BRITISH STANDARD

BS EN 1568-1:2008

Fire extinguishing media — Foam concentrates —

Part 1: Specification for medium expansion foam concentrates for surface application to water-immiscible liquids

ICS 13.220.10

British Standards

National foreword

This British Standard is the UK implementation of EN 1568-1:2008. It supersedes BS EN 1568-1:2000 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee FSH/18, Fixed fire fighting systems, to Subcommittee FSH/18/3, Foam concentrates.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Agents extincteurs - Emulseurs - Partie 1: Spécifications pour les émulseurs moyen foisonnement destinés à une application à la surface de liquides n'ayant pas d'affinité pour l'eau

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Foreword

This document (EN 1568-1:2008) 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of an identical text or by endorsement, at the latest by September 2008, and conflicting national standards shall be withdrawn at the latest by September 2008.

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

This document supersedes EN 1568-1:2000.

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

EN 25923, Fire protection — Fire extinguishing media — Carbon dioxide (ISO 5923:1989)

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 615, Fire protection — Fire extinguishing media — Specification for powders (other than Class D powders)

This standard is Part 1 of EN 1568 which has the general title "*Fire extinguishing media - Foam concentrates*". The other parts are:

— 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

— Part 4: Specification for low expansion foam concentrates for surface application to water-miscible liquids.

As fire fighting foams are chemical agents or chemical preparations EC directives 1967/548/EEC, 1999/45/EEC, Regulation (EC) 1907/2006 (REACH) and 2006/60/EEC apply and should be taken into account.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Classes of fire are defined in EN 2 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 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 manufacturers should not be mixed.

It should be noted that 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 should not in normal usage present a significant toxic hazard to life in relation to the environment. The current versions of EC directives 67/548/EEC, 2006/60/EEC, 1999/45/EEC and Regulation (EC) 1907/2006 apply when considering the testing of ecotoxicological properties and safety in the work environment.

1 Scope

This document specifies requirements for chemical and physical properties, and minimum performance requirements of medium expansion foams suitable for surface application to water-immiscible liquids. Requirements are also given for marking.

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

2 Normative references

The following referenced documents are indispensable for the application 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 3104:1994)*

EN 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 3219:1993)*

EN ISO 3696, *Water for analytical laboratory use - Specification and test methods (ISO 3696:1987)*

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*

3 Terms and definitions

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

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
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 Annex A gives information on grades of foam concentrate.

3.8
foam solution
solution of foam concentrate in water

3.9
sediment
insoluble particles in the foam concentrate

3.10
spreading coefficient
value which indicates the ability of one liquid to spread spontaneously across the surface of another

NOTE The spreading coefficient indicates the possibility of film forming, but it does not measure its quality.

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
interfacial tension
tension within the interface between two immiscible liquids

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 µm 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 µm sieve and the percentage volume of sediment shall be not more than 1,0 % when tested in accordance with Annex C.

5 Viscosity of the foam concentrate

5.1 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 $mm^2 s^{-1}$, the container shall be marked in accordance with Clause 11 l).

5.2 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 mPa.s at 375 s^{-1}, the container shall be marked in accordance with Clause 11 m).

6 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 ± 1) °C.

7 Surface tension of the foam solution

The surface tension (determined in accordance with F.2.1) 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.

8 Spreading coefficient of the foam solutions

NOTE The spreading coefficient indicates the possibility of film-forming, but it does not measure its quality. Certain properties of film-forming foams are not defined are note defined by this standard.

8.1 Before temperature conditioning

The foam solution prepared using the concentrate, if it is claimed by the supplier to be "aqueous film-forming", sampled in accordance with Annex B shall have a positive spreading coefficient over cyclohexane when tested in accordance with F.2.2.

8.2 After temperature conditioning

The foam solution prepared using top and bottom half-samples, see E.4, of the foam concentrate, if it is claimed by the supplier to be "aqueous film-forming", sampled in accordance with Annex B and conditioned in accordance with Annex E, shall have a positive spreading coefficient over cyclohexane when tested in accordance with F.2.2.

9 Expansion and drainage of foam

9.1 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 potable water shall be tested in accordance with Annex G. If appropriate, a further sample of the same concentration made with simulated sea water in accordance with G.4 shall also be tested.

NOTE Expansion is dependent on the foam concentrate and the equipment used to make the foam. The test equipment of G.1 tends to give expansions higher than some other equipment so the expansion limit is above the 20 limit for medium expansion (see 3.4).

