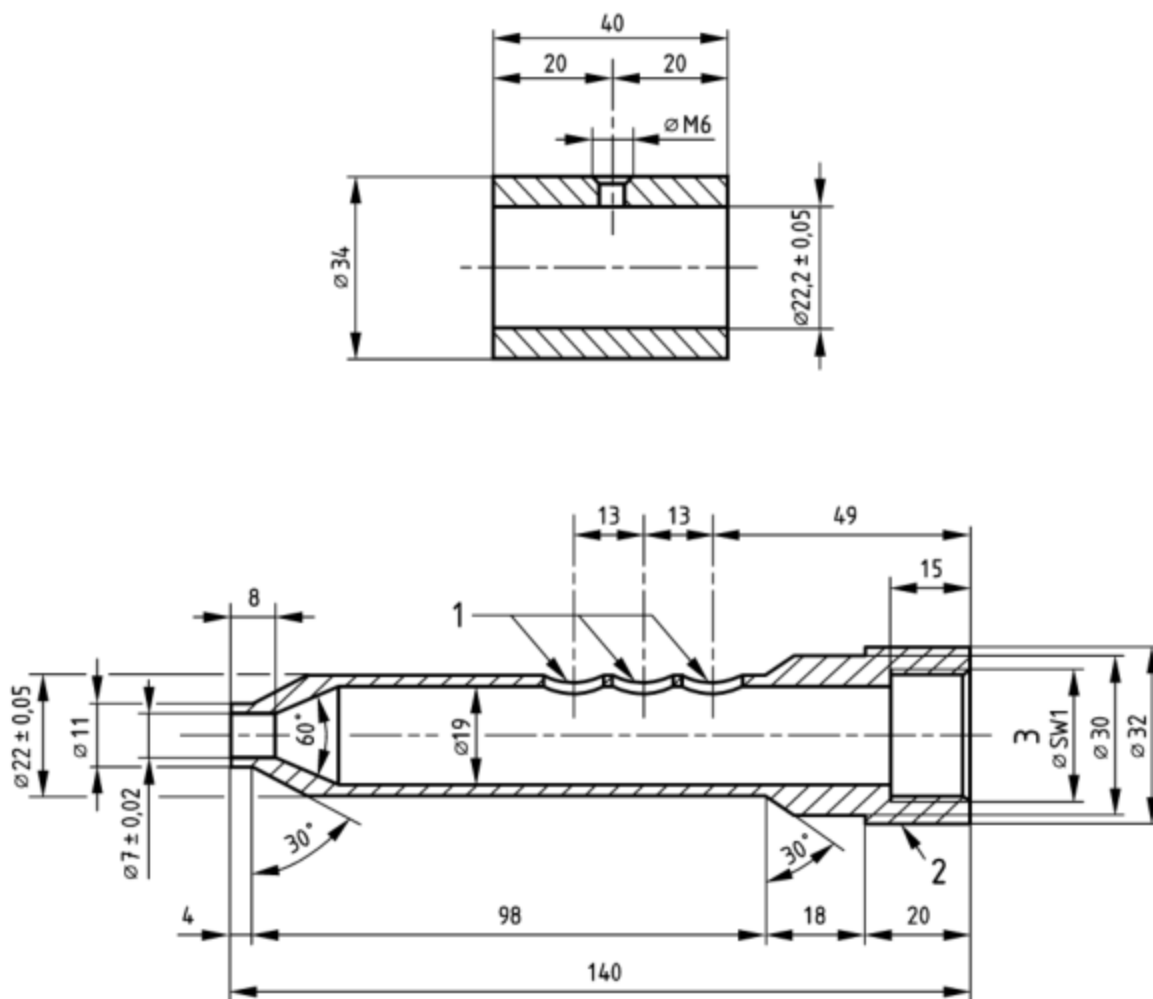


Key

- 1 nozzle with foam diverter (see Figure I.3)
- 2 coupling (see Figure I.4)
- 3 mixing tube (see Figure I.5)
- 4 stabilizing tube (see Figure I.6)
- 5 Venturi tube (see Figure I.7)
- 6 orifice plate G (see Figure I.8)
- 7 spacing piece (see Figure I.9)
- 8 orifice plate P (see Figure I.10)
- 9 inlet (see Figure I.11)

