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Specification for wetting agents for application on Class A fires

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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

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

Introduction

Firefighting wetting agents are widely used to control and extinguish Class A fires and for inhibiting reignition.

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

A specification for portable extinguishers can be found in ISO 7165.

Specification for wetting agents for application on Class A fires

1 Scope

This document specifies the essential properties and performance of liquid wetting agent concentrates used to make wetting agents for the extinction and inhibition of reignition of fires of Class A fuels.

This document specifies the minimum performance on certain test fires.

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 1568-3:2018, *Fire extinguishing media — Foam concentrates — Part 3: Specification for low expansion foam concentrates for surface application to water-immiscible liquids*

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

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

ISO 3219, *Rheology*

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

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

ISO 7165, *Fire fighting — Portable fire extinguishers — Performance and construction*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
characteristic value
value declared by the *wetting agent* (3.6) *concentrate* (3.2) manufacturer for the chemical and physical properties and the performances of the *wetting agent solution* (3.9), and wetting agent concentrate

3.2
concentrate
wetting agent (3.6) liquid that, when mixed with water in the appropriate concentration, gives a *wetting agent solution* (3.9)

3.3
sediment
insoluble particles in the *wetting agent* (3.6) *concentrate* (3.2)

3.4
temperature for use
maximum and minimum temperature claimed by the manufacturer between which the *wetting agent* (3.6) *concentrate* (3.2) is ready for use

3.5
Class A fire
fire involving solid materials, usually of an organic nature, in which combustion normally takes place with the formation of glowing embers

Note 1 to entry: See ISO 3941:2007, Clause 2 for the classification of fires.

3.6
wetting agent
liquid added to water to produce a solution with a surface tension less than that of water alone, which is capable of readily spreading across and penetrating into *Class A fuels* (3.7)

Note 1 to entry: Wetting agents are not required to produce foam.

3.7
Class A fuel
solid material, usually of an organic nature (such as vegetation, wood, cloth, paper, rubber, and some plastics), in which combustion can occur at or below the surface of the material with or without the formation of glowing embers

3.8
freezing point
temperature at which the first ingredient of a mixture starts to solidify or freeze out

3.9
wetting agent solution
solution of *wetting agent* (3.6) *concentrate* (3.2) and water

4 Type and use of wetting agent concentrates

4.1 General

Wetting agent concentrates shall be capable of providing positive fire testing results if tested in accordance with Annex F. See also Annex H.

4.2 Use with sea water

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

NOTE Increased corrosiveness can occur on equipment used if a wetting agent solution is prepared using sea water.

5 Tolerance of the wetting agent concentrate to freezing and thawing

The wetting agent concentrate shall be preliminarily sampled and conditioned in accordance with Annex A.

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

Wetting agent concentrates in conformance with Annex B shall be tested for conformance with the appropriate requirements given in other clauses and subclauses of this document (indicated by the term "conditioning" in their respective headlines) after freezing and thawing in accordance with A.2.1.

6 Sediment in the wetting agent concentrate

6.1 Sediment before conditioning

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

6.2 Sediment after conditioning

Any sediment in the concentrate aged in accordance with Clause A.2 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.

7 Determination of viscosity

7.1 Newtonian wetting agent concentrates

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

7.2 Pseudo-plastic wetting agent concentrates

The viscosity of the wetting agent 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: "This concentrate can require special proportioning equipment.".

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

8 pH of the wetting agent concentrate

8.1 pH limits

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

8.2 After conditioning

The difference in pH between before and after conditioning according to Clause A.2 shall not be greater than 1,0 pH units.

9 Surface tension of the wetting agent solution

9.1 Before conditioning

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

9.2 After conditioning

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

The value obtained after conditioning according to Clause A.2 shall not be less than 0,95 times, or more than 1,05 times the value obtained before conditioning.

10 Test fire performance

Wetting agent solutions shall extinguish a wood crib fire according to Clause F.2 and pass the test for extinguishment of deep-seated fires according to Clause F.3.

11 Corrosion

Where used in aircraft or other applications involving corrosion sensitive technologies, appropriate corrosion tests should be conducted and the information should be provided to end users.

12 Toxicology and environmental Information

Manufacturers of concentrates shall provide information about the toxicological and eco toxicological impact of their product at its highest recommended concentration following Annex G.

13 Marking, packaging and specification sheet

13.1 Marking

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

a) designation (identifying name) of the concentrate and the words “wetting agent concentrate”;

b) recommended concentration for use;

c) any tendency of the wetting agent concentrate to cause harmful physical effects, the methods required to avoid them and the first aid treatment if they occur;

d) recommended storage temperature and temperature of use;

e) if the concentrate complies with Clause 5, it shall be marked with the words “Not affected by freezing and thawing.” or, if the wetting agent concentrate does not comply with Clause 5, the words “Do not freeze.”;

f) nominal quantity in the container;

g) supplier's name and address;

h) batch number;

i) it shall be marked with the words “Not suitable for use with sea water.” or “Suitable for use with sea water.”, as appropriate.