9.2 After temperature conditioning

The foams produced from the solutions prepared with potable 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 9.1 using potable water (i.e. before temperature conditioning) by more than 20 % of the value obtained in 9.1 using potable water; and

b) 25 % drainage times which do not differ from each other or from the value obtained in 9.1 using potable water (i.e. before temperature conditioning) by more than 20 % of the value obtained in 9.1 using potable water.

If appropriate repeat the tests 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. These foam solutions shall have the following:

c) expansions which do not differ from each other or from the value obtained in 9.1 using the simulated sea water (i.e. before temperature conditioning) by more than 20 % of the value obtained in 9.1 using the simulated sea water in accordance with G.4; and,

d) 25 % drainage times which do not differ from each other or from the value obtained in 9.1 using the simulated sea water (i.e. before temperature conditioning) by more than 20 % of the value obtained in 9.1 using the simulated sea water in accordance with G.4.

10 Test fire performance

The foam produced from foam solutions prepared using the foam concentrate sampled in accordance with Annex B at the supplier's recommended concentration with potable water, and if appropriate at the same concentration with the simulated sea water in accordance with G.4, shall have an extinction time not more than 120 s and a 1 % burn-back time not less than 30 s, when tested in accordance with H.1 and H.2.

NOTE The values obtained with sea water can differ from those obtained with potable water.

11 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 "medium expansion fire-fighting foam concentrate" and the number and date of this European Standard (i.e. EN 1568-1:2008);

NOTE For medium expansion concentrates which also conform to other parts of EN 1568 additional markings may be used as given in those parts.

c) if the concentrate conforms to Clause 8 the words "aqueous film-forming";

d) recommended usage concentration (most commonly 1 %, 3 % or 6 %);

e) any tendency of the foam concentrate to cause harmful physiological effects, the methods needed to avoid them and the first aid treatment if they should occur;

f) recommended maximum storage temperature and lowest temperature for use;

g) if the concentrate does not conform to Clause 7, 8.2 and 9.2 after conditioning in accordance with E.2, the words "Do not store below 0 °C";

h) the nominal quantity in the container;

i) the supplier's name and address;

j) the batch number and the date of manufacture;

k) the words "Not suitable for use with sea water" or "Suitable for use with sea water" as appropriate;

l) if the foam concentrate is Newtonian and the viscosity at the lowest temperature for use is more than 200 $mm^2 s^{-1}$ when measured in accordance with EN ISO 3104 the words ‘’This concentrate can require special proportioning equipment”;

m) if the foam concentrate is pseudo-plastic and the viscosity at the lowest temperature for use is greater than or equal to 120 mPa.s at 375 s^{-1} the words “Pseudo-plastic foam concentrate. This concentrate can require special proportioning equipment";

n) the lowest extinguishing performance class and the lowest burn-back resistance level obtained during testing to each part of EN 1568 (if tested to more than one part) with all fuels in potable water and sea water.

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 can contain fluorinated surface-active agents with additional stabilisers;

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.

Annex B
(normative)

Preliminary 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 will provide a representative sample of the foam concentrate to be tested.

NOTE Nominal 25-litre 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 ± 5) °C, the other after ageing for (24 ± 2) h at (60 ± 2) °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 are suitable.

C.2.2 Centrifuge, operating at (6 000 ± 600) m s^{-2}.

NOTE The centrifuge described in ISO 3734 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

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

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, to and including the lowest temperature for use claimed by the manufacturer in steps of 10 ºC. 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 before the sample is applied in the apparatus.

The test should be performed 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 600s^{-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}).

Measure the shear stress at least at 8 different shear rates over the range (0 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 the Equation (D.1).

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

D.2.4 Results

Report the results as a table including test temperature (ºC), shear rate (s^{-1}), Shear stress (Pa), and apparent viscosity (mPa.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 ºC, 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 ± 3) ºC

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 ± 3) ºC.

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 ± 1) h. At the end of this period store the container(s) for not less than 48 h and not more than 72 h in an ambient temperature of (20 ± 5) ºC.

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

E.3 High temperature conditioning

E.3.1 Apparatus

Oven, capable of achieving a temperature of (60 ± 3) ºC.

E.3.2 Procedure

Set the temperature of the oven to (60 ± 3) ºC.

If the foam concentrate sample has not been conditioned in accordance with E.2 use foam concentrate sample 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 days. At the end of this period store the container(s) for not less than 48 h and not more 72 h in an ambient temperature of (20 ± 5) ºC.