Figure I.2 — Foam-making nozzle for small scale fire test

Dimensions in millimetres

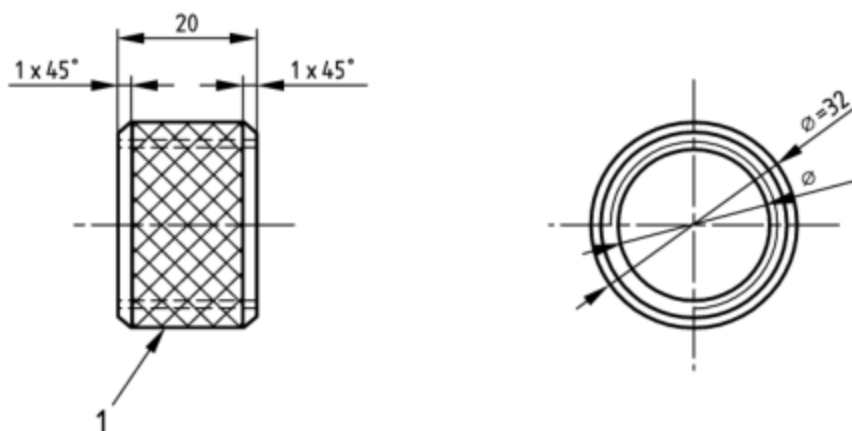


Key

- 1 3 holes $\varnothing H$
- 2 Knurled
- 3 16 threads

Figure I.3 — Sleeve and item 1: Nozzle with foam diverter

Dimensions in millimetres



Key

1 coarse knurled

Figure I.4 — Item 2: Coupling

Dimensions in millimetres

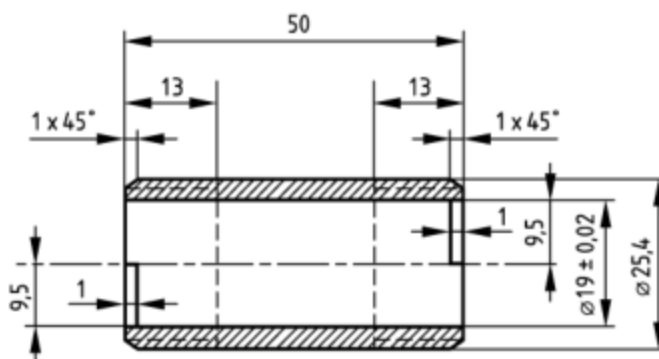
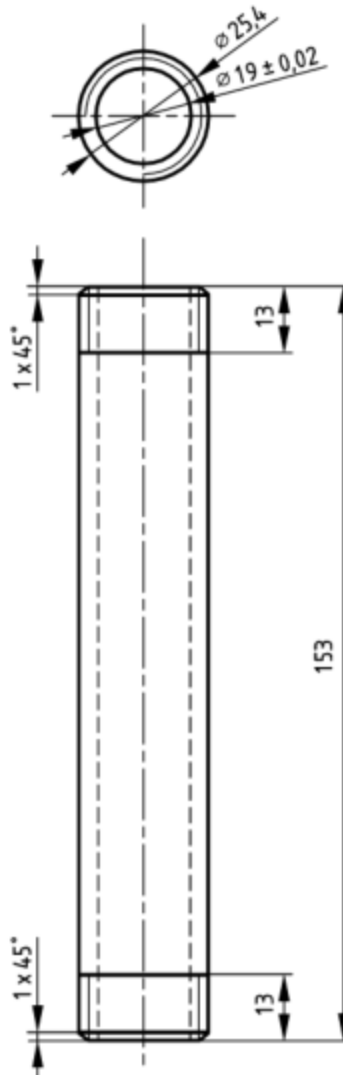