13.1.2 Markings on shipping containers shall be permanent and legible.

13.1.3 Non-Newtonian concentrates should be appropriately identified.

13.2 Packaging

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

13.3 Specification sheet

13.3.1 The manufacturer shall provide a list of the characteristic values.

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

13.3.3 If the wetting agent 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}, it shall be marked with the words “Pseudo-plastic wetting agent concentrate. This concentrate can require special proportioning equipment.”.

NOTE Refer to ISO 7076-1 for additional details on proportioning equipment.

13.3.4 Non-Newtonian concentrates should be appropriately identified.

Annex A
(normative)

Preliminary sampling and conditioning of the wetting agent concentrate

A.1 Preliminary sampling

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

Store samples in tightly closed containers.

NOTE Containers of capacity 20 l are suitable.

A.2 Conditioning of wetting agent concentrate

A.2.1 If the supplier claims that the concentrate is not adversely affected by freezing and thawing, condition the concentrate sample through four cycles of freezing and thawing, generally as described in Clause B.2, before conditioning in accordance with A.2.2.

If the wetting agent concentrate is adversely effected by freezing and thawing, it is conditioned in accordance with A.2.2 without prior freezing and thawing.

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

A.3 Subsequent testing

Test samples shall be prepared in accordance with Clause A.1, or A.2.1 and A.2.2 as appropriate. Shake the sample container before sampling for further tests.

Annex B
(normative)

Determination of tolerance to freezing and thawing

B.1 Apparatus

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

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

B.1.2 Tube, polyethylene, approximately 10 mm in diameter, approximately 400 mm long and sealed and weighted at one end, with suitable spacers attached; see Figure B.1 for a typical form.

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

B.2 Procedure

Set the temperature of the freezing chamber (B.1.1) to at least 10 °C below the freezing point of the sample measured in accordance with EN 1568-3:2018, Annex K.

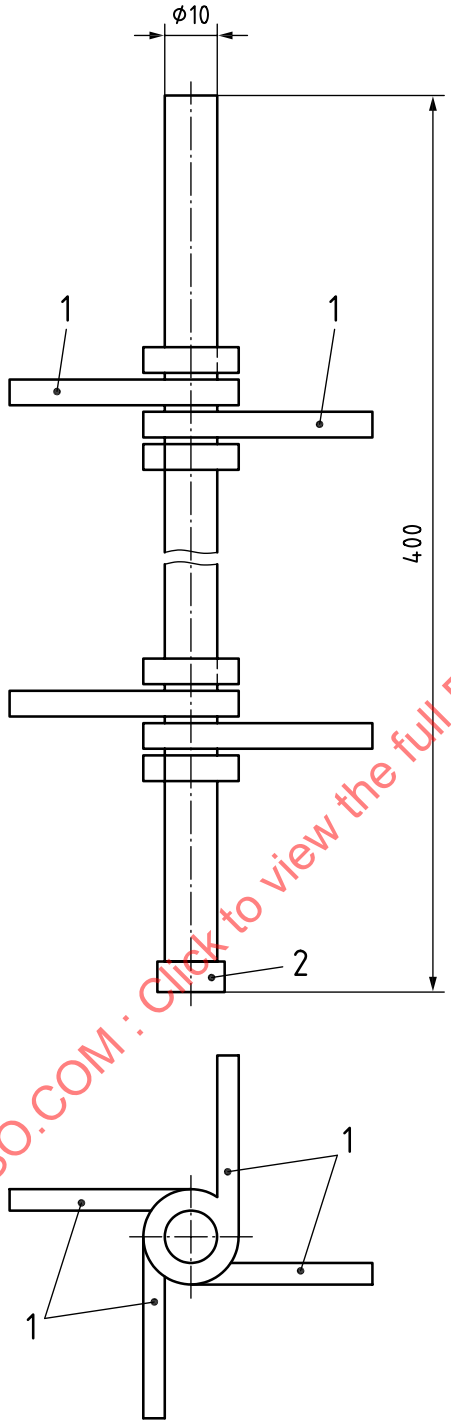
To prevent the glass measuring cylinder (B.1.3) from breaking due to expansion of the wetting agent concentrate on freezing, insert the tube (B.1.2) into the measuring cylinder with the sealed end downward, weighted if necessary to avoid flotation, with the spacers to ensure that it remains approximately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

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

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

Examine the sample for stratification and non-homogeneity.

Nominal dimensions in millimetres



Key

1 spacers (e.g. plastics cable strap)

2 weight at sealed end

Figure B.1 — Typical form of polyethylene tube

Annex C
(normative)

Determination of percentage of sediment

C.1 Sampling

Use a sample prepared in accordance with Clause A.1. Ensure that any sediment is dispersed by shaking the sample container. Take two samples, testing one immediately and the other after ageing for (24 ± 2) h at (60 ± 2) °C in a filled container without access to air.

C.2 Apparatus

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

C.2.1 Centrifuge tubes, graduated.

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

NOTE A centrifuge and tubes in accordance with ISO 3734 are suitable.

C.2.3 Sieve, of nominal aperture size 180 µm, in accordance with ISO 3310-1.