E.4 Division into top and bottom half-samples

E.4.1 Apparatus

E.4.1.1 Top half-sample container(s)

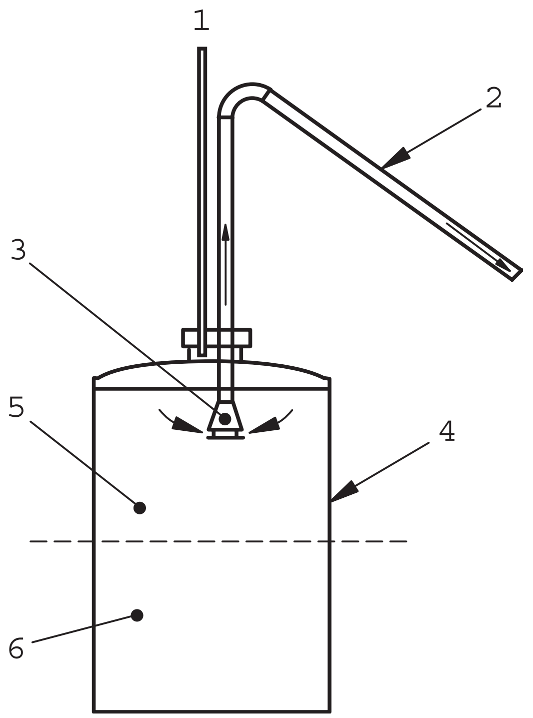
Sealable empty container(s), suitable for the foam concentrate to be tested, of minimum half the volume of the sample container(s) as described in Annex B.

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 (8-15) mm
3 detachable cone and plate, diameter (25-35)mm, height (40-50)mm, distance between cone and plate (10-12)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 a vertical direction so that the inlet of the delivery pipe is positioned below the surface, at a vertical distance of approximately 1/3 in to 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 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 is preferably kept in the original sample container.

Before subsequent testing starts of the top and bottom half-samples for Clauses 7, 8 and 9, 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 and spreading coefficient

NOTE See Clauses 7 and 8.

F.1 Materials

F.1.1 Solution of foam concentrate, at the recommended usage concentration in distilled water complying with EN ISO 3696 (Grade 3) or demineralized water; the water having a surface tension greater than 70 $mN.m^{-1}$ when tested in accordance with F.2.1.

F.1.2 For determination of spreading coefficient only, cyclohexane of purity not less than 99 %.

F.2 Procedure

F.2.1 Surface tension

Determine the surface tension of the solution at a temperature of (20 ± 1) °C using the ring or plate method of ISO 304. In the test report state which method (ring or plate) was used.

F.2.2 Spreading coefficient

After measuring surface tension in accordance with F.2.1 introduce a layer of cyclohexane at (20 ± 1) °C onto the foam solution, being careful to avoid contact between the ring or plate and the cyclohexane. Wait (6 ± 1) min and measure the interfacial tension. Calculate the spreading coefficient between the solution and cyclohexane from the Equation (F.1):

$$S = T_c - T_s - T_i \tag{F.1}$$

where

S is the spreading coefficient in millinewtons per metre;

T_c is the surface tension of the cyclohexane determined in accordance with F.2.1 in millinewtons per metre;

T_s is the surface tension of the foam solution in millinewtons per metre;

T_i is the interfacial tension between the foam solution and cyclohexane in millinewtons per metre.

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

Annex G
(normative)

Determination of expansion and drainage time

NOTE See Clause 9.

G.1 Apparatus

G.1.1 Collecting vessel (see Figure G.1) of volume V approximately 200 l and accurately known to ± 2 l equipped with a bottom discharge facility which ensures a complete emptying.

G.1.2 Foam-making equipment with nozzle as shown in Figures G.2 and G.3 which when tested with water has a flow rate of 3,1 l/min to 3,4 l/min at a nozzle pressure of (5,0 ± 0,1) bar.

G.1.3 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 ± 2,5) °C

G.3 Procedure

G.3.1 Prepare two samples of foam concentrate in accordance with Annex B. Condition one 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 potable 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 the simulated sea water prepared in accordance with G.4.

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

G.3.3 Wet the vessel internally and weigh it. Record the mass (M_1). Set up the foam equipment and adjust the nozzle pressure within the range (5,0 ± 0,1) bar to give a flow rate of 3,1 l/min to 3,4 l/min. With discharge facility closed, collect foam, taking care that voids are not formed in the vessel, starting the timing device when the vessel is half full. As soon as the vessel is full, stop collecting foam and strike the foam surface level with the rim. Weigh the vessel and record the mass (M_2).