Figure I.5 — Item 3: Mixing tube



Key

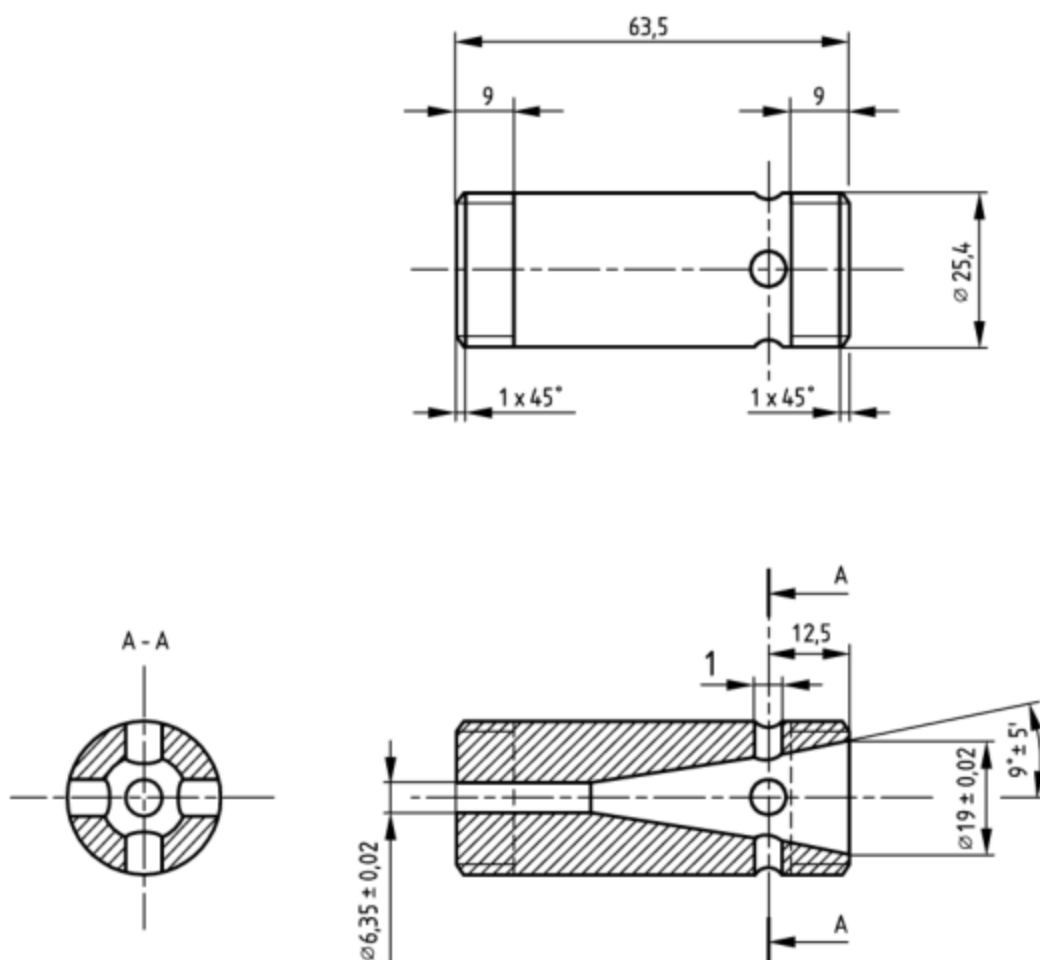
Thread: Whitworth, 16 tpi

Chamfer each end $1 \times 45^\circ$

End faces to be at 90° to axis.