C.2.4 Wash bottle, plastic.

C.3 Procedure

Centrifuge each sample of the concentrate for (10 ± 1) min. Determine the volume of the sediment and record it as a percentage of volume of the centrifuged sample volume.

Wash the contents of the centrifuge tube (C.2.1) onto the sieve (C.2.3) and check whether the sediment can be dispersed through the sieve by the jet from the plastic wash bottle (C.2.4).

Annex D
(normative)

Determination of viscosity for pseudo-plastic wetting agent concentrates

D.1 General

This annex gives the procedure for determining the viscosity for pseudo-plastic wetting agent concentrates. The procedure is described in the ISO 3219 series.

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

D.2 Viscosity determination

D.2.1 Apparatus

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

D.2.1.1 Viscometer, rotational, fitted with a temperature control unit that can maintain the sample temperature within ±1 °C of the required temperature, in accordance with the ISO 3219 series with the following parameters:

— maximum shear stress: ≥ 75 Pa;

— maximum shear rate: ≥ 600 s^{-1}.

D.2.2 Test temperature

The viscosity of the wetting agent concentrate shall be measured at temperatures from 20 °C 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 test should be performed in accordance with the following test procedure:

a) adjust the temperature control unit;

b) set the gap;

c) apply the sample;

d) wait a minimum of 10 min (period of no shear) to reach temperature equilibrium;

e) pre-shear for 1 min at 600 s^{-1};

f) wait 1 min without shearing;

g) measure the shear stress for 10 s at each shear rate, starting at the lowest shear rate (preferably at 75 s^{-1}).

Measure the shear stress at least at eight different shear rates over the range 0 s^{-1} 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, *v*, expressed in millipascal-seconds, from Formula (D.1):

$$v = 1\,000 \times \frac{s_1}{s_2} \tag{D.1}$$

where

s_1 is the shear stress, expressed in pascals;

s_2 is the shear rate, expressed in reciprocal seconds.

D.2.4 Results

Report the results as a table, including the test temperature (°C), shear rate (1/s), shear stress (Pa), and apparent viscosity (mPa·s).

Annex E
(normative)

Determination of surface tension

E.1 Reagents

E.1.1 Wetting agent solution, at the recommended concentration for use in freshly made analytical water complying with grade 3 of ISO 3696:1987 and surface tension not less than 70 mN/m.

NOTE The solution can be made up in a 100 ml volumetric flask using a pipette to measure the wetting agent concentrate.

E.2 Procedure for surface tension

Determine the surface tension of the solution (E.1.1) at a temperature of (20 ± 1) °C using the ring method in accordance with ISO 304.

E.3 Synthetic sea water

Prepare the synthetic sea water by dissolving the components listed in Table E.1.

Table E.1 — Components of synthetic sea water

Mass percentage	Component	Chemical formula
2,50	Sodium chloride	NaCl
1,10	Magnesium chloride	$MgCl_2 \cdot 6H_2O$
0,16	Calcium chloride	$CaCl_2 \cdot 2H_2O$
0,40	Sodium sulphate	Na_2SO_4
95,84	Potable water	—

NOTE This can be achieved by controlling the level of the liquid/wetting agent interface in the plastics tube at the outlet.

Annex F
(normative)

Determination of fire test performance

F.1 General

The following tests shall be conducted at the manufacturer's recommended concentration and shall remain the same for all tests.

If a wetting agent concentrate is marked as suitable for use with sea water, test fire performance shall be tested with both fresh and synthetic sea water according to Clause F.2.

F.2 Wood crib fire test

The evaluation of wood crib fire performance shall be executed according to one of the following options.

a) Option 1: The test result using the wetting agent shall extinguish at least a 3A crib in two out of three consecutive attempts. Execute the wood crib fire test following the requirements for general and Class A test fires in ISO 7165 using a portable fire extinguisher listed with a 2A rating. A 2A rated fire extinguisher uses a maximum of 9,5 l water. The fire test with the wetting agent shall be executed with the same device using a maximum of 9,5 l of wetting agent solution.

b) Option 2: The test result using the wetting agent shall extinguish at least a 2A crib in two out of three consecutive attempts. Execute the wood crib fire test following the requirements for general and Class A test fires in ISO 7165 using a portable fire extinguisher listed with a 1A rating. A 1A rated fire extinguisher uses a maximum of 6 l water. The fire test with the wetting agent shall be executed with the same device using a maximum of 6 l of wetting agent solution.

F.3 Deep-seated fire test

F.3.1 General

The following tests shall be conducted three times with plain water and three times with the wetting agent solution.

The test is passed if the wetting agent solution extinguishes the cotton in all three runs and if the average of the collected runoff is less than the average of the plain water run-off.

F.3.2 Apparatus

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

F.3.2.1 **Cylindrical basket**, of perforated sheet steel, 114 mm in diameter and 178 mm high.

F.3.2.2 **Raw cotton**, (100 ± 2) g.

F.3.2.3 **Steel cylinder**, 35 mm in diameter, 33 mm long.

F.3.2.4 **Water**, (250 ± 0,1) ml.