Calculate the expansion *E* from the Equation (G.1):

$$E = \frac{V}{M_2 - M_1} \tag{G.1}$$

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 weight 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 whilst preventing the passage of foam. For each sample carry out the test three times.

NOTE The vessel should be cleaned from running foam outside after the strike of the foam.

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

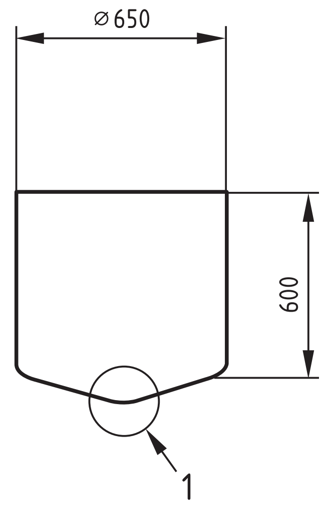
G.4 Simulated sea water

Prepare the simulated sea water by dissolving the following components:

% by weight	Component	
2,50	Sodium Chloride	($NaCl$)
1,10	Magnesium Chloride	($MgCl_2$, $6H_2O$)
0,16	Calcium Chloride	($CaCl_2$, $2H_2O$)
0,40	Sodium Sulphate	(Na_2SO_4)
95,84	Potable water	

All dimensions are nominal and in millimetres.

Nominal volume 200 l

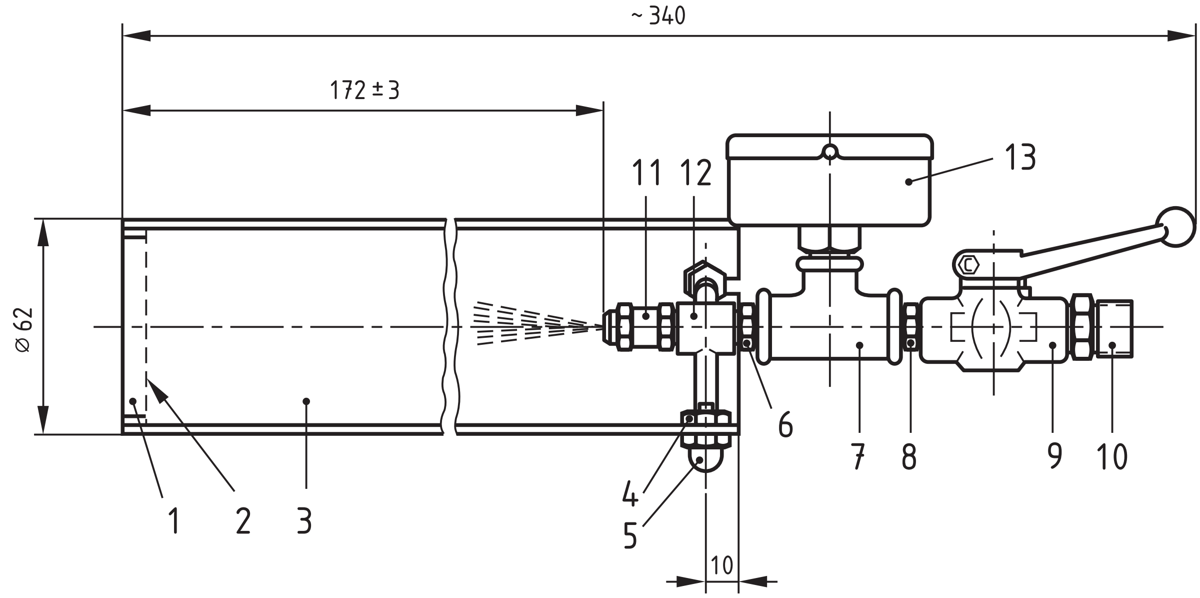


Key

1 bottom discharge facility

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

Dimensions in millimetres



Key

		No	Size			No	Size
1	ring	1		8	nipple	1	G-1/4"
2	net	1		9	valve	1	G-1/4"
3	pipe	1		10	nipple	1	G-1/4"-3/8"
4	nut	1	M6M 6	11	nozzle	1	G-1/8" GG 3,5
5	acorn nut	3	MHM 6	12	collar	1	
6	nipple	1	G-1/4"-1/8"	13	pressure gauge	1	G-1/4" 1-1,6MPa D=40
7	tee	1	G-1/4"				

It is essential that the nozzle is coaxial with the barrel of the foam branch and that the pressure gauge is positioned so as not to interfere with the air inlet of the branch.