Figure I.6 — Item 4: Stabilizing tube

Dimensions in millimetres

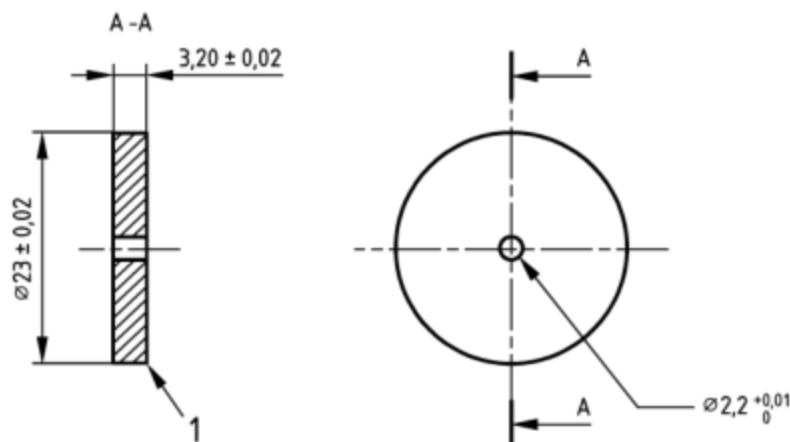


Key

1 4 holes $\varnothing 6$ at 90° in same plane

Figure I.7 — Item 5: Venturi tube

Dimensions in millimetres



Key

1 slight radius

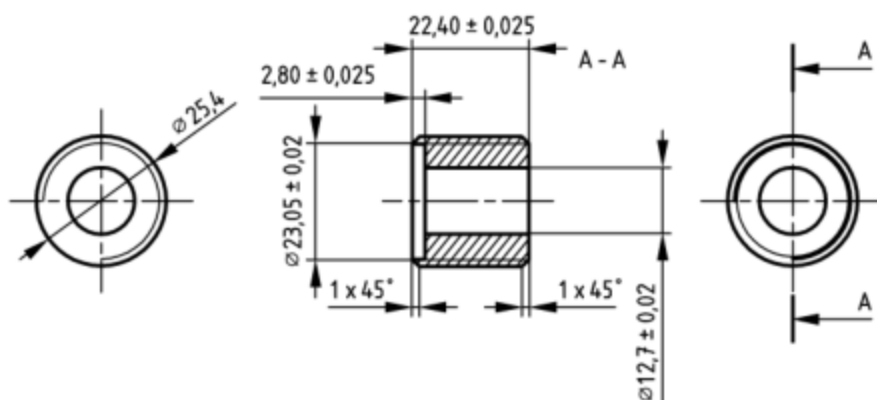
Faces parallel to within 0,02

Hole concentric with O.D. to within 0,02

Hole at 90° to each face within 0,01

Figure I.8 — Item 6: Orifice plate G

Dimensions in millimetres



Bore and counter bore concentric to O.D. within 0,02

Counter bore face parallel to end face within 0,02

Counter bore faces and end faces square with axis to within 0,01

Chamfer thread edges 1 × 45°, leave other edges sharp

Figure I.9 — Item 7: Spacing piece

Figure I.10 — Item 8: Orifice plate P

Dimensions in millimetres

Bore and counter bore concentric to O.D. within 0,02

Figure I.11 — Item 9: Inlet



Annex J (informative)

Description of a radiation measurement method

J.1 Evaluation

Radiation measurement is a convenient and objective way to monitor the performance of a foam during the fire performance test. It reduces the need for visual observations (except for flame flickers and time for complete extinction).

This annex describes the equipment and procedure² which have been used in a series of tests at one testing laboratory, and the methods used to interpret and present the results. The method is suitable for low and medium expansion foams, but not for high expansion foams.

J.2 General arrangement of test

Place two radiometers diametrically in relation to the tray as shown in Figure J.1. The distance between the radiometers and the rim of the tray should be not less than twice the diameter of the tray and the height above the rim not less than 1,5 m.

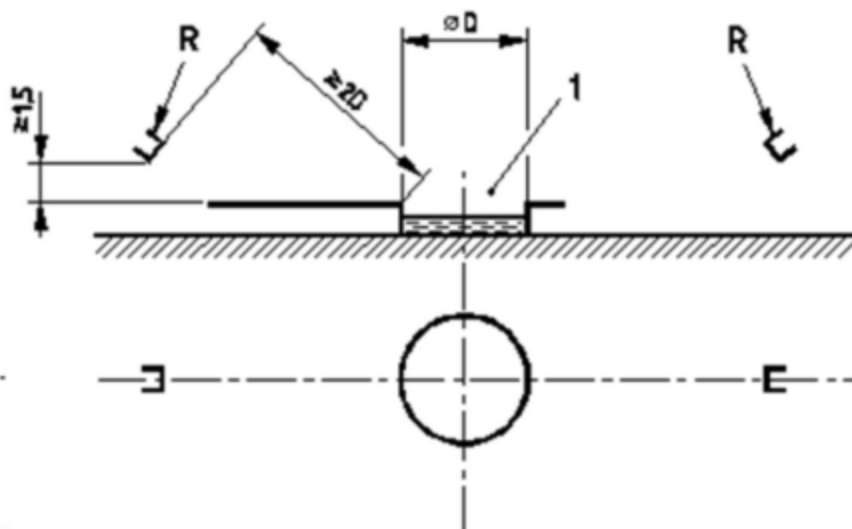
NOTE Maximum distance is limited by the sensitivity of the radiometers.

Record the radiation levels continuously or with intervals not exceeding 1 s.

2) Further details are given in Nordtest Method NT Fire 023, obtainable from Nordtest, Postbox 22, SF - 00341 Helsinki, Finland.

Nordtest Method NT Fire 023 is an example of a suitable product available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product.

Dimensions in metres



Key

R radiometers

1 circular fire tray

Figure J.1 — Location of the radiometers for recording of the heat radiation during fire performance tests

J.3 Technical data for radiometers³⁾

Use two radiometers of the Gardon gauge or Schmidt-Boelter type, cooled with water maintained at a constant $(30 \pm 10) ^\circ\text{C}$ during the measurements.

The radiometers shall absorb at least 90 % of the incoming radiation within the range of wavelengths $0,6 \mu\text{m}$ to $15,0 \mu\text{m}$.

For a fully developed fire the radiometer reading should be not less than 0,6 times full scale.

The radiometers shall have a maximum nonlinearity of $\pm 3 \%$ of the nominal range of measurement, and a maximum response time of 2 s (up to 63 % of full response).

NOTE A radiometer with protective glass can be used, provided that the requirements for spectral sensitivity are satisfied. If it is assumed to be desirable, the recommendation to use the range of measurement can be changed, if the radiometers have a better linearity. Less than 40 % utilization is not advisable as the influence of background radiation might cause too high an effect.

J.4 Procedure

Correct the output from the two radiometers by deducting the background radiation recorded from 5 s to 10 s after the point of time for complete extinction.

Determine the mean value of the output from the two radiometers.

3) An example of suitable apparatus is the Medtherm Series 64 supplied by Medtherm Corp., P.O. Box 412, Huntsville, AL, USA.

The Medtherm Series 64 supplied by Medtherm Corp. is an example of a suitable product available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product.



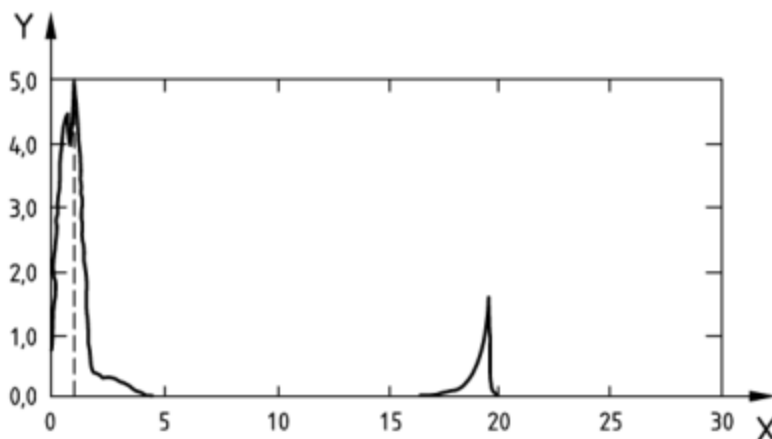
Determine the average radiation value (free burning radiation value) by averaging the recorded values over the 25 s period starting from the 30 s to the 5 s before start of the foam application (see Figure J.2).

Determine the relative radiation by dividing the output radiation from the radiometers with the calculated average free burning radiation value.

Instantaneous radiation values are subject to random fluctuations. Plot radiation values averaged over the period ± 5 s for each time value to produce a smoother curve, which facilitates interpretation.

The adjusted relative radiation is shown for the extinguishing test in Figure J.3 and for the burn-back test in Figure J.4. 90 % control is equivalent to the relative radiation 0,1.

NOTE The procedure set out here implies that computer controlled measuring practice is applied.



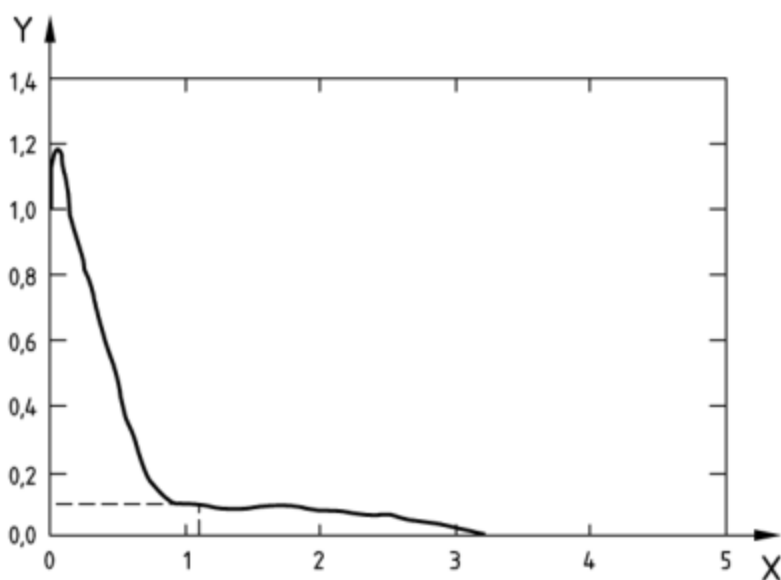
Key

X time, min

Y radiation, kW/m²

NOTE Foam application starts at 1 min, stops at 5 min. Burn-back test starts at 15 min.

Figure J.2 — Typical absolute radiation levels throughout a test



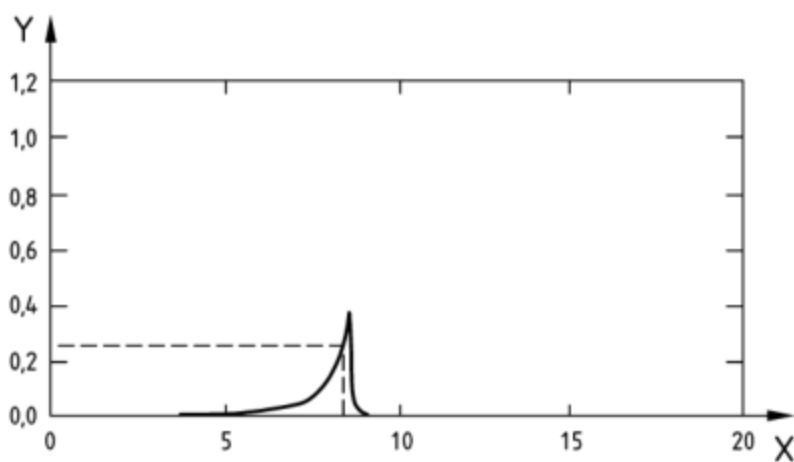
Key

X time, min

Y relative radiation, dimensionless

NOTE Foam application starts at 0 min, stops at 4 min, 90 % control is achieved at about 1 min 8 s.