Figure G.2 — Medium expansion foam-making nozzle[1]

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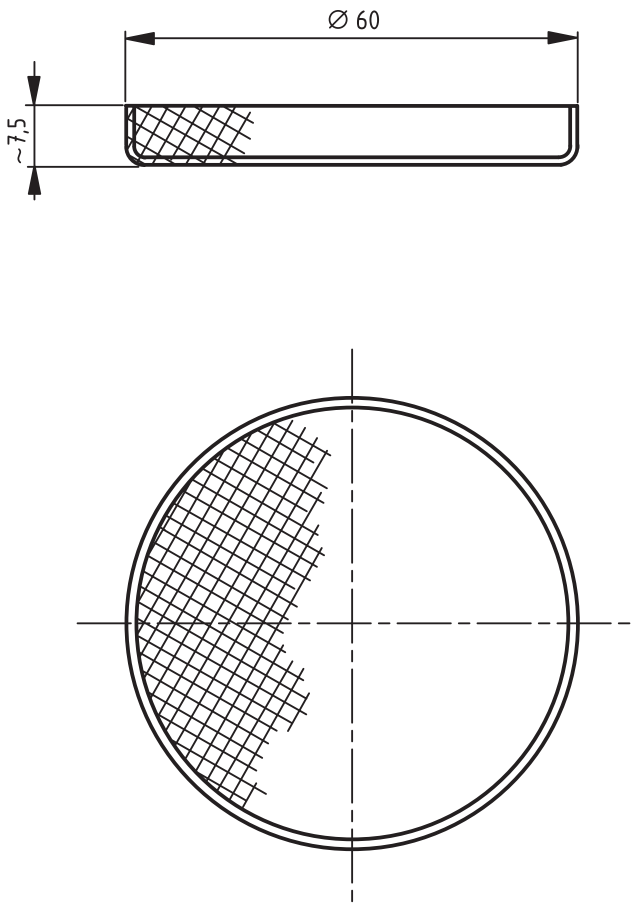
[1] An example of a suitable apparatus, available commercially, is supplied by Svenska Skum AB, P O Box 674, S-442, 18 Kungalv, Sweden. This information is given for the convenience of users of this standard and does not constitute an endorsement by CEN of this product.



24 mesh per inch, wire diameter 0.4 mm

Figure G.3 — Net (2)

Annex H
(normative)

Determination of test fire performance

NOTE 1 See Clause 10.

NOTE 2 The tests described in this annex are more expensive and time consuming than the other tests described in this 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.1 General conditions

H.1.1 Test series and criteria for success

H.1.1.1 Foam concentrates not compatible with sea water

Carry out two or three tests (the third test is not necessary if the first two are both successful or if both are not successful). The concentrate conforms to Clause 10 if two tests are successful.

H.1.1.2 Foam concentrates compatible with sea water

Carry out one of the first two tests with potable water and the other with the simulated sea water of composition given in G.4. If both are successful repeat the test with the greater of the two extinction times. If the extinction times are identical repeat the sea water test. If the repeat test is successful terminate the test series. If the repeat test is unsuccessful carry out a second repeat test.

If one of the first two tests is not successful repeat the test. If this repeat test is successful carry out a second repeat test; otherwise terminate the test series. The concentrate conforms to Clause 10 if three tests are successful.

H.1.2 Temperature and wind speed

Carry out the tests under the following conditions:

a) air temperature	(15 ± 5) °C;
b) fuel temperature	(17,5 ± 2,5) °C;
c) water temperature	(17,5 ± 2,5) °C;
d) foam solution temperature	(17,5 ± 2,5) °C;
e) maximum wind speed in the proximity of the fire tray	3 m/s.

NOTE If necessary some form of wind-screen can be used.

H.1.3 Records

During the fire test record the following:

a) location;

b) air temperature;

c) fuel temperature;

d) water temperature;

e) foam solution temperature;

f) wind speed;

g) 90 % control time;

h) 99 % control time;

i) extinction time;

j) 1 % burn-back time.

NOTE It is recommended that the 25 % burn-back time is recorded. Control times and burn-back time can be determined either visually by an experienced person or from thermal radiation measurements. Annex I gives details of a method suitable for medium expansion foams.

H.1.4 Foam solution

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

Use potable 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.

H.1.5 Fuel

Use an aliphatic hydrocarbon mixture having physical properties according to the following specification:

a) distillation range: 84 °C to 105 °C;

b) maximum difference between initial and final boiling points: 10 °C;

c) maximum aromatic content: a mass fraction of 1 %;

d) density at 15 °C: (700 ± 20) kg/m^3.