Figure J.3 — Typical relative radiation levels throughout a test



Key

X time, min

Y relative radiation, dimensionless

NOTE Burn-back starts at 0 min.

Figure J.4 — Typical relative radiation levels during burn-back

Annex K

(normative)

Freezing point determination

K.1 General

NOTE See Clause 5.

This test is derived from the test procedure in EN ISO 5764 [8] of determining the freezing point of milk.

K.2 Apparatus

K.2.1 Cooling bath, capable of attaining temperatures below minus 30 °C.

K.2.2 250 ml double-neck flask with stirrer.

K.2.3 Thermocouple.

K.2.4 XY-recorder for plotting a curve of temperature against time.

K.3 Procedure

K.3.1 Fill (200 ± 2) ml sample into the 250 ml double-necked flask.

K.3.2 Insert the stirrer and the thermocouple probe into the double-necked flask in such a way that the thermocouple probe does not touch the stirrer, and is completely covered by liquid.

K.3.3 Insert the flask into the cooling bath.

K.3.4 Start the stirrer, and adjust the speed so that the entire volume of liquid is slightly agitated, but no air is drawn into the liquid.

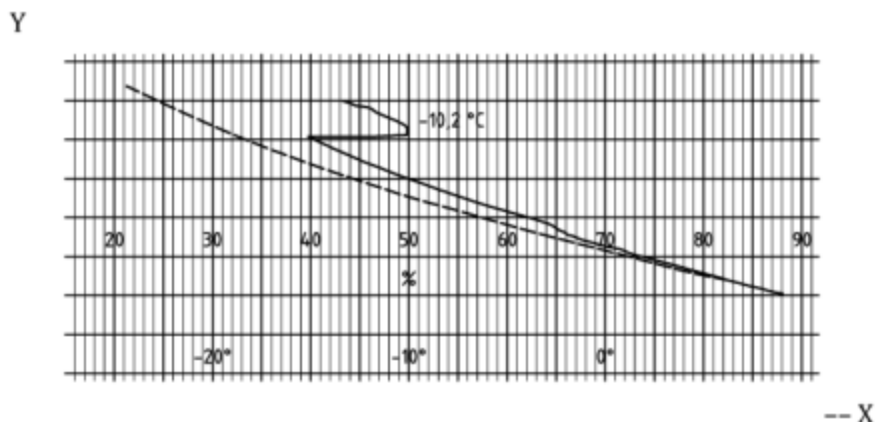
K.3.5 Set the cooling bath temperature to 5 °C to 10 °C below the expected freezing point of the liquid.

K.3.6 Note the temperature, and plot a graph of temperature against time.

K.3.7 The temperature curve will drop until a certain point, when it will rise for a period before dropping again.

K.3.8 The freezing point of the liquid is the highest point of this part of the graph, before the curve starts to drop again.

K.4 Example of a temperature against time curve for evaluation



Key

X temperature

Y time

Figure K.1 — XY-Plotter (temperature against time curve)

Interpretation of the curve:

The obtained curve should look like as given in Figure K.1. The temperature drop is from right to left (Axis X), the dashed line curve obtained from bath temperature and the solid line curve from the sample.

The slight temperature rise shown in the solid line curve is caused by the crystallization heat released by the freezing out of the first component. The maximum (shown here as $-10,2\text{ °C}$) is to be recorded as the freezing point.



Annex L (normative)

Stability/Separation test of foam concentrate

L.1 General

NOTE See Clause 9.

The foam concentrate shall not separate, stratify or precipitate as indicated by two or more distinct layers or the presence of solid deposits at the bottom of the container.

L.2 Apparatus

L.2.1 Freezing chamber, capable of achieving a temperature of $(0 \pm 1) ^\circ\text{C}$.

L.2.2 Oven, capable of achieving a temperature of $(50 \pm 3) ^\circ\text{C}$.

L.2.3 Two 500 ml graduated cylinders with stoppers, approximately 400 mm high and 65 mm in diameter.

L.3 Procedure

Two 500 ml graduated cylinders with foam concentrate shall be filled, sealed with stoppers and then placed in the conditioning environment (freezing chamber and oven) where foam concentrate will not be exposed to agitation such as stirring or shaking.

Place one filled cylinder in the freezing chamber and maintain at the required temperature $(0 \pm 1) ^\circ\text{C}$ for 30 days.

Place one filled cylinder in the oven and maintain at the required temperature $(50 \pm 3) ^\circ\text{C}$ for 30 days.

After 30 days conditioning the foam concentrates shall be visually examined (without letting the sample equilibrate to room temperature) to determine compliance with Clause 12.

Do not agitate, stir or shake the content of the graduated cylinders at any time until the entire test is finished.

Annex M (normative)

Occupational health and ecotoxicological testing

This annex provides guidance on how the occupational health and ecotoxicological information can be determined. The manufacturer shall provide data for the parameters for both foam concentrate and foam solution at the maximum concentration for use recommended by the manufacturer.

Table M.1 — Parameters for foam concentrate and foam solution

| Parameter | Proposed method |
|--|--------------------------------------|
| Bacteria | |
| Luminescent bacteria or Activated sludge | EN ISO 11348-2 EN ISO 23753-1 |
| Aquatic life | |
| Fish | OECD 203 |
| Daphnia | OECD 202 |
| Algae | OECD 201 |
| Degradation | OECD 301f |
| Mammals | |
| Acute toxicity, oral, rats | OECD 420 |
| Skin irritation and corrosion | OECD 404 |
| Eye irritation | OECD 405 |

The data should be generated following the procedures in accordance with the most recent version of the Council Regulation (EC) No 1272/2008 (CLP) [2], Council Regulation (EC) No 440/2008 [6] and Regulation (EC) No 1907/2006 (REACH) [3].

REACH and CLP allow the application of mathematical methodology to evaluate the toxicological properties of a mixture based on the toxicological information of its constituents in order to reduce animal (vertebrates) testing as much as possible.

The selection of alternative test conditions shall be meaningful for the typical use of the foam agent (e.g. acute fish toxicity on fresh water or marine fish).

The test report/reports shall mention the method used (mathematical or testing) and reference the source of the data provided.

It might be useful for users of foam concentrate to have requested information for all recommended proportioning ratios.

Annex N (informative)

Example of a technical data sheet

| Technical sheet | Data | | Data / Content |
|--|-------------------|-------------------|---|
| Commercial Name of Foam | | | |
| Manufacturer (Place of Production) | | | Manufacturer location or Company name |
| Grades of Foam | | | Synthetic or Protein |
| Type | | | AFFF, AFFF-AR, S, S-AR, F3, F3-AR, P, FP, FFFP, P-AR, FP-AR, FFFP-AR |
| Aqueous film-forming | | | Yes / No |
| Concentration of use | | | % [non polar]; [polar] |
| Use | | | Polar liquid, hydrocarbons (or Water Miscible / Water Immiscible) |
| Types of Application | | | Gentle application and/or Forceful application |
| Expansion | | | Low, medium, high expansion |
| Compatible with sea water | | | Yes / No |
| Physico-chemical data | Data | | Data / Content |
| pH value | @ 20°C | | ± |
| Density | @ 20°C / [g/ml] | | ± g/ml |
| Shape and Colour | | | |
| Sediments | | | ≤ 0, % |
| Type of viscosity and value | | | Newtonian / Pseudo-plastic |
| | | | ISO 3104 or ISO 3219 (for pseudoplastic) |
| | Method | | Concentrates at a shear rate of 75 s-1 and 375 s-1 for all given temperatures |
| | Testing Geometry | | [cone+plate; spindle] |
| | @ 20°C | | mm²/s or Cps or mPa.s |
| | @ 0°C | | mm²/s or Cps or mPa.s |
| | @ Lowest use temp | | mm²/s or Cps or mPa.s |
| Special proportioning / pumping equipment required | | | Yes / No |
| Do not store below (Freezing point) | | | °C |
| Tensiometry | | | [ring; plate] |
| Surface tension | | | [mN/m] |
| Expansion and Drain times values Simulated Fresh water @ 20°C | Low | Expansion | values in case on dual concentration use |
| | | Drain time @ 25 % | If applicable [MIN:SEC] |
| | | Drain time @ 50 % | If applicable [MIN:SEC] |
| | Medium | Expansion | values in case on dual concentration use |
| | | Drain time @ 25 % | If applicable [MIN:SEC] |
| | | Drain time @ 50 % | If applicable [MIN:SEC] |
| | High | Expansion | values in case on dual concentration use |
| | | Drain time @ 25 % | If applicable [MIN:SEC] |
| | | Drain time @ 50 % | If applicable [MIN:SEC] |
| Expansion and Drain times values Simulated Sea water @ 20°C | Low | Expansion | values in case on dual concentration use |
| | | Drain time @ 25 % | If applicable [MIN:SEC] |
| | | Drain time @ 50 % | If applicable [MIN:SEC] |
| | Medium | Expansion | values in case on dual concentration use |
| | | Drain time @ 25 % | If applicable [MIN:SEC] |
| | | Drain time @ 50 % | If applicable [MIN:SEC] |
| | High | Expansion | values in case on dual concentration use |
| | | Drain time @ 25 % | If applicable [MIN:SEC] |
| | | Drain time @ 50 % | If applicable [MIN:SEC] |