NOTE 1 The normal value of surface tension of the aliphatic hydrocarbon mixture measured in accordance with F.2.1 is 21 mN.m^{-1} to 22 mN.m^{-1}.

NOTE 2 Typical fuels meeting this specification are certain solvent fractions sometimes referred to as commercial heptane.

H.2 Fire test

H.2.1 Apparatus

H.2.1.1 Circular fire tray of stainless steel grade EN: X5CrNi18-10 with dimensions as follows:

a) internal diameter at rim (1480 ± 15) mm;

b) depth (150 ± 10) mm;

c) nominal thickness of steel wall 2,5 mm.

NOTE The tray has an area of approximately 1,73 m^2.

H.2.1.2 Foam-making equipment as described in G.1.2

H.2.1.3 Stainless steel burn-back pot, of nominal thickness 2,5 mm, diameter (150 ± 5) mm and height (150 ± 5) mm, with a bracket so that it can be suspended directly on the rim of the fire tray. The upper rim of the burn-back pot shall be level with and in contact with the upper rim of the fire tray.

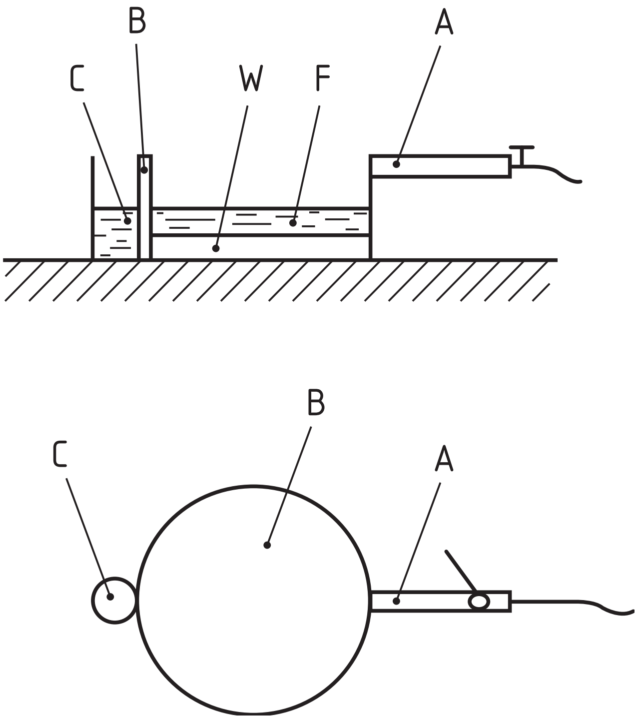
H.2.2 Test procedure

Place the tray directly on the ground and ensure that it is level. Add approximately 30 l of water and (55 ± 2) l of fuel, to give a nominal 50 mm fuel depth, with approximately 100 mm between the fuel surface and the upper rim of the tray wall.

Suspend the burn-back pot containing (0,9 ± 0,1) l of fuel on the sheltered side of the fire tray.

Ignite the fuel not less than 3 min and not more than 5 min after adding it. Not less than 45 s after full involvement of the surface of the fuel mount the medium expansion nozzle horizontally on the rim of the tray as shown in Figure H.1. Start foam application (60 ± 2) s after full involvement. Apply foam for (120 ± 2) s. Record the extinction time as the time after the start of foam application at which all flames in the fire tray are extinguished. Following foam application allow the fire in the burn-back pot to burn until sustained flames appear above the foam blanket. Record this time as the 1 % burn-back time.

If the burn-back pot is extinguished due to overflow of foam during foam application, re-ignite it immediately.



Key

A - foam-making nozzle
B - tray
C - burn-back pot, suspended outside tray
F - fuel
W - water

Figure H.1 —Test fire arrangement for medium expansion foam

Annex I
(informative)

Description of a radiation measurement method

I.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 procedure[2] 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.

I.2 General arrangement of test

Place two radiometers diametrically in relation to the tray as shown in Figure I.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.