| Extinguishing performance class | Data | | Data / Content |
|---|-------------------------|---------------------------|---------------------------------------|
| Compliance with: *Latest version by default / specify if different | EN 1568-1* [Heptane] | | Pass / Not tested |
| | EN 1568-2* [Heptane] | | Pass / Not tested |
| | EN 1568-3* [Heptane] | | Rating Fresh Water / Rating Sea Water |
| | EN 1568-4* | <u>Acetone</u> <u>IPA</u> | Rating Fresh Water / Rating Sea Water |
| Other Listings or Approvals | | | UL, ICAO, IMO ... |
| Miscellaneous | Data | | Data / Content |
| Lowest temperature for use | | | ... °C |
| Minimum Storage temperature | | | ... °C |
| Maximum storage temperature | | | + ... °C |



Annex O (informative)

A-Deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC member.

This European Standard does not fall under any Directive of the EU.

In the relevant CEN/CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

Denmark

Clause

Deviation

Clause 14

The foam concentrates are covered by Regulation No. 540 of 2nd September 1982 from the Danish Ministry of Labour concerning substances and materials and by Regulation No. 801 of 23rd October 1997 from the Danish Ministry of Environment and Energy concerning classification, packaging, labelling, sale and storage of chemical substances and products.

These regulations set up requirements for marking of products injurious to health together with information.

Germany

Introduction and Clause 2

Verordnung über Stoffe, die die Ozonschicht schädigen (Chemikalien-Ozonschichtverordnung - ChemOzonSchichtV); BGBl I, 2012, Nr. 12, 419–412.

The ordinance prohibits the use of ozone layer destroying halogenic hydrocarbons in Germany

Clause 14, NOTE

Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen (VawS).

When chemical substances constituting a hazard to water (e.g. fire extinguishing media like foam concentrates) are handled (like storing, filling, manufacturing, treating) in facilities the Ordinances on Facilities for Handling dangerous Substances of the Bundesländer have to be considered. Operators of such facilities are obliged to perform or to establish safety measures aimed at the protection of waters (precautionary principle). Prerequisite for appropriate safety measures is the assessment of substances and mixtures/preparations and its classification into Water Hazard Classes (Wassergefährdungsklassen) according to the Administrative Regulation on the Classification of Substances Hazardous to Waters (Verwaltungsvorschrift wassergefährdende Stoffe; VwVwS) of 17 May, 1999.

The safety measures may concern for example storage facilities, storage volume, facility equipment, special surveillance obligation or notification duties.



The classification according VwVwS is based on § 4 a Ordinance on Hazardous Substances (Gefahrstoffverordnung - GefStoffV), which is directly linked with the European Directive 67/548/EEC. Classified substances listed in Annex 1 of EU Directive 67/548/EEC are published in „Bundesanzeiger“ by the Federal Ministry of Labour and Social Affairs.

The hazardous potential of a substance or mixture depends besides its intrinsic properties on the kind of facility, the handled volume of the substances and on environmental conditions.



Bibliography

- [1] Commission Directive 2006/60/CE of 7 July 2006 amending Annexes to Council Directive 90/642/EEC as regards the maximum residue levels of trifloxystrobin, thiabendazole, abamectin, benomyl, carbendazim, thiophanate-methyl, myclobutanyl, glyphosate, trimethylsulfonium, fenpropimorph and clormequat
- [2] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging (CLP) of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006
- [3] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC
- [4] EN 2, *Classification of fires*
- [5] EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*
- [6] Council Regulation (EC) No 440/2008 of 30 May 2008 laying down test methods pursuant to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
- [7] ISO 3734, *Petroleum products — Determination of water and sediment in residual fuel oils — Centrifuge method*
- [8] EN ISO 5764, *Milk — Determination of freezing point — Thermistor cryoscope method (Reference method) (ISO 5764)*
- [9] EN 1568-1, *Fire extinguishing media — Foam concentrates — Part 1: Specification for medium expansion foam concentrates for surface application to water-immiscible liquids*
- [10] EN 1568-2, *Fire extinguishing media — Foam concentrates — Part 2: Specification for high expansion foam concentrates for surface application to water-immiscible liquids*
- [11] EN 1568-3, *Fire extinguishing media — Foam concentrates — Part 3: Specification for low expansion foam concentrates for surface application to water-immiscible liquids*