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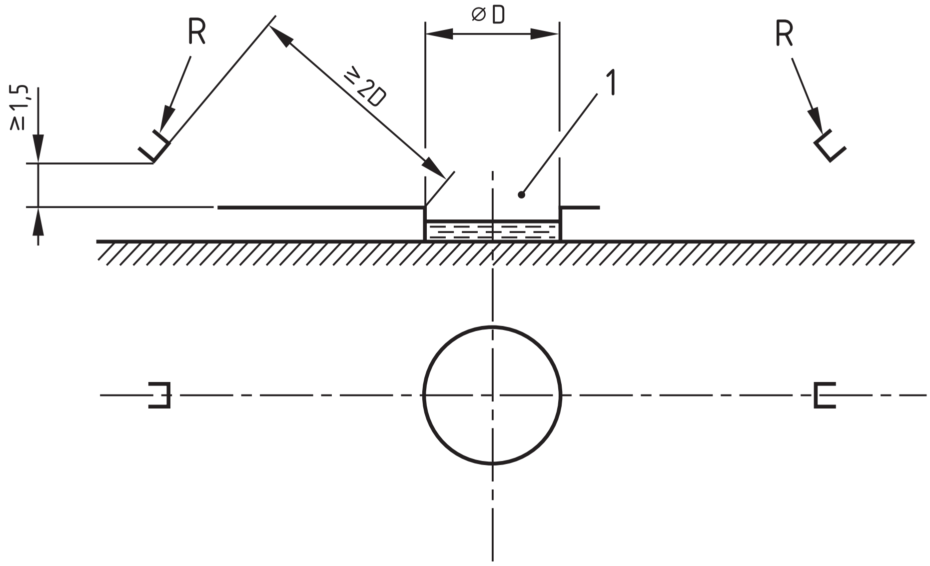
[2] Further details are given in Nordtest Method NT Fire 023, obtainable from Nordtest, Postbox 22, SF - 00341 Helsinki, Finland.

Dimensions in metres



Key

R – radiometers
1 – circular fire tray

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

I.3 Technical data for radiometers[3]

Use two radiometers of the Gordon or Schmidt-Boelter type. The meters should be water-cooled. The temperature of the cooling water should be (30 ± 10) °C, and held constant during the measurements.

The radiometers should absorb at least 90 % of the incoming radiation within the range of wavelengths 0,6 µm to 15,0 µm.

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

The radiometers should have a maximum non-linearity of ± 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 on spectral sensitivity are satisfied. If it is assumed to be desirable, the recommendation to use the range of measurement as above can be changed, if the radiometers have a better linearity. Less than 40 % utilisation is not advisable as the influence of background radiation might cause too high an effect.

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[3] An example of suitable apparatus, available commercially, is the Medtherm Series 64 supplied by Medtherm Corp., P O Box 412, Huntsville, AL, USA. This information is given for the convenience of users of this standard and does not constitute an endorsement by CEN of this product.

I.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.

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 I.2).

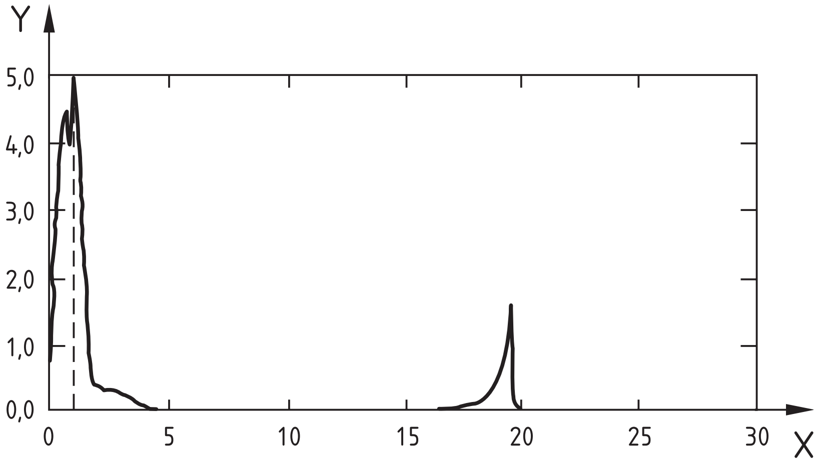
Determine the relative radiation by dividing the output radiation from the radiometers with the calculated average free burning radiation value.

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 I.3 and for the burn-back test in Figure I.4. 90 % control is equivalent to the relative radiation 0,1.

The description above implies that computer controlled measuring practice is applied.

NOTE Figures I.2, I.3, and I.4; show radiation data from a test carried out in accordance with Part 3 of this standard and are illustrative of the type of information generated by this technique.

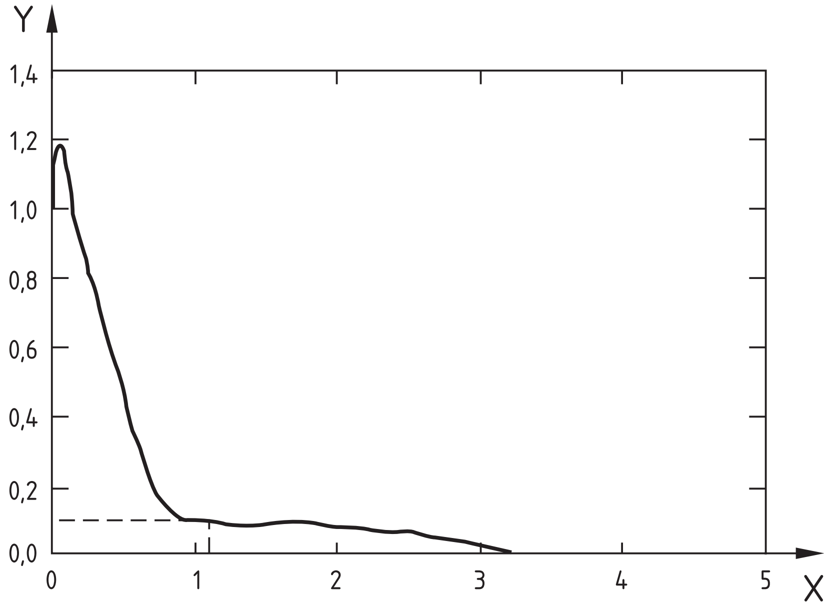


Key

X: duration time, min
Y: radiation, kW/m^2

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

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

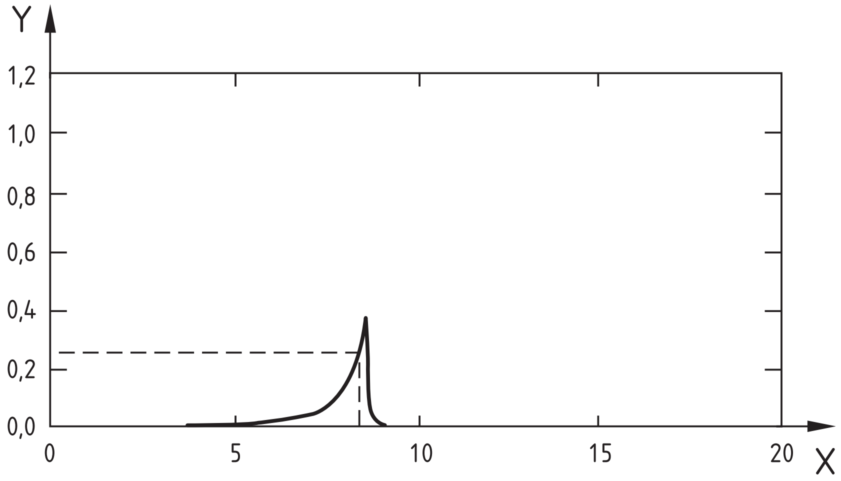


Key

X-axis time, min
Y-axis 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 I.3 — Typical relative radiation levels throughout a test



Key

X-axis time, min
Y-axis relative radiation, dimensionless

NOTE Burn-back starts at 0 min (25 % is at about 8 min 30 s).

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

Annex J
(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.

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 11	Deviation 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, 2006, Nr. 53, S. 2638-2641 The ordinance prohibits the use of ozone layer destroying halogenic hydrocarbons in Germany
Clause 11	Verordnung zur Anpassung der Gefahrstoffverordnung an die EG-Richtlinie 98/24/EG und andere EG-Richtlinien (Verordnung zum Schutz vor Gefahrstoffen (Gefahrstoffverordnung - GefStoffV)) (VMBl, 1999, Nr. 2, S. 43-44) The foam concentrates are covered by Ordinance on Hazardous Substances concerning substances and materials concerning classification and labelling of chemical substances and preparations. These regulations set up requirements for marking of substances and preparations hazardous to health and to environment. The marking according GefStoffV does not replace any marking by possibly concerned transportation laws.
Clause 11, NOTE 1:	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.

Administrative Regulation on the Classification of Substances Hazardous to Waters of 17 May, 1999 (Verwaltungsvorschrift wassergefährdende Stoffe; VwVwS)

The classification of substances hazardous to waters required by § 19 g Federal Water Act (Wasserhaushaltsgesetz) is described in the Administrative Regulation on the Classification of Substances Hazardous to Waters (VwVwS). 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] ISO 649-2, *Laboratory glassware — Density hydrometers for general purposes — Part 2: Test methods and use*

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

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